Co2olBricks

Integration of Climate Protection and Cultural Heritage Aspects in Policy and Development Plans

Report of Co2olBricks Work Package 3: Policy Development

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Cover graph:

Map of brick buildings in Hamburg, City of Hamburg Ministry of Urban Devlopment and Environment, from the Backsteinerfassung 2009 (Gathering of Number of Brick Buildings) by Prof. Peter Zander, Prof. Carsten Nibbes, Anina von Lilienfeld-Frisch, Anne-Florence Harder et. al.

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Why the Report? Aim and addressed to whom?

This report is a result of the priority of improved transnational transfer of technology and knowledge. Through the common formulation of guidelines, manuals, as well as the common implementation of pilot projects, transnational transfer of knowledge and technology between the participating countries will occur.

The main aim of this document, together with the complementary documents "Joint Declaration" and "Policy Paper", is to advance the political discussion on the national and transnational level about the political and administrative anchoring of the essential combination of climate protection and preserving cultural heritage. To integrate these aspects into future policy developments and to create the political and administrative basis for technical, educational and economical solutions, a common position has to be considered on different levels and in different sectors. With a concerted action in mind, new cooperation models between administration agencies, architects, engineers, and housing companies, building companies and affected building owners can be established and the public funding for the refurbishment of historic buildings can be adjusted.

Target groups are local administrations and politicians in the Baltic Sea Region (BSR) dealing with urban development, building regulations and subsidy systems; housing companies and other interested parties in the BSR who have monuments on their estates; different Chambers and Associations in the BSR affected by the issues in historic buildings, energy efficiency measures and handcrafts, or a consortium comprised of one or the other target groups.

› Innovation means successful production, assimilation and exploitation of novelty in the economic and social spheres. ‹

1. Introduction: About the project

Co_2olBricks aims to find solutions about how to make historic buildings energy efficient while preserving their cultural heritage value. The key objective of the project is to combine cultural heritage protection with active climate protection measures.

The European Union's Baltic Sea Region Programme 2007–2013 promotes regional development through transnational cooperation. The strategic objective is to make the Baltic Sea Region an attractive place to invest, work and live in. The Programme co-finances Co_2olBricks, which is a project in the field of priority 1: Fostering innovations. Innovation means successful production, assimilation and exploitation of novelty in the economic and social spheres. The priority supports innovation sources and facilitation of transnational transfer of technology & knowledge, in particular targeted at small and medium size enterprises (SMEs). Another objective is to strengthen the capacity of people for absorbing new knowledge.

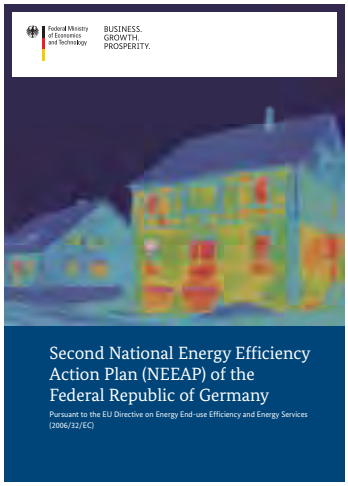
The project has an overall budget of €4.3m and Lead Partner is the Department for Heritage Preservation of the Ministry of Culture in Hamburg. Listed below are Co_2olBricks 18 partners from 9 countries and their respective contributions to this report. The conclusions of each chapter were drawn from the discussions during the work package meeting in Kiel, 3–6 June 2013.

No	Partner	Country	Chapter
01	Department for Heritage Preservation, Hamburg.Lead partner	DE	3.1 – 3.3; 5.1; 7.1–7.3; 8.1
02	Ministry for Urban Development and Environment, Hamburg	DE	3.1
03	Vocational Training Centre, Hamburg	DE	5.2
04	Environment Department, City of Kiel	DE	3.4
05	Stockholm City Museum, Stockholm	SE	3.5
06	Energy Agency Southeast Sweden, Växjö	SE	
07	Swedish National Heritage Board, Visby. Work package leader, WP3	SE	4, 6 and 9; Compilation
08	Malmö Environment Department, Malmö	SE	3.6
09	Danish Building Research Institute, Copenhagen	DK	2.2
10	Information Centre for Sustainable Renovation, Tallinn	EE	

No	Partner	Country	Chapter
11	Kothla-Järve Town Government, Kothla-Järve	EE	
12	Centre for Development Programmes (EMI-ECO), Tallinn	EE	2.3
14	Riga City Development Department, Riga	LV	
15	Riga Technical University, Riga	LV	2.4
16	European Foundation of Monuments Protection, Gdansk	PL	
17	Republican Centre for Technology Transfer, Minsk	BY	
18	Vilnius Gediminas Technical University, Vilnius	LT	
19	KIINKO Real Estate Education, Helsinki	FI	

Further information is accessible on the project website:
http://www.co2olbricks.eu/

1.1 The European context of the project



Front page of the German 2nd National Energy Efficiency Action Plan (NEEAP), picturing heat transmission through traditional buildings

To meet the commitments on climate change made under the Kyoto Protocol, the European Commission has established fundamental Policy documents for climate action, "Climate Change"[1] and "Energy for a changing world"[2]. One of the main goals of the European Union (EU) is reducing energy consumption and eliminating energy wastage. There is significant potential for reducing consumption, especially in energy-intensive sectors such as buildings. At the end of 2006, the EU pledged to cut its annual consumption of primary energy by 20% by 2020.

To achieve the goals for energy efficiency, the European Commission is working with different policy instruments; policy orientation as the National Energy Efficiency Action Plans (NEEAP) and programmes like Intelligent Energy Europe[3] and legislation.

1.1.1EPBD – Energy Performance of Buildings Directive

In 1993 the EU Council Directive (93/76/EEC) was issued, limiting carbon dioxide emissions through recommendations for new buildings and for improving the energy efficiency in the existing building stock.[4]

In 2002 the EU Directive on the Energy Performance of Buildings (EPBD, Directive 2002/91/EC) was published, requiring all EU countries to enhance

1 *http://ec.europa.eu/clima/policies/adaptation/index_en.htm*

2 *http://ec.europa.eu/clima/news/index_en.htm*

3 *http://ec.europa.eu/energy/intelligent/index_en.htm*

their building regulations and to introduce energy certification schemes for buildings.[5]
In 2010 (Directive 2010/31/EU) the recast of EPBD was adopted, clarifying and simplifying certain provisions, extending the scope, and moving towards more effective measures.[6]

1.1.2 Calculating the energy performance of buildings

Article 3 of Directive 2010/31/EU states that Member States shall apply and adopt a methodology for calculating the energy performance of buildings at national or regional level. This methodology is based on the common general framework for the calculation of energy performance of buildings.[7]

1.1.3 Exceptions from measures for certain categories of buildings

Article 4, paragraph 1, of Directive 2010/31/EU states that Member States shall take the necessary measures to ensure that minimum energy performance requirements for buildings or building units are set with a view to achieving cost-optimal levels.
However, in the same Article 4, paragraph 2, it states that Member States may decide not to apply the necessary measures to several categories of buildings, including buildings officially protected as part of a designated environment or because of their special architectural or historical merit, in so far as compliance with certain minimum energy performance requirements would unacceptably alter their character or appearance.[8]

1.1.4 Energy Efficiency Directive

On 25 October 2012, the EU adopted Directive 2012/27/EU on energy efficiency. Current estimates show the EU is not on track to achieve its target of reducing its estimated energy consumption for 2020 by 20%.
As a result, new measures on energy efficiency are now being proposed for implementation throughout the economy to bring the EU back on track to achieve its objective by 2020. One change, among others, is that public

4 *http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:1993:237:0028:0030:EN:PDF*

5 *http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:001:0065:0065:EN:PDF*

6 *http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:153:0013:0035:EN:PDF*

7 Annex I of the Directive 2010/31/EU

8 Article 4, Directive 2010/31/EU

bodies would need to buy energy-efficient buildings, products and services, and refurbish 3% of their buildings each year to drastically reduce their energy consumption.
In the future, considering that several historic buildings and monuments are today housing public bodies: Will old buildings be able to meet the demands of the directives and still be attractive on the property market and for the users or will the directives consider old buildings and adjust the demands?

1.2 Summary of Co_2olBricks policy development

Through the project, similarities between the partner countries have been clarified but so have the many differences. We are partners with very different backgrounds – from the cultural heritage and educational sector, local governments, researchers and private businesses – who have learned to recognise the differences between the countries' approaches and each other along the way during the project.
All of the countries have ratified international conventions such as the Venice Charter of 1964 and the ICOMOS (International Council on Monuments and Sites) from 1965 which offers advice to UNESCO on World Heritage Sites, but make different interpretations of the contents, which results in different approaches regarding restoration.
The countries also have very different conditions, e.g. regarding the economy, energy goals and supply, the condition of buildings and historic background, etc. In countries spared from wars, authentic material and building elements are still left, which can explain why they have a more precautious approach to reconstruction and changing of buildings' materials and elements.
At the first meeting, there were discussions about whether or not brick buildings also include other stone buildings. The partners talked about what a historic building or monument is. Some countries have a national list of buildings and the selection is made at the central level.
Other countries protect through legislation but leave selection and evaluation to the regional level – which often is part of, or a preventive measure to, exploitation in spatial planning. The project agreed upon a definition in the baseline study – similar to EPBD: architecturally, culturally or historically valuable buildings are referred to as "historic buildings".
In some countries, there are no energy efficiency measures at all in the protected buildings and therefore there is no discussion or issue on what to actually do.

Same thing goes with energy certification, while both energy assessments and energy certificates are accomplished in historic buildings in other countries. The project experience is that European directives, national legislation and action plans for improving energy efficiency are shaped by new buildings or existing, modern buildings and focus on the energy saving measures which are most cost effective at present. In the current climate and energy debate on energy efficient buildings, the focus is only on energy use in the operational phase. The value of energy that is embodied in existing structures in the form of materials and building is seldom included in calculation models. The historic buildings are usually handled either by exemption or not at all. Very few policy instruments neither highlight opportunities nor the adjustments that must be made regarding specific expertise and processes to work with protected buildings. Hence, the actions and studies for energy efficiency in historic buildings are considered too expensive, according to the survey on energy certificates and audits within the project.
Exceptions are measures within funding and labour skills in Germany – KfW Denkmal – and the national research programme Save and Preserve in Sweden. Furthermore, during the project time, work for a European standard, CEN TC346/WG8 "Energy efficiency of historic buildings", which involves several Co_2olBricks partners, has begun. Participation is largely due to the expertise we have acquired and the contacts we have made through the project. Sweden is to our knowledge the only EU country which since 2012 also demands energy certificates for historic buildings when they are sold or rented. An analysis of the risks for historic buildings was not included in the assessment report prompting the legislation change, nor was the current lack in the area of both the expertise and the processes to secure the cultural heritage value of the buildings. The utility of establishing energy certificates can be questioned because profits and the number of buildings are small in this context. Protections which are in the building regulations of existing buildings will ensure that there will be no requirements put through that would unacceptably alter the character or appearance of the buildings. On the other hand, if the energy certificates were adapted to include historic buildings and their specific conditions – if performing energy audits, measurements on the actual building and suggestions for energy saving measures were customised and evaluated by experts – historic buildings might contribute to the EU's energy goals and climate protection to a greater degree than today.

1.3 About the Report

This report is a compilation of the main outputs of Work Package 3 (WP 3), Policy Development which is the basis for the project's recommendations. The recommendations are to be found in the complementary documents "Joint Declaration" and "Policy Paper" of the Co_2olBricks project.
The report is built up around the results which evolved through the partners' activities in their region through round tables and stakeholder meetings, expert seminars and thematic workshops. The report enhances examples of public financing available for the refurbishment of historic buildings, read more in Chapter 7 *Support programmes and certification*.
The territorial development evolved through pilot projects for example in Hamburg and their relation to the active climate protection plans along with municipal policy papers and development plans with integrated cultural heritage and climate change aspects in Hamburg, Stockholm and Kiel, in Chapter 3 *Balancing heritage preservation and climate protection*. Finally, relevant results from similar projects and networks are merged into the report in Chapter 8 *Relevant projects and networks*.

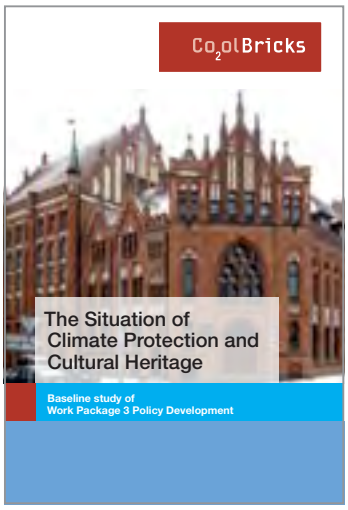
1.3.1 Background to the Report

During the project's first year, a baseline study was conducted within WP 3. The baseline study answers to the BSR programme output "Thematic expertise" and is an identification and evaluation of European and national legislation related to energy efficiency and cultural heritage conservation collected by the project partners in WP 3.
The aim of the baseline study was to identify issues and topics that need to be brought up in the partners' stakeholder groups and in roundtable meetings in order to fulfil the main aim: advancing the political discussion on a national and transnational level about the political and administrative anchoring of the essential combination of climate protection and cultural heritage aspects.

1.3.2 WP3 Baseline study

Given the results of the Baseline study:

- EPBD (Directive 2010/31/EU) is implemented through national building regulations which mainly focus on new or existing modern buildings. Therefore there is a need for building regulations adapted to historic buildings.



Front page of Co₂olBricks WP3 Baseline study, 1st milestone of the work package

- Methods and competence in energy efficiency measures in heritage buildings of all involved stakeholders in the planning and carrying through of a major renovation (energy experts, architects, building conservators, craftsmen, officials etc.) is needed.
- The financial mechanisms and legislation are not harmonised with legislation and the intentions of preservation. Therefore there is a need for specific public funding for energy efficiency in historic buildings.

1.4 Targets of the Report

Targets were set at the WP 3 workshop in Copenhagen during the project's midterm conference in September 2012. The Report on "Integration of Climate Protection and Cultural Heritage" should be a collection of examples forwarded to the target groups, focusing on:

- **Balancing heritage preservation regulations with climate protection programmes and action plans.** Both energy efficient measures for climate protection and preservation of cultural heritage values have to be taken into consideration in urban planning and district developments. A questionnaire aiming at creating the basis for the conclusions and analysis of the report among the project's partners indicates that few climate protection programmes and action plans provide guidelines to or even mention how to deal with historic buildings. This report illustrates some examples from Hamburg, Kiel, Stockholm and Malmö where this has been done, read more in Chapter 3.
- **Implementation of local funding programmes** – specialised subsidy systems have to be developed to support the preservation aspects. This report illustrates the example of *Backsteinsfonds* in Hamburg, read more in Chapter 7.1.
- **Qualification of experts** (architects, conservators, engineers, etc.) as illustrated by the German example of *Energieberater Denkmal* issued during the project time, read more in Chapter 5. Co₂olBricks Work Package 5 (WP 5), Education has, within the project, developed curricula for craftsmen which are briefly presented in Chapter 4. More information can be found in the WP 5 handbooks.
- **Models for decision-making processes** in major rehabilitations of historic buildings. This target is illustrated by the rehabilitation of *Materialgaarden* in Copenhagen, a process briefly described in Chapter 2.2.

› The in-depth energy analysis some countries carry out is useful when it is based on each individual building and contains the actual values. ‹

2. Major renovations and energy analysis

The conservation programme and methodology for calculating the energy performance of buildings in major renovations of historic buildings is illustrated in this chapter by a survey within WP 3, the purpose of which was to identify how the system of energy audits works in each partner country and then compare the differences. The Danish Building Research Institute describes the decision-making process and the importance of interdisciplinary work and expertise in the model for cooperation in upgrading of historic buildings. The Centre for Development Programmes (EMI-ECO) shows, through the analysis made in brick buildings in Tartu, the importance of real calculations in the actual buildings.

Tranhusgatan, Visby – before and after external insulation. Photo: Tor Broström and Therese Sonehag.

2.1 Result of Survey on energy audits and certificates among Co_2olBricks partners

Based on a survey within the Co_2olBricks project, we found that the purpose, content and methodology of energy audits for the calculation of energy performance of buildings, vary between countries.
In the partner countries, these audits are performed differently and by people with varied expertise. When discussing the circumstances pertaining to the performance of energy audits in historic buildings, one must be specific as regards the scope and competence of those who perform the energy audit.

2.1.1 Content of the energy certificate

The certificate contains an assessment of the building's energy consumption and a proposal on energy conservation.
The survey shows that an energy certificate requires that an analysis be performed in most countries (except Estonia), but the scope of this analysis varies between the countries. All countries evaluate individual building elements and heating systems.
In most countries, proposals on energy saving measures and cost estimates for each building component and system are provided in the compulsory energy certificate, but the suggestions are generic, i.e. they refer to general values for the building type/construction – not actual, measured values.
No country seems to follow up on the quality of the proposed measures in the energy certificate in a systematic way.

2.1.2 In-depth energy analysis

A more comprehensive energy analysis of measurements of the actual values of the building occurs in Finland, Germany, Poland, Latvia and Estonia (but is optional and can be partially financed by public funds).
A similar system can be found in Poland, with specific skills for subsidised energy analyses.
The in-depth energy analysis some countries carry out is useful when it is based on each individual building and contains the actual values. Some of the partners argue that energy analysis is tedious and difficult to finance, but there are examples where significant energy savings can be made even in the context of historic buildings. The opinion of several partners is that balancing between reasonable costs for conducting this analysis and reasonable energy efficiency measures set against the building's heritage values may involve constraints.

2.1.3 Application of energy certificates in historic buildings

Energy labelling is not suitable for historic buildings but can be applied, according to some partners. Most partners believe that the evaluation of today's energy certificate is useless as it only sets the default values and standard recommendations. The common conclusion among the project's

partners is that energy efficient action proposals that do not alter the building's heritage values are not possible to do without an in-depth energy analysis.

Some countries (Sweden, Finland) indicate that the persons conducting energy certificates must have knowledge of historic buildings to provide proposals for action, but only Germany imposes special requirements on the energy expert in historic buildings with a special education and grants for this – *KfW Denkmal*.

Only Sweden has introduced energy certificate requirements under the Directive 2010/31/EU for historic buildings. In Germany there is a requirement for publicly funded renovations of historic buildings. Energy audits for historic buildings are implemented to some extent in most countries, but on a voluntary basis. Energy Analysis that is associated with some form of interdisciplinary contribution from persons with special knowledge exists in historic buildings in Germany, Latvia, Finland and to a very small extent in Poland and Lithuania.

Some partners believe that energy certification of historic buildings will be mandatory in the near future but most believe that it will take long time. Most partners believe the energy certificate in its current version is not meaningful for historic buildings. However, an energy analysis conducted by or in collaboration with people with special knowledge of the cultural buildings is an asset because there is great potential to save money, energy and cultural values.

Fæstningens Materialgård in Copenhagen. Photo: Therese Sonehag.

2.2 Model for cooperation between parties upgrading historic buildings

Denmark has carried out a number of case studies demonstrating comprehensive energy upgrading of historic buildings. These case studies include and demonstrate a model for cooperation between authorities and the owner of a historic building on the implementation of acceptable measures required for carrying out energy upgrading.
In Denmark, historic buildings include listed buildings and buildings worthy of preservation. These two categories of buildings are handled differently by the authorities. However, in principle the model for cooperation between authorities and the owner of a historic building can still be used to implement acceptable measures required for carrying out an energy refurbishment.

- Listed buildings. The decision-making processes related to energy upgrading of listed buildings are carried out in cooperation/dialogue with the Heritage Agency. The Heritage Agency possesses the expertise and has to agree to nearly all issues. The Heritage Agency is an agency under the Ministry of Culture, which has the overall responsibility for the management of Denmark's cultural heritage. The agency is an authority on listed buildings and conservation, historic and archaeological relics.
- Buildings worthy of preservation. The decision-making processes related to energy upgrading of buildings worthy of preservation are carried out in cooperation/dialogue with local authorities. Non-Government Organisations have good examples and knowledge and also possesses the expertise in these cases.

The model describes a process for the selection of measures for energy upgrading of the historic building stock, including:

- How to tackle restoration of a listed building.
- How to compose and organise an interdisciplinary workgroup consisting of the building owner, authorities (i.e. Heritage Agency), architect and engineer.
- How to evaluate a single measure for reducing the energy consumption.

The model consists of a series of meetings to narrow down the number of feasible and acceptable measures to achieve a reduction of the energy consumption of an actual building. Every process is gathered around a body of decision-making meetings called the Workgroup Assessment. A row of four Workgroup Assessment meetings seems necessary. The aim of the process is to select acceptable measures. For the model shown on page 20,

the authority is represented by the Heritage Agency. Each specific case might need expertise from different authorities. A sketch of the model is shown on page 20.

2.2.1 Terms of the model

The model includes a number of terms, including:

- Design Brief. A construction brief was compiled at an early stage of the process and was needed to form the basis for choosing feasible refurbishing measures and to carry out energy evaluation calculations. The brief was to include: building history, current condition of the construction and individual building materials and identified heritage values connected to the building or a building complex all together.
- General List. A list of all the potential energy-saving initiatives that should be considered in connection with the renovation of any building or any group of buildings was created. Initiatives such as windows, secondary glazing, solar screening, solar shading, post insulation of outer walls, ceilings and ground slab, air tightness, heat pump, light bulbs, daylight control, and for a building complex a central heating and cooling system, power supply, ground source and a central technical system controlling electricity, air exchange, hot water supply, rain water collection, solar panels, photovoltaic, heat emitting, ventilation, room occupation and so on. It was important that the General List initially contained a comprehensive list of refurbishment measures that could be used as an energy upgrade initiative. The list should, as a starting point, compile all energy upgrade measures regardless the architectural and heritage value of the buildings, as the proposals should not take into account the location, actual building geometry, costs, use and function of the building or similar features that could immediately mean that the proposal measures were not to be implemented. The General List was created in order to consider all available initiatives as broadly as possible.
- Assessment Scheme. For each energy-saving initiative on the General List an Assessment Scheme was made, the scheme was used to evaluate and keep track of the evaluation made for every initiative to recall why/why not the energy-saving initiative was/was not recommended for further development through the process.

- Project-Specific List. The Project-Specific List was compiled by removing the energy-saving initiatives that were not feasible from the General List. An initiative may have been removed from the list of optional measures for many reasons, for example due to conservation interests or due to architectural, structural and/or indoor climate issues, etc.
- Info Sheet. An info sheet was compiled for all measures that passed to the Project Specific List. The info sheet was created to quantify the scope of each measurement and to estimate the energy-saving potential. A simple payback time and the expected C02 savings were estimated and used for the cost-benefit analysis.
- Indoor climate level. In order to distinguish between different quality levels of indoor climate conditions in primary rooms, as well as being able to describe a desired future level if the building was to be used as an office building, the standard DS/EN ISO 7730 [3] was to be implemented. For other uses of the building, other requirements were to be addressed, i.e. HVAC (Heat, Ventilation and Air Control) and indoor climate issues.

2.2.2 Workflow process

The model consists of a workflow process, including:

- Design Brief. A construction brief needs to be compiled at an early state of the process and form the basis for the energy project. The brief needs to include: building history, description of the existing conditions together with an architectural value analysis of the building complex.
- General List. Initially a comprehensive list of energy-saving initiatives. The list needs to be compiled without regard to the architectural and heritage value of the buildings, just as the proposals did not take into account the location, actual building geometry, function or similar features that could immediately mean that the proposals could not be implemented. The General List was created in order to consider all available initiatives as broadly as possible, without taking into account the specific conditions of a building and was adjusted through the workgroup assessment meetings.

The General List and the Assessment Schemes are created for all energy-saving proposals for future assessment.

2.2.3 Workgroup assessments

Acceptable feasible measures are found from a series of Workgroup Assessment meetings. A number of four assessment workgroup meetings needs to be performed.

Workgroup assessment I:

Workgroup Assessment meeting I functions as a rough sorting of the measures of the General List. All the project group members make an overall assessment. Thus, each General List proposal is to be subjected to a first interdisciplinary evaluation. Based on the first overall assessment, an upgraded General List of proposals suitable for further work is produced.

Workgroup assessment II:

Prior to Workgroup Assessment meeting II, it is recommended, based on the existing consumption readings for water, heating and electricity, to produce an estimated overview of how the existing consumption of heat loss, hot water supply and electricity were distributed and consumed in the building. At this time the building must be entered into a model using a simulation programme for indoor climate evaluation and energy consumption, measurement and evaluation. The individual buildings in the building complex must be recorded with the existing components, construction, floor areas and their orientation. The simulation model can be supplied with the existing consumption data from use and lighting systems. The model creates an opportunity to see the existing energy consumption distributed on the individual building components but can also be used to get an idea of the existing thermal environment in the different buildings, areas, floors and rooms.

The info sheets must be provided with the calculated figures and developed for energy-saving proposals on the General List that, based on the first evaluation, were recommended for further development. The info sheet holds the scope of each measure and its estimated effect on the future consumption. The result of Assessment II is to create a more detailed description of the energy-saving proposals as well as the impact of the proposed refurbishing measures and their influence on energy consumption, CO_2 savings and effect on the indoor climate. Results are also entered in the Project-Specific List.

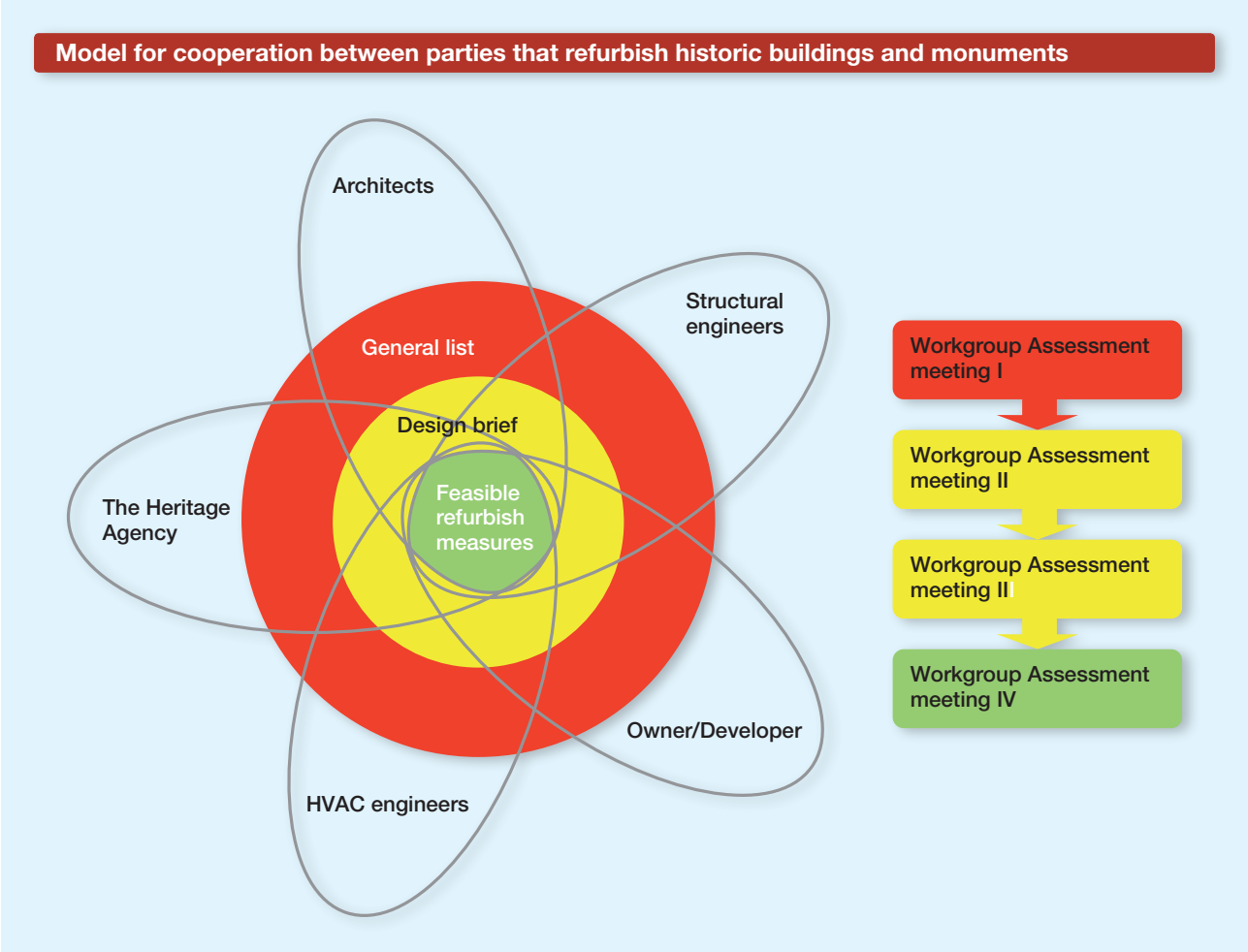
Workgroup assessment III:

Workgroup Assessment meeting III is based on the results of Workgroup Assessment meeting II. Each energy-saving proposal on the Project-Specific List is to be evaluated and considered in detail.
Workgroup Assessment meeting III is conducted in order to make a solution-specific selection of energy-saving measures that create synergy and that are reasonable in relation to the requirements for the interior layout.

Workgroup assessment IV:

Workgroup Assessment meeting IV is undertaken in order to go through and correct the adopted measures in case the measures did not create synergy or did not meet the overall expectations nor lead to the expected effects on C02 reduction, energy savings and the indoor climate.
More detailed description of the model is given in the report Fæstningens Materialgård, at the website: *http://www.co2olbricks.eu/*, for Climate Change, Cultural Heritage & Energy Efficient Monuments, Co_2olBricks.

Sketch of the model for cooperation between parties that refurbish historic buildings and monuments. Illustration: Torben Valdbjørn Rasmussen, Danish Building Research Institute (SBi)



2.3 Studies and measurements, Tartu, Estonia

Partner 12 (EMI-ECO) of the project "Co_2olBricks" was to determine the energy performance value (EPV) of the brick and stone buildings which are protected or located in milieu valuable areas in Tartu. In Estonia, energy performance in historic stone buildings was not measured or analysed before the project.

The conclusions of this study are based on an energy performance analysis in 19 buildings, 7 of which are schoolhouses, 4 apartment buildings and 8 defined as other types of buildings (e.g. community house, public administration building).

In addition, the total energy consumption in historic buildings in public use was compared with the respective average characteristics of another 64 buildings publicly used in Tartu (hereinafter named as reference group).

The results of the research show the average total annual energy consumption in the buildings studied was 193 kWh/m² while in the reference group of buildings it was (only) 16% lower. The results will serve as baseline data for in-depth analysis of energy performance.

The goal of the study was to determine the average level of total energy consumption in historic brick and plastered stone buildings in the City of Tartu because this data did not previously exist. To evaluate the state of energy performance, the total energy consumption in historic buildings in public exploitation was compared with the respective average characteristics of another 64 buildings publicly used in Tartu.

Residential building of A. von Oettingen (architect Rudolf von Engelhardt), built in 1880, now listed as building monument and used as community house. Photo: Ave Elken.

The criteria for obtaining a sample of buildings were as following:

1. Brick or plastered stone building built before 1945.
2. Buildings with different functions (apartment house, school, community house).
3. The building is in permanent use and with central heating.
4. The building owner committed to participate in the study.

Due to various issues and problems, only 19 buildings (21% apartment houses, 37% educational buildings, 42% other buildings) met the selection criteria.

EPV evaluation methodology in Estonia stipulates that the heated area needs to be taken into account when calculating the EPV value. The gross heated area of the buildings analysed is 33,134 m².

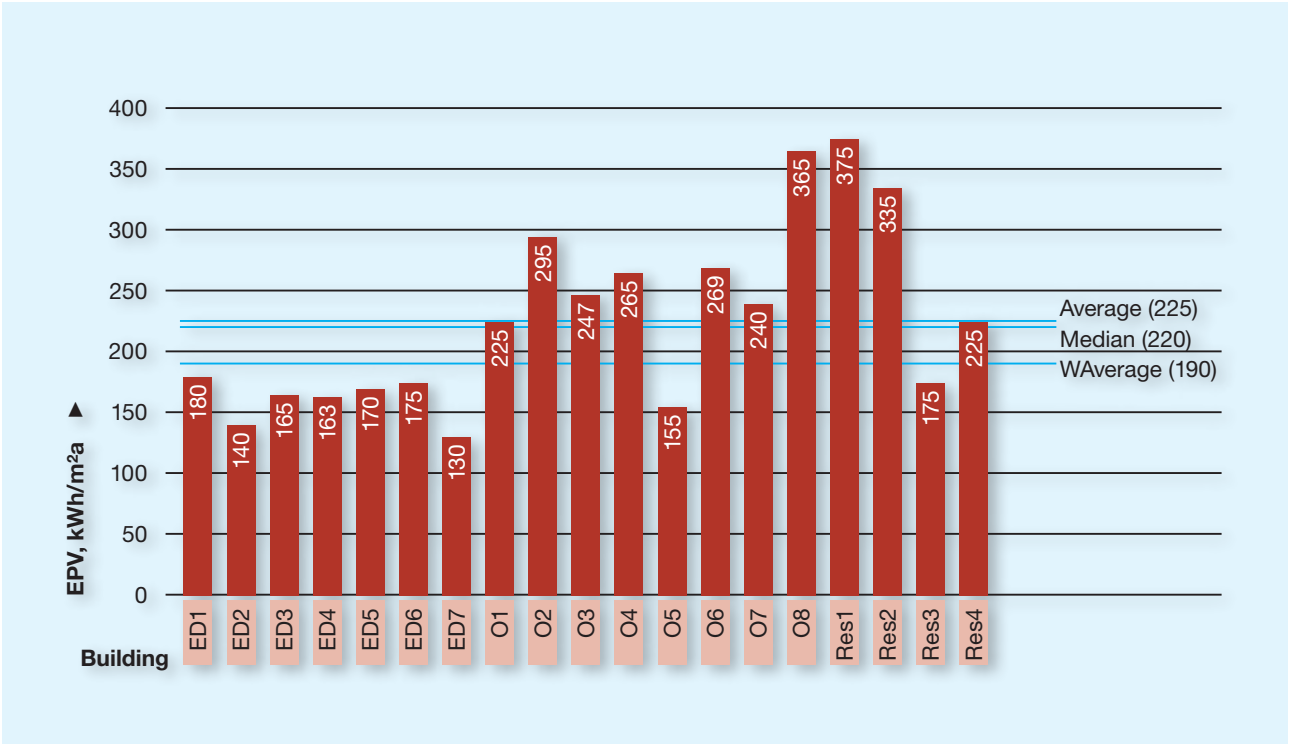
To determine the specific weighted energy consumption (SWEC) of buildings, following criteria were used:

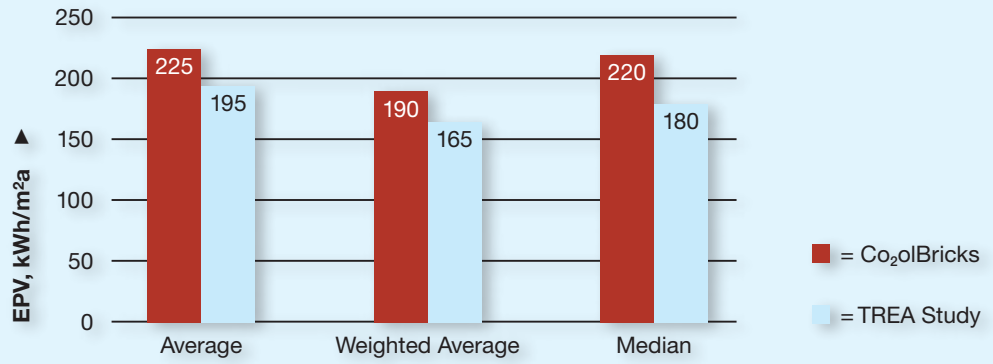
- Calculations were based on the measured consumption of the last 3 years.
- Heating consumptions were reduced to a normal year with the degree-day method and the balancing temperature fixed at 17 C.

All types of energy consumed in a building were considered and analysed in detail (heating, ventilation, natural gas, lighting, water consumption, appliances, etc.).

The graph 1 shows the EPV values in different types of buildings studied.

EPV values in different types of buildings studied. Illustration: Centre for Development Programmes (EMI-ECO





The average EPV of Co₂olBricks and average EPV in reference sample. The graph shows that the average annual EPV in Co₂olBricks buildings and the reference buildings was 14% (28 kWh/m²) higher. Illustration: Centre for Development Programmes (EMI-ECO)

The figures for energy consumption in Tartu were compared to respective values in other partner countries and found to be similar.
The main conclusions to be made from the study performed are as follows:

- Municipalities need a baseline study about energy performance value in historical buildings to make adequate refurbishment plans.
- The state of art of EPVs in historical buildings compared with modern buildings or EPV values in other countries is much better than it was afraid of – the average value was about 16% higher compared to data collected from group of reference buildings.
- Only EPV analysis is not enough to make in depth conclusions for refurbishment planning.

The results will serve as baseline data for in-depth analysis of energy performance.
Links to more information: *http://emieco.ee/coolbricks*

2.4 Analysis of energy audits prepared for 10 brick buildings in Riga, Latvia

Energy audits were done from November 2011 to February 2012 for the following buildings in the city of Riga:

- Barona Street 80
- E. Smilga Street 1
- Jekabpils Street 19a
- Lomonosova Street 12
- Martina Street 7
- Patversmes Street 1
- Petersalas Street 17
- Skolas Street 25
- Staraja Rusas Street 24/26
- Maskavas Street 8

Energy audits in the ten buildings were made by a team of specialists consisting of a team leader and assistants. The team leader had received an energy auditor certificate which allowed him to do building energy audits. The team leader had 3 assistants to collect data and do calculations. The team leader was responsible for quality control of the calculated data. A professor from Riga Technical University was also involved in quality control of the energy audit.

Many problems had to be faced during the carrying out of the energy audits. The main problem was to collect all the data needed for making the calculations. In the historic buildings there was a lack of measurement data – in some cases the measured energy consumption of buildings was unlikely to be true. In these buildings some of the apartments are heated by local heating and there is no energy consumption measurement data for these apartments. Also, getting into the buildings for inspection was very hard to do. The local house management company often could not provide the needed help. Therefore energy auditors visited buildings by themselves.

The buildings in which energy audits were done are not protected buildings but they have historic value. Some of the buildings are situated in areas which have protected status. The historic value of the buildings includes the style of architecture of these buildings. In some cases decorative facade elements of the buildings increase their historic value.

All calculations that were done during energy auditing were done in accordance with existing regulations on building energy performance and calculations on building energy performance. Calculations were done

according to MC (Cabinet of Ministers) regulations Nr. 39 "Building energy performance calculation method". The only thing that was modified to suit the old buildings is that there were measurements taken that usually are not done for typical buildings. The main measurement that was done was measuring of the wall heat transfer coefficient. This provided the possibility of using exact data. Measured energy consumption data was also analysed more carefully than in a typical energy audit.

2.5 Conclusions derived from major renovations and energy analysis

- It's possible to improve energy efficiency of historic buildings without destroying their Heritage values.
- For the energy efficiency refurbishment of a historic building, a team of at least 2 experts (Conservator, energy expert/architect) is necessary.
- A specific energy analysis is an advantage for historic buildings.
- An iterative process which includes all relevant parties is needed to reach the combined goals for energy standards and heritage values.
- Municipalities need partners to consult with in energy efficiency matters.
- A building log-book should be kept voluntarily and would be very helpful.

› One result of Co_2olBricks is the argument that the authorities and planners have to include historic buildings in master plans and major renovation permits, considering the limitations of heritage preservation. ‹

3. Balancing heritage preservation with climate protection

The EPBD is implemented not only through building regulations but also through environmental programmes and specific action plans. Energy demands in new and existing buildings are defined in action programmes which investors and property owners must follow in building developments. One result of Co_2olBricks is the argument that the authorities and planners have to include historic buildings in master plans and major renovation permits, considering the limitations of heritage preservation. Heritage preservation regulations in municipal papers and development plans must be considered and balanced with climate protection programmes and action plans. This is illustrated by four Co_2olBricks project cases – the pilot projects in Hamburg, contributed by the Department for Heritage Preservation, in Kiel by the Environment Department and in Malmö by the Environment Department. In Stockholm, the City Museum describes the planning process of the on-going Gasworks area, were the last WP 3 meeting was also held in April 2013.

3.1 Masterplan Climate Protection, Hamburg, Germany

Hamburg is affected in a number of ways by climate change. For Northern Germany, the scientists forecast an average temperature rise of 2.8 to 4.7°C by the end of the century, depending on the scenario considered. There will probably not be more rainfall in the course of the year, but there will be a change in its distribution. Hamburg will also suffer more frequently from extreme weather situations, such as dry summers with extreme heat periods, and high precipitation levels in winter with severe storms. Thus climate change is a threat to the future of the City of Hamburg, for the health and safety of its people, for its economic and social structure, and for the natural spaces and wildlife of the metropolitan region.
The Climate Action Plan 2007–2012 was Hamburg's response to this challenge. Hamburg aims to achieve a substantial contribution by 2020 to the national goal of a 40% CO_2 reduction, as compared to the emissions level in 1990. Then, by mid-century, carbon emissions are to be only 4 million tonnes; that is a reduction of 80%. The Climate Action Plan 2007–2012 was a first step towards fulfilment of these targets.
Within the Climate Action Plan 2007–2012 no statements concerning the balance between climate protection goals and heritage preservation were made.

In June 2013 the new **Masterplan Climate Protection** as successor of the Climate Action Plan 2007–2012 came into effect. Its purpose is, to set a long term strategy for a future framework of steps, with quantified goals. The following subjects are highlighted in the baseline report, which is the basis for the Masterplan Climate:

- **Building** and housing: Heating and hot water supply for buildings must be practically carbon-free by 2050. Achievement of this goal requires energy-efficiency improvement in existing buildings and in new buildings, by means of insulation, use of renewable energies, and improvements in heating systems.
- **Transport:** Transport, especially passenger car transport, accounts for 25% of all CO_2 emissions. A range of different measures are recommended for emission reduction – improvements in public transport, more cycling, more incentives for walking, and also innovative technologies and concepts such as electric vehicles, car sharing and ride sharing.
- **District heating:** Hamburg's heating production and delivery systems are to be improved in the short- and medium-term, to contribute to emission reduction.

Within the measures financed by the Hamburg Climate Action Plan 2007–2012, a total sum of €750,000 has been invested in order to investigate alternative ways of increasing energy efficiency in historic buildings without changing the facade. Part of this programme was a special brick fund since Hamburg is characterised by a predominance of brick facades. Additionally, a task force to preserve the red brick townscape in Hamburg was built with the Chief Planning Officer of the City state of Hamburg as head. One of the first activities was an inventory of the Brick buildings/quarters in Hamburg (see picture/map on the front page of this publication).
In the new **Masterplan Climate Protection**, a specific statement about heritage preservation is being made: "In the case of energy refurbishment, heritage preservation issues and the preservation of important characteristics for the townscape of buildings, ensembles and quarters are being considered."

Pilot project Holstenkamp in Hamburg:

Via the general provision in the Masterplan Climate, that the issues of heritage preservation have to be respected, more operative instruments, e.g. funding programmes, should be considered. This is necessary, because it already became obvious in the preparation and planning phase of the pilot project that, for example, the wall tempering system does not fit to the

Holstenkamp ensemble, Hamburg 2012. Photo: Jan Prahm

current funding schemes. For that reason, as a precondition to get the public funding, extra calculations had to be conducted to prove that the planned CO_2 reduction will be reached.
Links to further information: Masterplan Climate: *http://www.hamburg.de/contentblob/4050236/data/masterplan-klimaschutz.pdf*

3.2 New Heritage Protection Law 2013, Hamburg, Germany

In Hamburg, consequently, not only the climate protection activities consider heritage issues (see chapter 3.1) but the new Hamburg Heritage Protection Law (HambDSchG) from April 2013 also considers that energy efficiency measures in historic buildings are a matter of importance.
§9 HambDSchG requires that changes in historic buildings have to be allowed by the Department for Heritage Preservation. This permission can be given if it is in the public interest, which is – among other things – issue of energy refurbishment and renewable energies.
A specific number of cases in which energy refurbishment measures in historic buildings are conducted will be monitored.
Link to the Hamburg Heritage Protection Law (in German):
http://www.hamburg.de/contentblob/3876724/data/hamburgisches-denkmalschutzgesetz.pdf

3.3 Heritage Preservation Plans, Hamburg, Germany

On the legal basis of §10 Hamburg Heritage Protection Law, the Department for Heritage Preservation is allowed to order a Heritage Preservation Plan when it is necessary for the long-term preservation of a monument. The Heritage Preservation Plan therefore regulates the objectives and requirements of the heritage preservation issues and facilitates the adjustment and approval processes in the building permission procedure.
This approach contains advantages for all participating parties – owners, architects, heritage and urban planning administrations – especially in the case of ensembles or quarters under heritage protection:

- The whole quarter is to be considered as one entity, which is often one of the main heritage values.
- All the different aspects, which touch the owners and the public, can be regulated in an adjusted process. That includes, for example, the question of energy efficiency measures.
- After the development work, all participants have to expend less effort: The owners can work within the regulations of the Heritage Preservation Plan on their own; they don't have to ask for permission in the case of single building measures.

Currently the Hamburg Department for Heritage Preservation is working on the development of initial pilot projects. A tender has been issued to find an architect to develop a Heritage Preservation Plan for a quarter from the 1950s. Although there are no results available up until now, the description gives a first impression about the content of a Heritage Preservation Plan:

- Historical Documentation of the quarter
- Baseline Study
  - Buildings from the outside
  - Buildings from the inside
  - Open space
- Detailed conservational research about the original colours, constructions, etc.
- Development of measures
  - Guideline
  - Development of measures for a long-term recovery of the original appearance of the quarter.

- Development of design requirements and binding patterns, e.g.
  - Design drawings of windows or winter gardens.
  - Design requirements and drawings for energy efficiency measures.
  - Design requirements for antennas, post boxes, etc.

All this has to be discussed with the stakeholders and approved by the Department for Heritage Preservation. Additionally, a handbook with all relevant information has to be compiled for the owners.

3.4 Garden-City Elmschenhagen, Kiel

The quarter garden-city Elmschenhagen was built between 1939 and 1945. The quarter includes 1,800 flats, mainly in two-storey brick row houses. Nearly 4,000 people live there. The row houses are unlisted historic buildings, no heritage. To conserve the quarter's characteristics in the long term, design guidelines have been fixed in the binding land-use plan.
Main requests for the future: design-guidelines fixed in the binding land use plan have to be adapted to technical requirements, e.g. ridge line elevations when roof insulation applies.

Easy understanding and access of information for owners and craftsmen regarding these design guidelines has to be initiated. The building regulatory agency will be able to control any alterations in the quarter. The model refurbishing concept has to be able to be altered in order to conform with future energy regulations (Germany EnEV 2014).

Typical row house in Elmschenhagen. Photo: Jasper Harten/ Jens-Peter Koopmann

3.4.1 Short description of the current state of affairs

During the last two years, single units and complete rows of houses were refurbished. Facades were optimised through cavity insulation or a thermal insulation composite system. Windows and doors were also replaced with higher efficiency solutions. Individual consultations for owners were also arranged informing them about additional energy-saving measures, e.g. cellar insulation, roof measures, boiler improvements.
As regards cavity insulation, special attention is paid to moisture penetration in decent old masonry work due to wind-driven rain, which is common in Schleswig-Holstein. Here more research is necessary. For basic investigation on site, our aim is to set up a checklist for the evaluation of existing masonry and joints.Another item on our agenda is optimising heat consumption through hydraulic adjustments. Some circulation systems will be investigated soon and used as examples. We are interested to find out about the energy-saving potential in single units/row houses and larger buildings containing rental flats.

3.4.2 Tested and proved

Design guidelines for aspects worth preserving combined with an obligation to obtain a permit for any change of appearance.
A model refurbishing concept including technical advice enables the implementation of the highest energy standards.
Government grants increase motivation and invite owners not only to undertake single measures but also to improve their building completely.

3.4.3 What has to be improved?

Due to lack of proper information and control, many refurbishments go unsupervised. The building regulatory agency (City of Kiel) does not have enough capacity to consult owners individually and keep a close eye on all alterations in this quarter. Basic information for owners and craftsmen has to be easily accessible. Motivation and awareness for preserving the quarter's character needs to be encouraged.

3.4.4 Recommendations

Before implementing cavity insulation, we strongly recommend an evaluation of the existing masonry facade to eliminate moisture damage by wind-driven rain.
Links to more information: *http://www.die-lernende-stadt.de/gruppe/quartiersprojekt-elmschenhagen-nord*
http://www.tohuusin-elmschenhagen.de/index.php?action=contents&tag=detail&uid=26&id=2865&kat=531&realkat=VW5zZXJlIEVkaXRvcmlhbHMdec1&zugehoerigkeit=209

3.5 Värtan Gasworks Stockholm, Sweden

The Värtan gasworks area is an early example of a centralised production of gas in order for municipalities to be able to secure important societal functions. The original buildings were designed by architect Ferdinand Boberg. The area consists of around 30 buildings, five of which are circular gas holders from three generations of the works. The City of Stockholm produced gas in the buildings in order to supply city gas to the Stockholm gas grid between 1893 and 2011. When the gas production ceased, the City of Stockholm took over the buildings and is currently planning to bring them back to life with new content.
The gasworks area is part of a larger area "The Stockholm Royal Seaport". Here, in what is one of Stockholm's prime locations, plans are under way to build a new environmental urban district with residential and office buildings. The gasworks area will be developed and the City of Stockholm has plans for an international stage for guest performers, a museum, a pre-school, a school and a library on the site, as well as other facilities and meeting places.
The Cultural Heritage Department at the Stockholm City Museum has been involved in the area since the 1970s. In 2009 an update of the classification of buildings in the area was done in order to have an overview of the historic buildings in the area. The classification map is a grading system for buildings taken into consideration when new plans or building permits are made for new buildings or renovations. The classification system has no legal status and the buildings are not listed. However, according to Swedish law (Planning and Building Act, Chapter 8, Section 13) buildings which are especially valuable from a historical, cultural, environmental or artistic viewpoint must not be altered. In 2010 a more thorough investigation of

Värtan Gasworks.
Photo: Göran Fredriksson.

the cultural, historical and artistic values in the area was made by Nyréns architects "Gasverket i Värtan – Antikvarisk förundersökning"
According to the Action plan of the area[9] the conservation of the old brick buildings is one of the overall goals in the development process. It is essential to the transformation of the gasworks from a closed down industry to a living urban environment that the area's architectural and historical value is preserved. The architectural and historical values of the buildings are defined before any measures are done and they will be protected in the development plans.
The EPBD is implemented not only through building regulations but also environmental programmes and specific action plans. In 2009 the City Council decided that Stockholm Royal Seaport should become a new environmentally profiled area. A general environment and sustainability programme was adopted by the Stockholm City Council in 2010[10] and this steers the work on eco-profiling. By 2030, the city district should become free of fossil fuels, be climate positive and have adapted to climate change.
Energy demands in new and existing buildings are defined in the Action programme which developers must follow. The energy use in existing buildings and energy efficient measures are to be decided after a study is carried out. The study should take into account material, indoor climate and cultural heritage values[11]. Measures to be applied are defined and decided in a process, not fixed numbers or levels.

9 Miljö och hållbarhetskrav vid markanvisning – Handlingsprogram Vid planering, projektering, byggande och förvaltning av bostäder, kontor och handel i nya och befintliga byggnader inom Gasverksområdet

10 2010–04–13: Övergripande program för miljö och hållbar stadsutveckling i Norra Djurgårdsstaden

The Stockholm City Museum has, in the framework of Co_2olBricks, suggested that the city should try a new European standard for Energy efficiency in historic buildings (EN 15759–1:2011) in the Gasworks area. The standard has been developed by, among others, Tor Broström at Högskolan Gotland, and part 1 focuses on church buildings. Unfortunately, it has not been possible to assemble (bring together) the different stakeholders in the city for this idea. However, this work has led to a future opportunity to work on standardisation processes within the city, such as an integral part of various environmental programs.
Links to more information: *http://bygg.stockholm.se/norradjurgardsstaden*

3.6 Sege Park, Malmö, Sweden

Sege Park is a former hospital area consisting of some 20 buildings, most of which were built in the 1930s. The area is currently undergoing a planning process that includes energy efficiency measures for the existing buildings and densification for additional residential housing. It is expected that, once development has finished, ca. 1200 people will be living in Sege Park.
The aim for the development is to supply renewable energy to the entire area, most of which should be produced within the area. This puts quite a lot of emphasis on efficiency measures being implemented in the existing buildings. At the same time there are restrictions due to cultural heritage values of the buildings.
Where possible, installations for the production of solar energy will be integrated in the buildings' facades and roofs.
When Sege Park was first built, its main purpose was to offer optimal conditions for recuperation and convalescence. The hospital's main focus was for the patients to be able to be outside and basically all food was produced within the area.
Sege Park is now on the verge of going through an important change again. The area will be developed to form a new part of the city, with densification projects, but at the same time preserve the existing buildings and give them a new function.
As it was then, the underlying concept for the new Sege Park is to be self-sustaining. All residents will have the possibility to grow food in the area. Likewise, Sege Park will be able to cover its own energy demand.

11 Source: Miljö och hållbarhetskrav vid markanvisning – Handlingsprogram Vid planering, projektering, byggande och förvaltning av bostäder, kontor och handel i nya och befintliga byggnader inom Gasverksområdet

The gate house to Sege Park has been glazed in to conserve energy without having too much impact on the visual appearance of the building. Photo: Hamin Mousavi, Malmö stad.

That means that on the one hand new buildings will be plus-energy houses, i.e. they produce more energy than they use. At the same time the existing buildings will be renovated, in particular with a focus on energy efficiency. A smart energy grid will connect the energy demand with the energy produced by solar thermal and photovoltaic panels installed within the area. Today Sege Park is already well known for its large solar energy installations. The excess energy is stored in the form of hydrogen and can be used in times when demand is higher than supply. Otherwise the hydrogen will be used as transportation fuel.

The older buildings in Sege Park were built in the 1930s and make up an important characteristic for the park and urban environment. To reduce energy usage, measures will be implemented that do not have a negative visual impact on the outside, such as optimised ventilation systems and roof insulation.

Another way of saving energy that has already been implemented is to glaze in entire or parts of buildings. The idea is that the air gap between the glass facade and the brick wall can be used with the help of automatic control devices to control the temperature in the building. Sensors can tell if the air is too hot or too cold and move the air correspondingly, partly between different rooms in the building, partly to a heat exchanger that heats the indoor ventilation air. The air source can be chosen depending on the temperature.

For other buildings in Sege Park, Lund Technical University has carried out a lifecycle analysis (LCA) based study in order to be able to compare different energy efficiency measures. The measures that were analysed range from insulation and exchange of windows to individual temperature control and metering and energy recovery from ventilation or waste water.
Based on assumptions on the development of future energy prices and other variables, it was possible to give a maximum allowable upfront investment cost for the different measures in order for them to be profitable over a building's lifetime
Links to more information: *http://malmo.se/segepark* (in Swedish)

3.7 Conclusions balancing heritage preservation with climate protection

- The EPBD is implemented not only through building regulations but also environmental programmes and specific action plans.
- Development plans etc. offer the opportunity to plan energy efficiency measures in historic buildings in a larger context (e.g. district heating, specific energy efficiency goals for different building types in one quarter).

› Due to the fact, that there are no specific regulations on improving energy efficiency of historic buildings, there is a need for models for decision-making, policies, guidelines and standards for analysing, realising and monitoring. ‹

4. Standards and Guidelines

None of the partners in Co_2olBricks has specific national rules concerning energy and historic buildings yet. Due to the fact, that there are no specific regulations on improving energy efficiency of historic buildings, there is a need for models for decision-making, policies, guidelines and standards for analysing, realising and monitoring. Shown below there are some examples of national guidelines in other countries. There is presently on-going work within the European Committee for Standardisation, CEN/TC 346/WG 8 Energy efficiency of historic buildings. This standard will be procedural, rather than defining general solutions. It will show a harmonised, systematic approach to facilitate the best decision in each individual case.

4.1 CEN TC 346/WG 8 Energy efficiency of historic buildings

Interdisciplinary work between the different competences involved in the work with energy efficiency in historic buildings will ensure that more qualified suggestions for energy saving measures are implemented. It will also improve the decision-making process and thereby the methodology of energy refurbishment of historic buildings.

The optimum solution would be if national policies and guidelines adapt and refer to European standards like "CEN/TC 346 Energy efficiency of historic buildings". It will be a tool for professionals and contractors in Europe who will benefit in producing appropriate and cost effective energy saving improvements, and the costs relating to managing existing valuable buildings will be reduced.

Before the work of developing a new standard started, a feasibility study was conducted by the convener of the group, Marte Boro at Directorate of Cultural Heritage in Norway. The study explains the frame of the problem and the scope of the standard. It states that special methods and standards are needed to improve energy efficiency in the European stock of existing buildings that represents great cultural and material resources.

The proposed standard aims at facilitating a sustainable management of these buildings by integrating energy saving measures with proper preservation of these buildings and monuments.

The standard will consider improvement of the whole building fabric[12], assessments of energy supply and energy carriers in addition to user behaviour and demand side management.

12 Fabric includes building interiors and subsurface remains as well as excavated material. Fabric may define spaces and these may be important elements of the significance of the place, according to ICOMOS Australia, The Burra charter : *http://australia.icomos.org/wp-content/uploads/BURRA-CHARTER-1999_charter-only.pdf*

Sustainability is a fundamental principal of the goal of reducing CO_2 emissions. Therefore, lifecycle analysis and considerations on embodied energy in existing buildings material and construction will be included as well as the possibility to compensate poor energy performance through the use of sustainable energy carriers. When considering sustainable management of the building, it should be seen in context, not only as individual buildings. Reviews of area-based solutions are part of the context of the standard.[13]

Other relevant standards that support the integration of climate protection and preserving historic buildings from CEN/TC 346 – Conservation of Cultural Heritage are:

- EN 15898:2011 conservation of cultural property – Main general terms and definitions
- EN 15759–1:2011Conservation of cultural property – Indoor climate – Part 1: Guidelines for heating churches, chapels, and other places of worship
- EN 16096:2012 Conservation of cultural property – Condition survey and report of built cultural heritage

Other relevant European standards concerning energy performance in existing buildings:

- EN 15603 Energy performance of buildings – Overall energy use and definition of energy ratings
- EN 15217 Energy performance of buildings – Methods for expressing energy performance and for the energy certification of buildings
- EN 16247–1:2012 Energy audits – Part 1: General requirements

CEN Technical Report defining key terms commonly used within energy efficiency and buildings:

- CEN/CLC/TR 16103:2010 Energy management and energy efficiency – Glossary of terms

13 CEN/TC346/WG8 N004 "Feasibility study – Guidelines for improving energy efficiency of architecturally, culturally or historically valuable building"

International standards/technical report dealing with definitions and general procedures for the overall building energy performance rating and certification:

- ISO/TR 16344, Energy performance of buildings – Common terms, definitions and symbols for the overall energy performance rating and certification
- ISO 16343: Energy performance of buildings – Methods for expressing energy performance and for energy certification of buildings
- ISO 16346: Energy performance of buildings – Assessment of the overall energy performance

4.2 Links to international documents within the heritage sector

UNESCO

Climate Change and World Heritage, Report on predicting and managing the impacts of climate change on World Heritage and Strategy to assist States Parties to implement appropriate management responses. *http://whc.unesco.org/documents/publi_wh_papers_22_en.pdf*

UN Convention concerning the Protection of the World Cultural and Natural Heritage 1972. *http://whc.unesco.org/archive/convention-en.pdf*

Recommendation on the Historic Urban Landscape *http://portal.unesco.org/en/ev.php-URL_ID=48857&URL_DO=DO_TOPIC&URL_SECTION=201.html*

ICOMOS

ICOMOS – International Charter for the Conservation and Restoration of Monuments and Sites (The Venice Charter) – 1964 *http://www.icomos.org/en/charters-and-texts*

ICOMOS – The Australia ICOMOS Charter for Places of Cultural Significance (The Burra charter) – 1979

ICOMOS – The Nara Document on Authenticity (Nara Conference on Authenticity in Relation to the World Heritage Convention, held at Nara, Japan, from 1–6 November 1994)

ICOMOS – Charter on the Built Vernacular heritage – 1999

ICOMOS – Principles for the analysis, conservation and structural restoration of architectural heritage – 2003

COUNCIL OF EUROPE

EU Convention for the Protection of the Architectural Heritage of Europe
CETS No.: 121 *http://conventions.coe.int/Treaty/Commun/QueVoulezVous.asp?NT=121&CM=1&CL=ENG*

4.3 National guidelines, energy efficiency in historic buildings

AUSTRIA

Austrian guideline (Austria 2011) "Energieeffizienz am Baudenkmal"
http://www.bda.at/documents/944221227.pdf

ENGLAND

Energy Efficiency and Historic Buildings Application of Part L of the Building Regulations to historic and traditionally constructed buildings English Guideline English Heritage 2011
http://www.english-heritage.org.uk/your-property/saving-energy/guidance/

DENMARK

Energiguiden – Danish guideline
http://www.bygningskultur.dk/Materiale/User+Upload+Files/Vidensbase+filer/energiguide_light_FINAL.pdf

GERMANY

Guideline Baden-Württemberg (August 2010) "Kulturdenkmale sanieren – Energie sparen – Energetische Verbesserung denkmalgeschützter Gebäude"
http://www.mfw.baden-wuerttemberg.de/fm7/1106/Kulturdenkmale%20sanieren-Energie%20sparen.pdf

Guideline Bayern
http://www.blfd.bayern.de/medien/brl_erneuerbare_energien_2012.pdf

Guideline Northrhine-Westfalia
http://www.denkmalpflege.lvr.de/publikationen/adr_bdk_leitfaden1.pdf

Guideline Saxony
http://www.bauenwohnen.sachsen.de/download/Bauen_und_Wohnen/Handlunganleitung_Energetische_Sanierung.pdf

Collection of best practice, Germany
http://www.denkmalpflege-forum.de/Download/Broschuere_VDL11.pdf

IRELAND

Irish guideline (Ireland 2010) "Energy efficiency in traditional buildings"
http://www.ahg.gov.ie/en/Publications/HeritagePublications/BuiltHeritagePolicyPublications/Energy%20Efficiency%20in%20Traditional%20Buildings%20(2010).pdf

SCOTLAND

A Climate Change Action Plan for Historic Scotland 2012–2017
http://www.historic-scotland.gov.uk/climate-change-plan-2012.pdf

UNITED STATES OF AMERICA

The Secretary of the Interior's Standards for Rehabilitation & Illustrated Guidelines for Rehabilitating Historic Buildings
http://www.nps.gov/tps/standards/rehabilitation/sustainability-guidelines.pdf

4.4 Conclusions standards and guidelines

- Experiences and lessons learned from the Co_2olBricks project should be contributed to the CEN TC346/WG8. This process shall be supported in the future.
- People working in this field have to know the conventions and charters mentioned.
- The guidelines and best practice collections are recommendable and should be used by experts and in specific competence centres which have to be installed. The guidelines have to be adjusted by the countries/regions/municipalities.

› We demand from every worker on a construction site that they have to be well prepared for their tasks. ‹

5. Education for expertise

The studies implemented during the project requested the development of new curricula's for architects, energy engineers, and other performers or stakeholders. This is illustrated by the Learning packages developed within Co_2olBricks Work Package 5, read a short introduction in 5.1 and separate publication of lecture material.
A lot of background knowledge is needed but hands-on skills and experience are also valuable. Therefore, the challenge we face in the field of cultural heritage buildings is basically calling for the expertise of specialists. We demand from every worker on a construction site that they have to be well prepared for their tasks. Nevertheless, we have to acknowledge that within the apprenticeship of Vocational Education and Training (VET) students there is hardly time to work on those specific topics. But the systems and opportunities of VET might vary throughout the countries of the Baltic Sea Region. So a special focus should be laid on advanced training.

5.1 Specific qualification for architects, engineers and conservators

To deal with both heritage preservation and energy efficiency, specific knowhow of the people involved needs to be mandatory in order to be successful and to balance both objectives: make the building fit for the future without destroying its cultural values.
Two examples for programmes to raise this knowhow from Germany are the "Brick consultant" and the "Energy consultant for historic buildings".

5.1.1 Brick consultant ("Backsteinberater"); Quality manager for brick facades ("Qualitätssicherer Backstein")

This is a local qualification programme organised by the architectural association in Hamburg. The six-day programme consists of the following modules:

- Current status of bricks and climate protection;
- History of brick city Hamburg;
- Brick as a material – stone and joint;
- Refurbishment and insulation;

- Basics of Hamburg real estate industry;
- Best practice examples;
- Working process as a “brick consultant”.

The participants of these modules can take part in the further education as certified quality manager for brick facades, which means another one-day module and an exam.

5.1.2 Energy consultant for historic buildings

This is a national further education programme in Germany with 60 lessons (45 min each) and ends with a written examination. The requirements for participants are: architect or building engineer and energy consultant and proven experience in heritage preservation. Content of the programme is:

- Basic knowhow in heritage protection and preservation
  - Basics of heritage protection
  - Basics of heritage preservation
  - Refurbishment methods
  - Inventory of the historic value
  - Historic architectural styles
- Public funding
  - Public funding programmes
  - Tax reductions
  - Application for public funding
- Laws, regulations and guidelines
- Assessment of the building physics of a historic building
  - Materials, buildings components, installations
  - Moisture proofing
  - Ventilation
  - Structural damage and causes
  - User behaviour
- Development of measures which fit to the historic building
  - Calculation models
  - Building/construction technique
  - Installations, HVAC
  - Demands on the user behaviour

- Holistic approach
  - Lifecycle consideration
  - Preservation of resources
  - Economic feasibility
- Development of a planning and refurbishment concept for a historic building
  - Draft of a refurbishment concept
  - Basics about the planning of refurbishments in existing buildings
  - Structure of the consulting report

Link: "Energieberater für Baudenkmale" (Energy consultant for historic buildings), (2011)
www.energieberater-denkmal.de/fortbildungsmodul_2011_12_14.pdf
Both programmes are not mandatory in order to work with historic buildings in general. But they are connected with public funding programmes see 6.1 and 6.2 in the way that only certified experts are allowed to take part in this.

5.1.3 Training module "Energy efficiency in historic buildings" for professionals

One task of Work package 5 was to create a handbook "Energy efficiency in historic buildings". Riga Technical University (Co_2olBricks Project Partner 15) therefor prepared a handbook and tested it in a three days training course. The participants of this training represented several target groups from architects and consultants to craftsmen. This practical experience allowed to improve the handbook and to emphasize some significant problems.

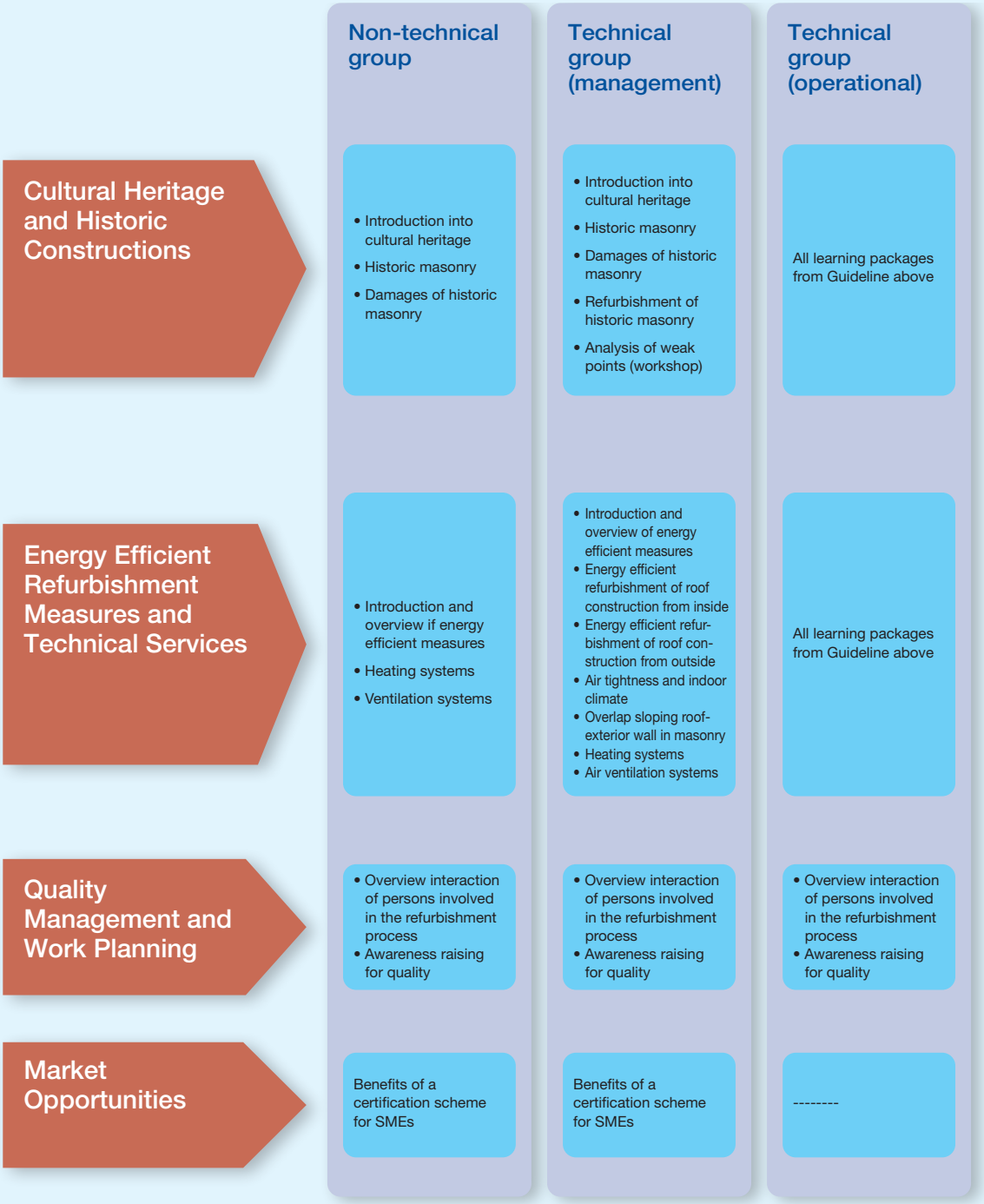
5.2 Training modules for craftsmen

All persons involved in the refurbishment process of a historic building require special knowledge equivalent to their function. Mainly the executing persons such as architects, engineers and craftsmen have to expand their competences because standard knowledge does not sufficiently account for the requirements of sensitive historic constructions.We recommend: To upgrade the knowhow and skills we need a comprehensive programme of further education. The core task of Work Package 5 was to compile new training modules covering all necessary topics for the relevant target groups. The example of project partner 03 Ausbildungszentrum-Bau in Hamburg GmbH (AZB), responsible for Vocational Educational Training (VET) in their region, demonstrates how this can work. Within the project they have developed a training scheme illustrating which skills are relevant for each target group with focus on craftsmen.

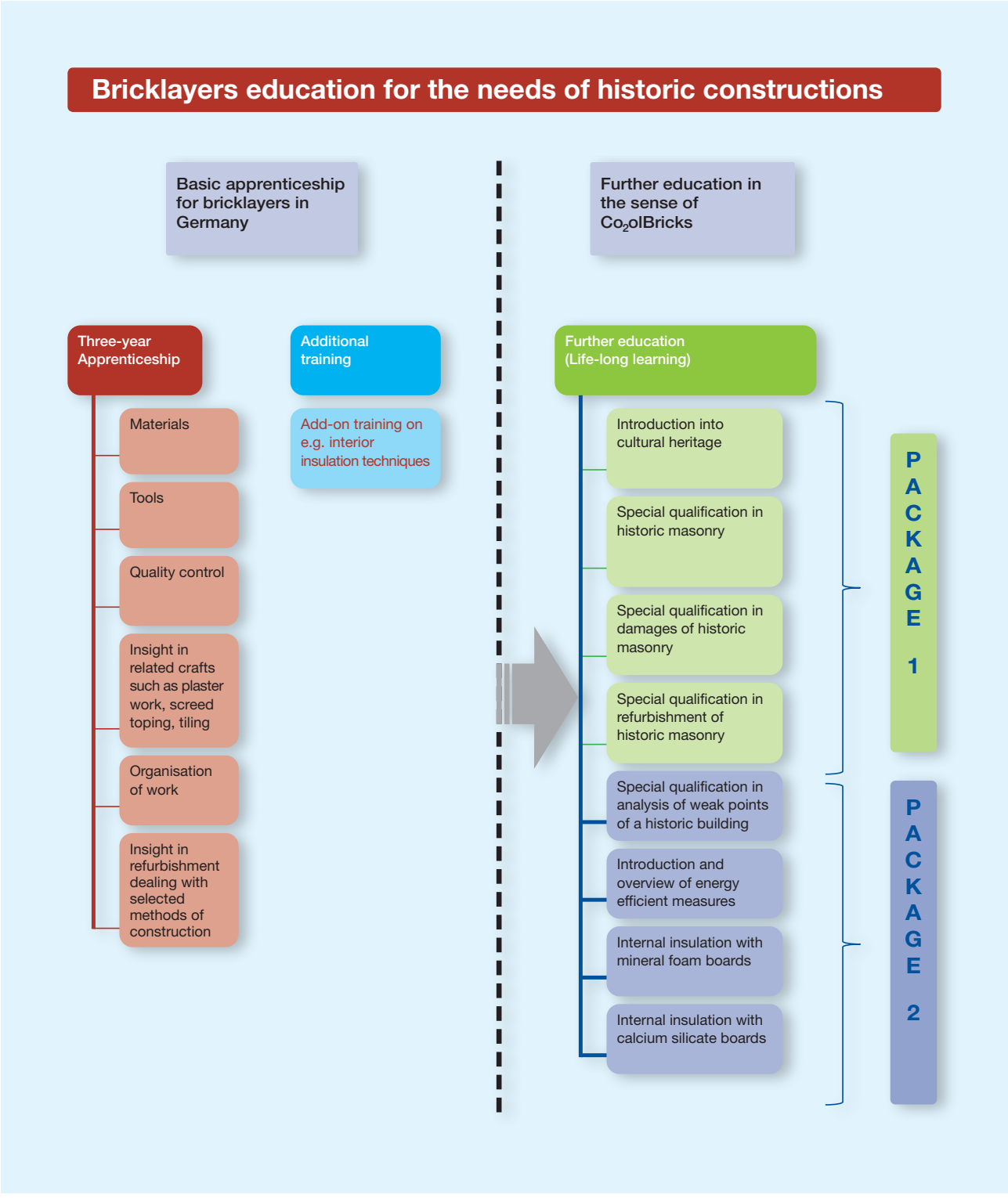
There are three main target groups:

Non-technical group	Technical group (management)	Technical group (operational)
Local authorities	Facility managers	Apprentices
Sales & facility managers	Architects, engineers	Skilled workers
Investors, developers	Local authorities (tech.)	Building supervising staff
Owners	Real estate developers	Architects, engineers
Occupants	Construction companies	Construction companies

Different training modules relevant for main target groups



The different training modules relevant for the three main target groups.



Shows how bricklayers should be educated for the needs of historic constructions. Illustrations 15+16: Ausbildungszentrum-Bau in Hamburg GmbH (AZB).

The educational material is divided into four categories. Moreover, each category consists of a wide range of topics. The listed topics are the ones developed and offered by AZB Hamburg:

- Cultural Heritage and Historic Constructions
  - Introduction into cultural heritage
  - Historic masonry
  - Damages of historic masonry
  - Refurbishment of historic masonry
- Energy Efficient Refurbishment Measures and Technical Services
  - Introduction and overview of energy efficient measures
  - Internal insulation with mineral foam boards
  - Internal insulation with calcium silicate boards
  - Energy efficient refurbishment of roof construction from inside and outside
  - Air tightness and indoor climate
  - Analysis of weak points
- Quality Management and Work Planning
  - Overview interaction of persons involved in the refurbishment process
  - Awareness rising for quality
- Market Opportunities
  - Benefits of a certification scheme for SMEs (Small and Medium sized Enterprises)

5.3 Conclusions education for expertise

- Specific education for the experts working in this field needs to be mandatory.
- All measures should be conducted by certified experts.

› There is a need for research and development programmes regarding energy efficiency and climate change regarding historic buildings. ‹

6. Research programmes

The Co_2olBricks project urges European and national governments to provide funding through the research framework programmes and other research funding programmes initiated to increase awareness of energy efficiency in cultural and historic buildings.
There is a need for research and development programmes regarding energy efficiency and climate change regarding historic buildings. The research and the legal procedure with implementing the EU directives should preferably go hand in hand. According to DIRECTIVE 2010/31/EU on the energy performance of buildings, every member country needs to have a national action plan for energy efficiency. Among the Co_2olBricks partners there is only Sweden who has a national research and development programme regarding energy efficiency in historic buildings stated in the national action plan for energy efficiency, which is illustrated below in chapter 6.1.

6.1 Spara och Bevara

"Spara och Bevara" is the Swedish national research programme for energy efficiency in cultural and historic buildings. Save and preserve (direct translation) is a research and development programme initiated by the Energy Agency to increase awareness of energy efficiency in cultural and historic buildings. The programme aims to develop and disseminate knowledge and technology solutions that contribute to improving energy efficiency in these buildings without their values and equipment destroyed or corrupted. The gentle energy efficiency will be achieved through interdisciplinary collaborations, where technology meets Conservation. The goal is to create a lasting foundation of knowledge in the field of energy efficiency in cultural and historic buildings and contribute to a long-term, sustainable management of the older building stock. For the periods 2006–2010 and 2011–2014 the Energy Agency dedicated and will dedicate 40 + 40 million SEK (approx. Euro 4,5 + 4,5m) for research.
National research programmes like the Swedish "Spara och Bevara" are requested. For example, research results need to be implemented in guidelines. More interaction between authorities will improve the implementation of research and might lead to better control of or a new introduction of subsidies and policies.
Some examples of and results within "Spara och Bevara" research projects:

6.1.1 Energy Efficiency and Preservation in Our Cultural Heritage, EEPOCH

The project concerns our building heritage, and a multiple case study was performed to find models for the balancing of energy and preservation demands. Preserved objects for the study were chosen within the Halland Model, a cooperation project which started in the 1990s recession. The aim at that time was regional growth, strengthening competitiveness, sustainability and development of building conservation.
First project period (2007–2011) result: The project shows that it is possible to develop a model for balancing energy and conservation requirements. However, there is a risk that either conservation or energy requirements stress/outweigh the detriment of one or the other requirement. The results of the project also show that it is possible to create a model for valuation and balance that both energy experts and building conservationists accept. The issues are complex, which intensifies the work, and all stakeholders must be involved in the choices to be made and the decisions that must be taken in the future to produce a functional approach and methodology.
http://www.chalmers.se/en/Projects/Pages/Energy-Efficiency-and-Preservation.aspx

6.1.2 Potential and Policies for energy efficiency in buildings built before 1945

In society today the greatest ambition is to reduce energy consumption in existing buildings and there are strategies for how these savings can be realised. The question is whether this is a threat or an opportunity for buildings with cultural heritage value. The regulations provide clear requirements with regard to consideration of the building's cultural value; the challenge is to apply this in some systematic form and with quality assurance. Discussions about energy efficiency in cultural heritage buildings relate to how cultural values and technological characteristics affect the abilities to save energy. With the conclusion of the first phase of the "Spara och Bevara" programme it is obvious that these problems are well documented in terms of monumental buildings, even if not all questions have been answered. However, for the considerably larger number of buildings with cultural heritage values but with no or weak protection, residencies and commercial buildings, there is no comprehensive problem description available. This means that there is considerable uncertainty

regarding their energy efficiency goals and means for accomplishment. This is not an isolated Swedish phenomenon; the same uncertainty exists in the rest of Europe.

The overall objective is to create conditions for careful energy efficiency in cultural heritage buildings by describing the problems and potentials. Partial goals for the project are to:

- Quantitatively describe how the techno-economic savings potential is affected by considerations of cultural value.
- Quantitatively and qualitatively describe the antiquarian and architectural consequences of the political objectives and the National Board of Housing, Building and Planning's new rules.
- Define measures, in the form of policies, information and technological solutions which need to be developed in order to harmonise the objectives of the energy sector with conservation goals.
- Transfer knowledge and experience from research and development that focus on modern building construction.

The project is expected to establish:

- A basis of national policies and guidelines for energy efficiency in cultural heritage buildings.
- Propose a form of energy performance review of cultural heritage buildings including benchmarks for energy performance.
- Identify the need for technological development.

For more information: *http://www.sparaochbevara.se/index.php?page=210*

Skokloster castle, one of the buildings where measurements of indoor climate are made by "Spara och Bevara" research projects. Photo: Therese Sonehag.

6.1.3 Energy efficiency and preventive conservation through climate control

This is a multidisciplinary project involving several Swedish universities. The aim of the project as a whole is to produce guidelines and recommendations for owners and/or custodians of historic buildings and their advisers, and this means that knowledge must be gathered and that tools and methods must be investigated. The objective is to enable an interdisciplinary approach combining fundamental theoretical studies and laboratory experiments applied in various building types to evaluate and demonstrate new solutions. The cooperation aims not only to solve given problems but also to identify new research questions for study. Indoor climate and climate control in cultural heritage buildings are internationally established research areas. The two basic research questions are:

- What type of climate is preferable with regard to usage and conservation?
- How is this achieved with long-term sustainability?

The first phase of the project positioned Swedish research in an international context and catalogued new informational resources through a number of reports, scientific papers and European standards. Previous projects exhibit knowledge gaps limiting the possibilities to realise the potential for energy efficiency and preventive conservation. It is about:

- The impact of indoor climate on buildings and objects; from drying damage to mould
- Risk analysis and indoor climate decisions
- Simulations to demonstrate the effects of different action alternatives
- Development of integrated strategies for extensive passive control, ventilation and humidity control.

The project partners are Gotland University, KTH (The Royal Institute of Technology) and the University of Gothenburg. Development of policies and guidelines are made in cooperation with National Board of Heritage.
For more information: *http://www.sparaochbevara.se/index.php?page=64*

6.2 Conclusions of the research programs

Further research in historic buildings should be conducted: e.g.

- Research on milieu or town level.
- Monitoring of existing projects (e.g. 3encult).
- Nationwide research is necessary to consider the national distinctions.

› There is a lack of knowledge and competence in dealing with energy efficiency in historic buildings. ‹

7. Support programmes and certification

The financial mechanisms and legislation are not harmonised with legislation and the intentions of preservation. There is a lack of knowledge and competence in dealing with energy efficiency in historic buildings. Communication between the different competences and interdisciplinary work needs to increase.
There are some examples of new curricula for the training of experts in energy efficiency of historic buildings, mostly energy experts. Training of conservation officers and antiquarians in energy efficient measures and problems, raising the awareness of property owners and changing user behaviour of the public are other examples of requirements.
According to the conclusions of the project there is a need for specific public funding and certified staff for energy efficiency in historic buildings. This is illustrated by the regional programme "Backsteinfonds" evolved in Hamburg during the project time and the national German programme, KfW Denkmal which has existed for about a year (in April 2013), both containing skills programmes as part of the quality management.

7.1 Support programme for brick facades, Hamburg, Germany

Red brick facades are formative for the townscape of Hamburg. Especially residential brick buildings from the 1920s and the post-World War II era are typical for large areas of the city. Due to the large number of flats and their often bad condition as regards energy efficiency, they are in the focus of refurbishment activities, which normally are concerned with outer wall insulation. To preserve these brick facades, the City-State of Hamburg launched a programme in 2012. It consists of two elements: A financial support programme called "Backsteinfonds"(brick fund) and an accompanying quality management programme called "Backsteinberater" (brick consultant); read more in chapter 5.1.
Both programmes were developed by a joint group of stakeholders from building and heritage administration, chamber of architects, house owner associations and the local public funding bank "Wohnungsbaukreditanstalt" (WK) under the lead of the Chief Planning Director of the City-State of Hamburg. The main objective was to take pressure off of the brick facades, and therefore a combination of financial support and specific knowhow was developed. Important to know is that these programmes are not exclusively for historic buildings but for all brick buildings relevant tor the townscape.

Behringstraße 76–82, Hamburg. Photo: Bendix Bürgener.

The "Backsteinfonds" is not a single programme in itself. It is integrated in the already existing financial support programmes of the WK by definition of additional support conditions: Refurbishment of joints and the use of brick slips and full bricks in the case of external insulation.
A precondition for any kind of financial support by the WK for energy refurbishment measures concerning building insulation is a check of the "brick relevance" of the building. In the case of "brick relevance" a refurbishment concept for the facade has to be compiled to get the funding. The costs for the quality manager are paid by the WK.
This check is conducted by a designated "quality manager for brick facades" who has to pass the advanced training course "Backsteinberater"; read more in chapter 5.1.
Links to more information: Wohnungsbaukreditanstalt Hamburg (public funding bank) – leaflet: Quality management for bricks facades (in German): *http://www.wk-hamburg.de/fileadmin/pdf/qualitaetssicherung/WK-Info_QS-B_Backsteinfassaden.pdf*

7.2 Public funding programme "KfW-Effizienzhaus Denkmal", Germany

In April 2012 a new public funding programme for historic buildings in Germany with a special focus on energy refurbishment was launched. In cooperation with the German heritage bodies, the public promotional bank of the Federal Republic of Germany "KfW" developed special conditions for eligibility for the energy upgrading for listed buildings and other especially

valuable building objects. The funding programme relies significantly on quality assurance through a qualified planning and construction supervision. The aim is "to take the pressure off the facade". The funding refers therefore to the primary energy demand, which should reach an overall target value of 160% in comparison to a new house. There is no specific requirement for the U-value of the envelope of historic buildings – and this differs from the usual eligibility criteria. Within the framework of mandatory skilled planning, an expert called an "energy consultant for heritage buildings" has to consider which energy-related measures are useful to carry out to maintain the appearance of the historic building and to preserve its heritage value. This approach allows a consideration of individual cases and the specific cultural values of the buildings.

An evaluation is planned for the financial aspects by the KfW, but there is no official information about the date. A first feedback from the local heritage conservators in Hamburg is that there many requests concerning this programme. That is confirmed by unofficial information that about 1,140 living units have received this funding up to now.

The coordination body for quality management from the VdL/WTA has received around 500 applications for the preliminary list of experts; 300 of them were confirmed and listed in an online database. The comprehensive further education programme and qualification system is currently being adjusted, because the initial experiences of the education institutes that should operate the qualification programme showed that it is too ambitious for the available time budget of 60 lessons.

Links to more information: Public funding programme "KfW Denkmal", Model B Grant:
https://www.kfw.de/inlandsfoerderung/Privatpersonen/Bestandsimmobilien/Finanzierungsangebote/Energieeffizient-Sanieren-Zuschuss-(430)/
Public funding programme "KfW Denkmal", Model A: Interest reduced loan:
https://www.kfw.de/inlandsfoerderung/Privatpersonen/Bestandsimmobilien/Finanzierungsangebote/Energieeffizient-Sanieren-Kredit-(151–152)/
"Energieberater für Baudenkmale" (Energy consultant for listed buildings), (2011) *www.energieberater-denkmal.de/fortbildungsmodul_2011_12_14.pdf*

7.3 Conclusions regarding support programs

- Financial support programmes for energy efficiency in historic buildings have to be developed.

› The aim of the project was to combine measures of energy efficient refurbishment of the housing stock with the overall improvement of residential neighbourhoods. ‹

8. Relevant projects and networks

8.1 EU projects

There are many projects, completed or on-going, focusing on the challenges of energy efficiency and valuable cultural buildings. Some of them are listed in Co_2olBricks Interim Brochure "Energy refurbishment of historic buildings in the Baltic Sea Region", to be downloaded at: *http://www.coolbricks.eu/fileadmin/Redaktion/Dokumente/Publications/04_Interim_Brochure_safe.pdf.pdf*.

8.1.1 UrbEnergy – Energy Efficient and Integrated Urban Development Action

About the project

In view of the increasing significance of energy efficiency in the field of urban development, the transnational cooperation project Urb.Energy was launched in January 2009. The aim of the project was to combine measures of energy efficient refurbishment of the housing stock with the overall improvement of residential neighbourhoods. The project was co-funded by the territorial cooperation programme "Baltic Sea Region Programme 2007–2013" as well as by the German federal programme "Transnational Cooperation". 15 partners from Estonia, Germany, Latvia, Lithuania, Poland and Belarus took part in the project and represented key actors in national activities for energy efficient settlement structures.

Urb.Energy's key objective was the development and implementation of integrated concepts and strategies for the comprehensive energy efficient renewal of residential areas in the Baltic Sea Region. The partners worked together to develop Integrated Urban Development Concepts (IUDC) to combine energy efficient housing refurbishment with the renewal of the energy supply infrastructure, the upgrading of the residential environment, the improvement of the social and economic infrastructure and the participation and mobilisation of residents.

Relevant results for Co_2olBricks issues

The UrbEnergy manual on holistic strategies for energy efficient refurbishment of the housing stock (link to the document: see below) includes general recommendations to develop energy efficient concepts as

well as good practice examples. Particularly the following recommendations are helpful in the case of the refurbishment of historic buildings:

- Integration of energy and climate concepts in integrated urban development plans is a success factor.
- Analyse the energy supply, energy consumption and energy efficiency potentials, because energy and climate concepts need a solid analytic base.
- Develop differentiated measures for neighbourhoods with heterogeneous and homogenous building structure.
- Secure the quality of the energy efficiency refurbishment works.

Further on, a number of very interesting cases studies are shown, four of which deal (partially) with historic buildings. The presented examples concern the following issues:

- Internal insulation, Insulation of rear facades
- Windows, roof, cellar
- ventilation
- Improvement of the heating system
- District heating, cogeneration, renewable energy

Further information

Projects website: *http://www.urbenergy.eu/*
Manual on holistic strategies: (*http://www.urbenergy.eu/fileadmin/urb.energy/medias/partners_section/Partner_Outputs/main_results/Energy_Efficient_Refurbishment_WP4_manual.pdf*)

8.1.2 AlpHouse- Alpine building culture and energy-efficiency

About the project

The Alpine area produced a wide range of characteristic building types which emerged out of a long-term adaption to climatic and geographic conditions. To preserve this cultural value and the traditional knowhow it was the aim of the AlpHouse project to try to understand the principles of traditional alpine architecture, integrate them in present-day construction, and develop them further.
For this purpose, nine project partners from Austria, Italy, Germany and France joined together to develop quality criteria with two central aims:

- Preservation and development of the cultural heritage of the Alpine Space, as represented by vernacular architecture, traditional settlement structures, regional materials and crafts techniques.
- Optimisation of energy efficiency and overall lifecycle costs of buildings and settlements, achieved by applying state-of-the-art technologies and detailed knowledge on ecology and specific local conditions.

The project explored and collected knowledge and skills in the various regions and passes them on to craftsmen, architects, planners, and decision makers so that they can develop individual local solutions oriented towards a common understanding of quality.
AlpHouse ended in 2012 and was funded by Alpine Space Programme of the European Union (EU) in the framework of the European Territorial Cooperation 2007–2013. The project is being continued by the follow-up project AlpBC, which is focused on regional planning and consulting strategies.

Relevant results for Co_2olBricks issues

One of the main project outputs are the AlpHouse Qualification Modules. They contain a wide range of relevant topics concerning energy refurbishment of traditional buildings from "Renovation strategies" up to "Optimization of windows", "Moisture in the building" and "Facades – Construction and insulation".
An overview about the Training modules is available on the AlpHouse website. Further material and information is being delivered via the AlpHouse Information Platform.
Further on, the final publication of the AlpHouse project gives a good overview about the project's activities and outputs.

Further information

Projects website:
*http://www.alphouse.eu/*AlpHouse Qualification Modules:
http://www.alphouse.eu/Training-Modules-en.html
AlpHouse Information Platform:
http://ispacevm14.researchstudio.at/alphouse/
Final Publication:
http://www.alphouse.eu/medien/medienpool/Final-Publication-AlpHouse-low-resolution.pdf

8.1.3 Longlife

About the project

Longlife (Longlife – Sustainable, energy efficient residential buildings in regard to European requirements and innovative technologies in the Baltic Sea Region) was a transnational project in the Baltic SeaRegion. The duration of the project was from January 2009 until January 2012. It was funded through the EU programme Baltic Sea Region 2007–2013. In the Longlife project, partners from Denmark, Lithuania, Poland, Russia and Germany worked together.

Longlife aimed to optimise methods and construction, to adapt and implement new technologies for buildings and to harmonise building procedures between participating countries. Therefore Longlife developed practices, innovative technologies, unified procedures and guidelines for and subsequently the design of a prototype of a sustainable, energy-efficient and resource-saving residential building in the Baltic Sea Region. The Longlife guidelines and unified procedures for energy efficiency, sustainability, resource-saving buildings and low lifecycle costs shall lead to a reduction of energy consumption during a building's lifecycle.

Relevant results for Co_2olBricks issues

Although the project's focus is on new buildings, the Longlife Prototype Catalogue can be a basis to plan the refurbishment with elements of it and to ensure an energy efficient and sustainable building that can also be certified by the Longlife Performance Pass. This certification indicates low energy demand of the building, ecological impacts such as CO_2 emissions and financial information in terms of initial, maintaining and operational costs. The Longlife pilot projects give an impression of this approach.

Further information

Projects website: *http://www.longlife-world.eu*
Pilot projects:
http://www.longlife-world.eu/res/dnl/en/Longlife%20Report%203.3.223.pdf

8.1.4 Build with CaRe – Energy saving buildings

About the project

Build with CaRe (Carbon Reduction) aimed to mobilise all forces in order to make energy-efficient building design the mainstream. Local and regional

authorities, universities and institutes from 10 regions in 5 countries in the North Sea Region were active in the Build with CaRe partnership. The project, which started in 2008 and concluded in 2011, was partly financed by the Interreg IV B North Sea Programme.

Relevant results for Co_2olBricks issues

Starting with the focus on newly built constructions in passive house standard, during the projects runtime, the selected projects focused more on refurbishments on existing buildings with components in passive house quality and on the renovation of historic buildings.
Demonstration buildings have been:

- the 105 year old Marischal College, being converted into the new Aberdeen City Council corporate headquarters,
- the medieval monastery Prittlewell Priory at Southend-On-Sea turning into a "Green Museum" and
- The renovation of 246 houses at the 1930s residential area De Koningsvrouwen van Landlust of Eigen Haard housing association in Amsterdam.

Further information

Projects website: *http://www.buildwithcare.eu/*

8.1.5 Climate for Culture

About the project

The CLIMATE FOR CULTURE project is funded by the European Commission, runs from 2009 until 2014 and consists of 30 partners from all over Europe and Egypt making multidisciplinary contributions. The research teams will assess the damage potential of climate change on our cultural heritage, its socioeconomic impact and possible mitigation strategies. Collections in historic buildings in different parts of Europe will be included for in situ investigation of present problems and for the prediction of future issues. For this purpose and for the first time ever, high resolution climate evolution scenarios will be coupled with whole building simulation models to identify the most urgent risks for specific regions with the aim of developing mitigation strategies. The risks thus identified and the economic consequences for European cultural heritage will be communicated to policy makers together with possible mitigation strategies to be included in future IPCC Reports.

Relevant (interim) results for Co_2olBricks issues

Even though the Climate for Culture project deals mainly with monuments, in the sense of castles, palaces, manor houses, churches and museums, there are several topics that are interesting for other historic buildings too, e.g. about:

- Standards
- The impact of temperature changes on the indoor climate of historic buildings.
- Developments in climate control of historic buildings

Further information

For more information: *http://www.climateforculture.eu/*
For reports see: *http://www.climateforculture.eu/index.php?inhalt=dissemination.publications*

8.1.6 3ENCULT – Efficient energy for EU cultural heritage

About the project

3ENCULT was a project co-funded by the European Commission under FP7 (EeB.ENV.2010.3.2.4–1). Start date: 1st October 2010. Duration: 3.5 years – until 31st March 2013. The project 3ENCULT aimed at bridging the gap between conservation of historic buildings and climate protection. It demonstrated the feasibility of 10% reduction in energy demand, depending on the case and the heritage value.
The main objectives were:

- The development of passive and active solutions for conservation and energy efficient retrofit including available products as well as new developments by involved SMEs,
- The definition of diagnosis and monitoring instruments, the long term monitoring (also for IEQ – Indoor Environment Controlling) and
- The development of planning and evaluation tools and concepts supporting the implementation,
- The quality assurance and control of success of the energy retrofit measures.

The joint task of conservation and energy efficient retrofit is highly interdisciplinary. The 3ENCULT consortium consisted of scientists and stakeholders, especially on the level of SMEs, from the fields of diagnostics, conservation, building physics, sustainability, architecture and lighting, thus

guaranteeing both, the development of sustainable solutions and the impact on European economy. Eight case studies demonstrated and verified solutions that are applicable to the majority of European built heritage in urban areas. Building owners and local historic preservation agencies are integrated in local case study teams.

Relevant (interim) results for Co_2olBricks issues

The following reports are directly connected to the issues of Co_2olBricks:

- Report on demand analysis and historic building classification.
- Relation historic buildings, EPBD and EPBD CEN Standards.
- Assessment of energy efficiency measures regarding their compatibility with conservation issues.
- Report on Energy Efficiency Solutions for Historic Buildings.

The projects efforts in developing a "Raumbuch" (a digital log book for the building) and studies on integrated urban planning key to retrofitting of historical building stock is also of interest.

Further information

For more information: *http://www.3encult.eu/en/project/welcome/default.html*

8.1.7 EFFESUS

About the project

EFFESUS is a research project investigating the energy efficiency of European historic urban districts and developing technologies and systems for its improvement. The term "historic urban district" in the context of EFFESUS, is defined as a significant grouping of "old" buildings built before 1945 and representative of the period of their construction or history, not necessarily protected by heritage legislation. EFFESUS is funded by the European Commission under its Seventh Framework Programme. The project's lifetime is from 2012 until 2016.

Relevant (interim) results for Co_2olBricks issues

EFFESUS will produce the Decision Support System, a software tool to help make informed decisions about improvement measures suitable for historic urban districts. The decision making will be supported by a multiscale spatial data model, a categorisation of historic buildings and urban districts and a

repository of energy efficiency retrofit solutions, for which EFFESUS will collect data on:

- existing building stock and its energy use and heritage significance
- local climatic conditions including regional climatic change predictions
- economic, lifecycle and technical assessments of improvement measures

EFFESUS will demonstrate in seven real case studies the applicability of its technological developments and the suitability of its software tool.
The case studies will be located in historic urban districts of seven European cities of very different building traditions, climatic conditions and cultural contexts, e.g.:

- Demonstration of new thermal insulating mortars for use as plaster and render.
- Demonstration of window upgrades measures and integration of intelligent indoor climate solutions.
- Demonstration of aero gel insulation products for use in cavities behind existing wall finishes.
- Demonstration of radiant reflective coatings for exterior application.

Further information

For more information: *http://www.effesus.eu/*

8.1.8 CLUE – Climate Neutral Urban Districts in Europe

About the project

The objective of the CLUE project is to increase the local and regional capacity in policy development which aims to facilitate the implementation and assessment of new solutions and technologies for a low carbon economy in urban areas. The consortium brings together local and regional authorities as well as universities from nine European countries, which are developing climate neutral urban districts.
Partners in the project are, besides the City of Stockholm (Lead partner) and the Free and Hanseatic City of Hamburg, municipalities and universities from the UK, Italy, Spain, Austria, Greece, Poland and the Netherlands.
CLUE is funded by the European Regional Development Fund through the INTERREG IVC programme.

Relevant (interim) results for Co_2olBricks issues

CLUE explores best practices in planning and implementation of systems, solutions and technologies for climate neutral urban districts as well as

methods for measuring, monitoring, reporting, verifying and assessing climate mitigating efforts.
The project activities result in best practice guides and policy recommendations on the integration of climate aspects in the urban development process. In addition, CLUE partners develop guidelines for measuring, reporting, verifying and assessing climate neutral technology as well as implementation plans for all participating regions.
As the project is currently in progress (2012–2014) the results will be available within until 2014.

Further information

For more information: *http://www.clue-project.eu*

8.1.9 HELTH

About the project

The main aim of the project HELTH – Healthy and Energy-efficient Living in Traditional Rural Houses – was to make rural buildings more energy efficient and to improve the indoor conditions, the renovation of their heating and ventilation systems as well as a modern approach to renewable energies as a potential alternative. For this reason the following five partners from Sweden, Finland and Estonia started a project co-financed by the Central Baltic Interreg IVA programme 2007–2013: Estonian Open Air Museum (Lead Partner), Gotland University, Tallinn University of Technology, Aalto University and Harju County Museum.
The project's duration was from May 2010 until August 2013 and the final conference took place in Tallinn on May 15th 2013.
The project was funded by the European Regional Development Fund through the INTERREG IVC programme.

Relevant (interim) results for Co_2olBricks issues

Even though the research and results do not deal exclusively with bricks, there are a lot of aspects that concern all types of historic buildings when dealing with energy efficiency measures. Publication of the project:

- A Technical survey of Estonian houses.
- A Technical survey of Finnish houses.
- A publication about "Biodegradation of structures and materials".
- A publication about "The Values in an Old Rural House".

Further information

For more information: *http://helthproject.eu/*

8.1.10 URBACT

About the project

URBACT is a European exchange and learning programme promoting integrated sustainable urban development. It enables cities to work together to develop solutions to major urban challenges, reaffirming the key role they play in facing increasingly complex societal changes. URBACT helps cities to develop pragmatic solutions that are new and sustainable, and that integrate economic, social and environmental dimensions. It enables cities to share good practices and lessons learned with all professionals involved in urban policy throughout Europe. URBACT II comprises 400 different-sized cities and their Local Support Groups, 52 projects, 29 countries, and 7,000 active stakeholders coming equally from Convergence and Competitiveness areas. URBACT is jointly financed by the ERDF and the Member States.

Relevant results for Co_2olBricks issues

Besides others URBACT is dealing with Building Energy Efficiency in European Cities. The current study (released in June 2013) covers for example the followings relevant issues:

- Building energy efficiency and policy integration.
- Financing energy retrofitting.
- The European built heritage and energy efficiency.

Further information

Report about Building Energy Efficiency in European Cities: *http://www.eukn.org/E_library/Urban_Environment/Environmental_Sustainability/Energy_Efficiency/Building_Energy_Efficiency_in_European_Cities_URBACT_2013*

URBACT-Website: *http://urbact.eu/*

8.2 Networks

Associated partner SuHiTo – sustainable historic towns

The Sustainable Historic Towns Working Group (SuHiTo) was formed in 2000 and is a forum for heritage authorities, urban planners and researchers, aimed at addressing common challenges. Since 2002 the working group has completed three major projects through to 2013. The projects are all designed to promote sustainable, best practice urban heritage management.

Project partner Swedish National Heritage Board is one of the partners in the forum and is part of Co_2olBricks network as associated partner.
"Urban Heritage – Good for the Climate!" is a recently completed project which establishes the status of urban heritage assets as an ecological resource and management challenge – in their respective participating countries – Norway, Finland, Estonia, Latvia and Sweden. The project's purpose is to look at the countries' policies and practise concerning safeguarding of the built heritage's environmental sustainability in management and planning.

Relevant results for Co_2olBricks issues

One conclusion is that improving energy efficiency is focusing on the individual buildings rather than on the district or urban scale. Furthermore, the energy discussion and calculations concentrate on the energy use in the building's operational phase, not embodied energy in the existing structure and material. To progress with a more holistic environmental thinking, the lifecycle perspective should be taken into account in legislation and practical evaluation of rehabilitation plans and projects.
A thorough understanding of traditional urban planning principles can be very useful in the planning of new sustainable neighbourhoods. The project suggests further study and evaluation of existing towns and cities that are already good examples of a sustainable city.

Further information

Links to more information about the network: *http://mg.kpd.lt/LT/16/Sustainable-Historic-Towns.htm*
Link to the report "Urban heritage –good for the climate!" *http://www.raa.se/wp-content/uploads/2013/05/SuHiTo-Project-Report-Eng.pdf*

8.3 Conclusions about relevant projects and networks

- An EU-project to collect, translate and disseminate data and information, e.g. national guidelines or best practice collections, would be very useful.

› **Historic building –** architecturally, culturally or historically valuable buildings. ‹

9. Glossary

Relevant terms and definitions:

Built heritage – see historic building.

Historic building – architecturally, culturally or historically valuable buildings. This definition is independent from the national laws and regulations for heritage preservation which differ a lot between the member states.

Listed building – a part of historic buildings are officially protected and defined within the project as "listed" buildings. This encompasses all buildings that are architecturally, culturally or historically valuable buildings and have a legal status that exempts them from energy efficiency obligations and which, for example, cannot be knocked down or altered without the permission of the authority responsible for the heritage preservation of the respective country, state, county or municipality. Some countries use a national list of historic buildings other countries use databases or development plans as instruments for keeping/listing historic buildings. The system of appointment of listed buildings differs among the countries.

Energy certificate – document recognised by a member state or legal person designated by it, which includes the energy performance of a building (EN 15217).

Energy audit – analysis for the calculation of energy performance of buildings.

In-depth (energy) analysis – a comprehensive energy analysis with measurements of the actual building, using actual energy performance values of the building in calculations. The term emerged from the survey on energy certificates and audits performed in 2013 within the work package, as the application of an energy audit seems to differ among the partner countries.

Energy refurbishment – see Major renovation.

Energy upgrading – see Major renovation.

Major renovation – defined in 2010/31/EU directive, article 2 paragraph 10 as: 'major renovation' means the renovation of a building where:

- the total cost of the renovation relating to the building envelope or the technical building systems is higher than 25% of the value of the building, excluding the value of the land upon which the building is situated; or
- more than 25 % of the surface of the building envelope undergoes renovation.

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Lead Partner: Free and Hanseatic City of Hamburg, Department of Heritage Preservation,

Grosse Bleichen 30, 20354 Hamburg, Germany

Project Coordinator: Jan Prahm · Phone: +49 40 428 24 729 · E-Mail: jan.prahm@kb.hamburg.de

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Authors:

Co_2olBricks Project Partners: Therese Sonehag, Torben Valdbjørn Rasmussen, Anne Randmer, Dagnija Blumberga, Dirk Humfeldt, Susanne Simpson, Lisa Sarban, Roland Zinkernagel, Jens Schwarz.

Compiled by work package leader, Therese Sonehag at Swedish National Heritage Board

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