CO2olBricks

Energy Refurbishment of Historic Buildings in the Baltic Sea Region

Final Report

Editors / content:

Hamburg | Denkmalschutzamt

Support:

Baltic Sea Region
Programme 2007–2013

Part-financed by the European Union
(European Regional Development Fund
and European Neighbourhood and
Partnership Instrument)

Cover picture:

International Heritage Plaques

Idea: Dr. Daniela Scherz, Free and Hanseatic City of Hamburg, Department of Heritage Preservation
Composing: farbton Kommunikation

Table of Contents


CONTRIBUTING TO A FLAGSHIP PROJECT OF THE STRATEGY

Dear Reader,

Andreas Kellner, Head of Department for Heritage Preservation, Hamburg

Only a few years ago one could have been forgiven for thinking that the protection of historic buildings and the mitigation of climate change were irreconcilable: in the one camp our cultural heritage, to be conserved unconditionally; in the other the global climate, to be saved by insulating all buildings.

Both societal goals continue to be right and important. Yet time has shown – and that has been more than borne out by three years of Co_2olBricks – that in real life things seldom appear black and white, and that both heritage and climate issues are of great importance for historic buildings. After all, the cultural value of a historic building can only be maintained in the long term if that building is actually used. This is especially true for historic residential buildings, such as the Hamburg housing developments dating from the 1920s, which need to be up-dated so that they remain attractive to tenants and owners. Higher expectations when it comes to comfort coupled with ever-increasing energy costs mean that energy-saving measures increasingly play a role alongside normal renovation and maintenance measures. Implementing such measures in a way that is compatible with the conservation of our built heritage helps both the building itself and the environment.

From the standpoint of practical building conservation in particular, two things are absolutely imperative here. Firstly, every historic building is unique and has its own individual historic value. That means that, in contrast to new building projects, there are no standard methods that can be applied; instead each case needs to be analysed in detail so that tailor-made solutions can be developed. Secondly, we are breaking new ground. That applies both the technology and the processes: For instance we have not yet any long-term experience with internal wall insulation systems. Moreover the energy efficiency rehabilitation of historic buildings requires the involvement of additional experts such as energy consultants what makes the procedures more complex.

In the past three years, the international Co_2olBricks project has been active in speeding up the process of harmonising heritage and climate interests during the energy efficiency rehabilitation of historic buildings in the Baltic Sea Region, as demonstrated impressively by the activities and results which are described in detail in this final report. I would like to single out just a few of them here:

- Raising wide awareness among the specialist public of the fundamental problems in the tension between the protection of historic buildings and the mitigation of climate change, and demonstrating potential solutions in seminars and discussions.

- Producing concrete case studies embracing many facets from different climatic zones that demonstrate examples of individual approaches to energy efficiency rehabilitation. As well as focussing on the monument in question, backed up by a series of analyses and pilot applications to actual buildings, the case studies take account of the surrounding neighbourhood. The latter offers additional opportunities for the energy efficiency rehabilitation of historic buildings, either by exploiting an intelligent interplay between "old" and "new" or by making the most of efficiency gains in homogeneous developments.

- Developing new process sequences that serve as a model for the complex teamwork between the parties concerned (owner, architect, energy consultant, conservator, etc.) both when analysing the building and when developing and implementing measures.

- Drawing up representative teaching materials for the training of those involved, whether planners (e.g. architects, energy consultants, building technicians, structural engineers), conservators or craftsmen, since the deciding factor in the quality of the work is the level of know-how of the parties involved and their mutual understanding of one another's expertise ("We are breaking new ground").

- Developing joint recommendations for all the people, companies and organisations involved, including calls for local, national and European politicians to develop the necessary information and financial support measures.

The critical success factor for these results is, in my opinion, the international and multi-disciplinary composition of the project partnership. The initial task was to build bridges, and success here depends on conservators and climate experts, universities, government departments and industry working together to seek solutions. That does not mean that everything has to be invented afresh; after all, Co_2olBricks is not an academic research project. On the contrary, it greatly benefits practical work if partners can get to know one another's activities on the spot, evaluate the activities together and draw the relevant conclusions. For example: To what extent can the specific German funding programme be applied to other Baltic states? What experience has gained Sweden with compulsory energy passes for historic buildings? Can I make use of the processes for energy efficiency rehabilitation of historic buildings developed in Denmark or Estonia?

All in all, the results of Co_2olBricks make clear that we have already taken a major step forward in last years. There is no longer really any controversial debate about "whether" energy efficiency rehabilitation can go hand-in-hand with historically appropriate building restoration. It is much more a question of "how", and here are still many detailed questions to be answered and much practical experience to be gained.

Andreas Kellner
Head of Department for Heritage Preservation, Hamburg

› With our results we would be happy to encourage further activities in the field of climate change mitigation and heritage preservation. ‹

1 Introduction

Hamburg in December 2013: with the Co_2olBricks Results Conference, three years of projects come to an end. Originally approved on 16 September 2010 by the Managing Authority of the Baltic Sea Region Programme 2007–2013, project No. 061 "Co_2olBricks – Climate Change, Cultural Heritage & Energy Efficient Monuments" started its public activities on 1 April 2011 with the International Expert Conference in Hamburg. After this kick-off the intensive work began, which can only partly be illustrated by the following figures:

Jan Prahm; Project Coordinator Co_2olBricks

- **16 transnational meetings** of the Project Partners were the main working platform, to commonly develop know-how, discuss ideas and work out solutions.
- More than **50 stakeholder meetings** in which the Project Partners discussed the Co_2olBricks issues with experts.
- More than **50 congresses, fairs and further events** where the Co_2olBricks Project Partners presented the project results.
- **18 reports** about researches, best practice examples, technical solutions and pilot projects were written.
- More than **25 different lecture materials** on energy efficiency and heritage preservation topics were developed and used in workshops.

But what these figures cannot show are the countless and very fruitful discussions between the international Project Partners about specific issues of climate change mitigation and heritage preservation, for example about technical issues within the joint on-site workshop at the pilot project in Kothla-Järve or the extensive discussion about the project Joint Declaration.

This "Final Report" will deliver comprehensive documentation about the setup, the various activities and results of the project's work as well as the experiences made in an international project.

For that purpose, in Chapter 2, first of all the starting position, the objectives and the setup of the project are described, which includes the presentation of all Project Partners, the Steering Committee and the Advisory Board.

The compiled results of the project's work are documented in Chapter 3, expressed as recommendations as well as an outlook on further activities in the future.

In Chapter 4 the Work Package Leaders of the project provide an insight on the procedures, activities and their lessons learnt during the work on issues of Political Development, Technical Solutions and Education and Economic Promotion. Additionally, the experiences in the management and the communication of an EU project are described.

The wide range of different events that were organised by Co_2olBricks, or in which Project Partners participated actively, are presented in Chapter 5 as a time bar of the project's three-year life.

Finally, the published Co_2olBricks brochures, reports, surveys, handbooks, lecture materials, etc., are listed with a brief introduction in Chapter 6.

Hopefully this Final Report will give you fruitful information. With our results we would be happy to encourage further activities in the field of climate change mitigation and heritage preservation.

Jan Prahm
Project Coordinator Co_2olBricks


CONTRIBUTING TO A FLAGSHIP PROJECT OF THE STRATEGY

› The main objective of the Co_2olBricks project was to push the process of balancing the different interests of climate change mitigation and heritage preservation. ‹

2 The Co_2olBricks Project

2.1 Starting point of the project

The conservation of heritage, in particular historical buildings, is a common goal in the Baltic Sea Region (BSR). Due to the common identity in the BSR, it is very important to protect the historical buildings in order to preserve the individual characteristics and thereby the attractiveness and competitiveness of the cities around the Baltic Sea. Also, the international and the EU CO_2-reduction targets have to be fulfilled.

The first wave of technical improvements, like modern heating systems, especially thermal insulations of the outer walls, produced incompatibilities with heritage and monument conservation affairs which led to unsatisfying solutions as the result of polarised decisions: No/bad climate change mitigation or no/bad heritage conservation.

Gable Kiel Elmschenhagen, source: Denkmalschutzamt Hamburg

2.2 Objectives of the project

The main objective of the Co_2olBricks project was to push the process of balancing the different interests of climate change mitigation and heritage preservation. For that purpose it is necessary on the one hand to elicit a broader sensitivity for the problem and on the other hand to make practical recommendations about how to deal with this area of conflict.

That means in detail:

- **Forward the political discussion** on the national and transnational level about the installation of new cooperation models between administrative institutions, architects, engineers, housing and building companies and affected building owners, leading to the implementation of new strategies for technically, administratively and historically adequate approaches and declaring a transnational common position.

- **Find technical solutions** concerning energy efficiency potentials of historical buildings and to implement, monitor and evaluate pilot projects for historic buildings with optimised energy.

- **Upgrade the knowledge** and education of architects, engineers, craftsmen, etc., and to harmonise the curricula with the objective of an open market.

2.3 Projects Setup – Partners, Bodies and Procedures

2.3.1 Co_2olBricks Project Partners

To reach these project objectives an international and multidisciplinary group of Project Partners joined together. The partnership is comprised of 18 partners from Denmark, Sweden, Finland, Estonia, Latvia, Lithuania, Poland, Belarus and Germany, combining know-how from heritage preservation departments, departments for protection of the environment, city administrations, universities, training institutions, representatives of housing societies, monument protection societies and energy agencies.

Co_2olBricks partners

The Co_2olBricks Project Partners in detail[1]:

1. Department for Heritage Preservation, Hamburg, Germany (Leadpartner and Work Package Leader 4)

The Department for Heritage Preservation is part of the Hamburg Ministry for Culture. The state preservation of monuments and historic buildings already started in Hamburg in 1920. Today it is based on a monument protection law which, in the meantime, has been amended several times. According to this law, cultural monuments are to be studied scientifically, to be protected and to be preserved, as well as to be involved in urban city development. *www.hamburg.de/kulturbehoerde/denkmalschutzamt*

2. Ministry of Urban Development and Environment, Coordination Centre for Climate Issues, Hamburg, Germany

After having been in charge of the Hamburg Climate Action Plan 2007–2012, since 2013, the Coordination Centre for Climate Issues has been responsible for the strategic and conceptual development of the Master Climate Action Plan as overarching strategy of Hamburg's climate protection policy as well as the implementation of precise activities. Furthermore the adaptation to climate change, including a climate adaptation strategy and the development of a climate impact monitoring, are part of the Coordination Centre's responsibilities. *www.hamburg.de/leitstelle-klimaschutz*

3. Vocational Training Centre, Hamburg, Germany

The Ausbildungszentrum-Bau GmbH (AZB) is Hamburg's vocational training centre for key building crafts. Since 1971 the AZB has been training young people for work in the construction trade. Additionally, experienced craftsmen are provided further education through training courses and seminars. The AZB is an acknowledged Centre of Competence for sustainable construction. In an information and communication centre you can experience house models in scale 1:1 demonstrating typical constructions of different periods of time. *www.azb-hamburg.de*

1 As two project partners quit the participation in the Co_2olBricks project in the late application / early implementation phase, in the numbering of the project partners the No. 13 and No. 18 had to leave blank.

Landes-
hauptstadt Kiel

4. City of Kiel Environment Department, Germany

The City of Kiel has over 230,000 inhabitants and is the capital of the federal state Schleswig-Holstein. Climate protection is a strategic objective of Kiel's policy. Since 2004 Kiel has been a member of ALIANZA DEL CLIMA. The Environment Department is responsible for the implementation of the Climate Protection Concept decided on by the city council in 2008. The City of Kiel is highly involved in activities in the field of energy efficient construction. In 2008 Kiel organised the Innovative Building Exhibition (InBA) included in the IEE project REBECEE and established an own advanced energy standard for new buildings and refurbishments. *www.kiel.de*

Stockholms stad

STOCKHOLM CITY MUSEUM

5. City of Stockholm, Stockholm City Museum, Sweden

The Stockholm City Museum's function is to preserve the city's cultural heritage, bring it to life and convey it to Stockholm residents, visitors and future generations. The City Museum's Cultural Heritage Department is the City of Stockholm's expert body on matters relating to archaeology, history of architecture and city planning. It protects and documents Stockholm's buildings and environments of value in terms of cultural heritage. The Department employs conservation officers and archaeologists. *www.stadsmuseet.stockholm.se*

Energikontor Sydost
Energy Agency for Southeast Sweden

6. Energy Agency for Southeast Sweden

The Energy Agency for Southeast Sweden (ESS) is owned by the municipalities in the region as well as the regional councils in Kalmar, Kronoberg and Blekinge. ESS is – as a non-profit company – the regional hub for energy efficiency actions in the southeast of Sweden and continuously promotes energy efficiency and the use of renewable energy sources in all parts of society including heating, electricity and transport on the local, regional and European level. *www.energikontorsydost.se*

SWEDISH NATIONAL HERITAGE BOARD
RIKSANTIKVARIEÄMBETET

7. Swedish National Heritage Board, Visby, Sweden (Work Package Leader 3)

The Swedish National Heritage Board is the agency of the Swedish government that is responsible for heritage and historic environment issues. The mission is to play a pro-active, coordinating role in heritage promotion efforts and to ensure that the historic environment is preserved in the most effective possible manner. *www.raa.se/*

8. City of Malmö, Environment Department, Sweden

The City of Malmö with its 300,000 inhabitants has ambitious targets related to renewable energy and energy efficiency. The city's goal is to cover its energy consumption to 100% by renewable energy by 2030, which means that energy efficiency measures need to be implemented on a large scale to meet this target. The Environment Department cooperates with other departments of the municipality on a broad range of activities in order to continuously implement sustainability measures. *www.malmo.se*

9. Danish Building Research Institute, SBi at Aalborg University, Denmark

SBi is the Danish Building Research Institute and is affiliated with Aalborg University. The Danish national building research institute develops research-based knowledge to improve buildings and the built environment. SBi identifies subjects that are important for professionals and decision-makers involved with building and the built environment and subsequently communicate their knowledge to these groups. *www.sbi.dk*

10. Information Centre for Sustainable Renovation NGO (SRIK NGO), Tallinn, Estonia

The Information Centre for Sustainable Renovation (SRIK) was established in 2001 as a subsidiary of the Estonian Heritage Society. SRIK aims to contribute to the creation and preservation of culture and environment-friendly surroundings. The information centre gathers and offers information, organises workshops and seminars, and initiates and carries out projects in line with SRIK's aims. SRIK also enhances the use of traditional and natural building and finishing materials in the construction and repair of buildings. *www.renoveeri.net*

11. Kothla-Järve Town Government, Estonia

Kohtla-Järve is a city and municipality in north-eastern Estonia with around 40,000 inhabitants. The town is important for the region because of its oil-shale processing. Although the presence of chemical industry is not favourable for preservation of buildings' outward appearance, the Town Council passed a resolution defining areas of heritage-protected architecture, which include both residential neighbourhoods and separate buildings. *www.kohtla-jarve.ee*

12. Centre for Development Programmes (EMI-ECO), Tallinn, Estonia
The Centre for Development Programmes EMI-ECO was established in 1992 as an independent, non-governmental, non-advocacy interdisciplinary consulting and training organisation aiming at support for sustainable development in Estonia. To achieve their goals, EMI-ECO initiates and carries out regional and organisation sustainable development programmes for public, private and non-governmental sector decision makers, also providing tailor-made professional development training events and facilitating networking between different stakeholders. *www.emieco.ee/en*

14. City of Riga City Development Department, Latvia
Riga City Development Department is the leading Riga municipal institution in the field of construction supervision, territory planning, detailed planning, elaboration of amendments to these and their control. The Department is an independent legal entity with its own balance and settlement account. Administratively, it is subordinate to the Riga City Council Chairman; the Department's operation is monitored by the City Development Committee. *www.riga.lv*

15. Riga Technical University Institute of Environment Protection and Energy Systems, Latvia
The Riga Technical University Institute of Environmental Protection and Energy Systems operates the study programme on Environmental Science and provides academic education on three levels: Bachelor of Environmental Science, Master of Environmental Science and doctoral studies. The main research areas are related to end use energy efficiency, production and utilisation of renewable energy sources, different types of fuels, climate technologies, Eco design, life cycle assessment, energy planning and social and economic aspects of energy supply. *www.rtu.lv*

16. European Foundation of Monuments Protection, Gdansk, Poland
The objectives of the Europejska Fundacja Ochrony Zabytków (EFOZ) are the regeneration and the management of historical objects, including promotion and international co-operation for these activities. The main forms of activity are research, taking over historical objects to restore them and provide maintenance, organising and financing conferences, seminars, trainings, granting awards and scholarships, and also information, publishing and promotion activities. *www.efoz.org.pl*

17. Republican Centre for Technology Transfer (RCTT), Minsk, Belarus
RCTT's primary goal is to promote the cooperation between developers, users of high technologies and investors with the aim that existing knowledge, facilities, or capabilities developed under a government or private research and development (R&D) funding are utilised to fulfil public and private needs. *www.ictt.by*

19. KIINKO – Real Estate Education, Helsinki, Finland
Kiinko Real Estate Education was founded in 1978 by Finland's main real estate associations. Through the owners and the institutional partners, Kiinko has close ties with the Finnish real estate and construction business. Since the beginning, Kiinko's mission has been to support the Finnish real estate and construction industry by providing top quality courses and education programmes for professionals involved in all aspects of the property business. *www.kiinko.fi*

20. Vilnius Gediminas Technical University, Lithuania (Work Package Leader 5)
Vilnius Gediminas Technical University is a state higher academic school which was established by the Parliament of the Republic of Lithuania. It is one of the largest schools of higher education in Lithuania and strives to be the leading school in technical and engineering education as well as the field of scientific research. The University provides 88 programmes for diploma engineers, undergraduate and graduate (Bachelor and Master) studies in the fields of Humanity Sciences, Physical Sciences, Social Sciences, Technological Sciences, Biomedical Sciences and Art Sciences. *www.vgtu.lt*

2.3.2 Steering Committee and Advisory Board

For the successful management of the partnership and the organisational involvement of external experts, the Project Partners stipulated the implementation of two attached bodies – the Steering Committee and the Advisory Board.

The Project Partners delegated nine persons (one for each participating country) to the Co_2olBricks Steering Committee. The duty of the members of the Steering Committee was supervision of the Co_2olBricks management. The progress of the project was regularly monitored in Steering Committee meetings where the Lead Partner and Work Packages Leaders reported about their past and future activities. Furthermore, important activities like the schedules for meetings, publications, the Joint Declaration or the planning of the Final Conference were discussed and determined.

The six Advisory Board Members from Norway, Sweden, Poland and Germany brought their expertise into specific topics, e.g. the question about definitions, specific technical solutions, the Joint Declaration or the development of a specific procedure for an energy analysis in historic buildings.

The BSR countries, source: Denkmalschutzamt Hamburg

2.3.3 Working Procedures

To organise the work in the complex field of climate change mitigation and heritage preservation, three Work Packages (WP) were implemented alongside the cross-sectional Work Packages "Administration" (WP1) and "Communication" (WP2):

- WP3: Policy Development.
- WP4: Technical Solutions.
- WP5: Education and Economic Promotion.

All three Work Packages structured their activities generally in three phases as follows:

Baseline phase: To get a common understanding of the problems addressed, the current situation and the specific conditions in the different partner countries, at first information for baseline studies of each Work Package were collected, compiled and discussed. The conclusions were the basis for the following activities

Working phase: In this second step the work focused on detailed and specific issues. In WP3 several instruments to balance heritage preservation and climate change mitigation were commonly discussed. In WP4 the joint work on pilot and research projects was conducted and in WP5 lecture material was developed.

Results phase: At the end of the project the developed material was compiled into several publications (see chapter 6.1). The main findings were summarised into a Joint Declaration of all Project Partners and described in detail by the Co_2olBricks recommendations (see chapter 3).

The **key success factors** in all these three steps of the project's work were the interdisciplinary formation of the Work Packages, the regular exchange between the Work Packages in the transnational meetings, the intensive discussion about the (interim) results with stakeholders and finally the feedbacks by the Steering Committee and the Advisory Board.


CONTRIBUTING TO A FLAGSHIP PROJECT OF THE STRATEGY

› The strict standards of the European Energy Performance of Buildings Directive (EPBD) are not suitable for historic buildings, since the minimum energy efficiency standards defined in the EPBD and related national laws are aimed at new buildings and non-historic buildings. ‹

3 The Co_2olBricks Recommendations

The Co_2olBricks recommendations are the summarised and concentrated findings of the project's work. They are the result of a comprehensive discussion within the project and with external stakeholders on how to push forward the energy upgrading of historic buildings without destroying their historic value. These recommendations complement in detail the Co_2olBricks Joint Declaration which was signed by the Project Partners at the Co_2olBricks Results Conference on 3 December 2013. They are separately published as "Co_2olBricks Policy Paper", available on the projects website.

3.1 Historic buildings are unique and must be treated as such

First of all it is important to understand that historic buildings are special and not comparable to new or other non-historic buildings. This is because of technical and architectural criteria on the one hand and the buildings' cultural value for society as a whole on the other.

The strict standards of the European Energy Performance of Buildings Directive (EPBD) are not suitable for historic buildings, since the minimum energy efficiency standards defined in the EPBD and related national laws are aimed at new buildings and non-historic buildings. Indeed, if these standards are implemented, historic buildings often lose their historic value. Because of the differing legal, economic and historical situations within the Baltic Sea Region, it is important for each country to devise its own best measures to exclude historic buildings from the strict minimum energy efficiency standard. This is in general a minor problem for protected buildings because they are usually excluded anyway. The bigger challenge is to conserve non-protected buildings of architectural, cultural or historical value. Therefore local municipality and heritage specialists have to work out local protection measures to allow non-listed historically valuable buildings an opportunity to keep their historical value.

But specific and individual energy efficiency measures for historic buildings are useful and important, both in conserving the buildings' cultural value and in making a contribution to reaching CO2-reduction goals. Such specific measures usually improve energy efficiency dramatically, though not as much as would have been possible in a non-historic building. It may be that 70

percent of possible energy savings are achieved, rather than 100 percent, but mitigation is not at the expense of heritage value.
Thus it can be stated that it is possible to improve the energy efficiency of historic buildings without destroying their heritage value.

3.2 Recommendations

3.2.1 Iterative rehabilitation process with all involved parties

It hardly seems a novel idea to demand cooperation during building projects. But current practical experience shows that this is by no means common in the field of energy efficiency measures for historic buildings. There are some reasons for this: energy efficiency rehabilitation in general is a relatively new subject and, in combination with historic buildings, new technical challenges and further stakeholders join the process.
To improve this situation more information is needed, as are better education and public support. But the first step must be that each energy efficiency activity affecting a historic building is automatically regarded as a joint rehabilitation process. In addition to the owner, at least two experts – the conservator and the architect/energy consultant – have to be part of this process in addition to specialised craftsmen. Factors such as the size, complexity and future use of the building will determine whether further interested parties, for example building engineers or members of the building administration, need to join.
Moreover it is important to recognise that the identification of measures for energy efficiency upgrading of historic buildings is an iterative process which needs to acknowledge both the conservation concept of the historic building and the energy efficiency solutions. It must be accepted that unknown historic values might emerge during the rehabilitation process, necessitating changes to the conservation concept and the possibilities for energy efficiency upgrading. A building log-book should be done voluntarily and would be very helpful.
An example of such an iterative process is the "Refurbishment of Faestningens Materialgaard, Copenhagen, Denmark", which reports in detail on a comprehensive workflow of five iterative steps and with participation of all relevant stakeholders: owner, conservator, architect, HVAC engineer.

To implement this it is recommended that

- **National, regional and local conservators, architects and all other involved planners** in cooperation with academia and experts develop, implement and improve professional standards and methodologies for the improvement of energy efficiency in historic buildings, e.g. the currently developed CEN-standard "Energy efficiency of historic buildings".
- **National, regional and local conservators, architects and all other involved planners** adopt this joint approach in their daily work.

3.2.2 Specific energy analysis for historic buildings

Besides surveying the heritage value of the historic building to develop a conservation plan, the first step to identify possible energy efficiency measures is a proper energy efficiency analysis. The question is which kind of energy analysis should be conducted. Standard energy audits, mandatory for non-historic buildings, can only be used for a rough comparison of a number of buildings but not as the basis for a detailed plan of rehabilitation measures because they are not precise enough and do not work with actual data, which is important for sensitive historic architecture. So a specific energy efficiency analysis has to be done (details are available in the Co_2olBricks suggestion on "Analysis of existing buildings for energy-saving measures taking into account the conservation of historical value"), for example:

- Actual measured energy consumption has to be used to assess current energy efficiency.
- Current use pattern and the future pattern have to be taken into account
- Exact analysis of the walls (e.g. material samples) has to be conducted.

The specific energy efficiency analysis must be carried out by specially trained and certified experts as exemplary done in Germany with the specialised "Energy consultant for historic buildings" (see chapter3.2.5). Obviously this kind of specific energy efficiency analysis is more expensive than doing nothing or a standard energy audit corresponding to the EPBD. Therefore our recommendation focuses on "major rehabilitation", which means that for minor building activities a comprehensive energy analysis should not be mandatory.

To implement specific energy efficiency analysis in historic buildings it is recommended that

- **National, regional and local conservators, architects, energy consultants and all other involved planners** conduct specific analysis in their daily work.
- **The providers of the planning and building services, in cooperation with academia and experts**, develop, implement and improve professional standards and methodologies for specific energy efficiency analysis in historic buildings.

3.2.3 Mutual consideration in policy papers and regulations

If policies on both "climate change mitigation" and "heritage preservation" are to be harmonised and adjusted, it is an absolute requirement for both topics to be considered and included simultaneously in all policy documents dealing with these issues.

The EPBD is implemented not only through building regulations but also through environmental programmes and climate strategies that have become common in local politics in recent years. In all these documents the special situation of historic buildings must be considered. How precise the consideration of heritage preservation in these papers should be depends on how operational they are. For example, in a climate strategy focussing on the next 10 years, a hint that "the interests of heritage preservation have to be considered" could be enough – as in the "Masterplan Climate 2020" of the Free and Hanseatic City of Hamburg.

On the other hand, climate change mitigation issues have to be considered in heritage preservation documents. These could be national, regional or local laws but also heritage preservation department guidelines for everyday work. As a consequence, in Hamburg not only do climate change mitigation activities consider heritage issues, but the new Hamburg Heritage Protection Law (HambDSchG) of April 2013 also addresses energy efficiency measures in historic buildings. In their daily work the conservators now have to consider energy efficiency issues and must keep records about their decision.

To implement this mutual consideration it is recommended that

- **National and regional parliaments, governments and administrations** include the role of heritage preservation and climate change mitigation in their regulations or guidelines.

3.2.4 Development plans as an opportunity for further options

The consideration of urban quarters as a whole is very important in reconciling energy efficiency with historic value. Although there are existing urban planning instruments which organise the development of defined areas of a town or village, at present it is uncommon for energy efficiency targets and heritage preservation issues to be jointly implemented in development plans or urban rehabilitation processes – even though this presents great opportunities. For example, stricter obligations for new buildings in a quarter might compensate for lower ones for the historic buildings without losing sight of the overall climate change mitigation goal for the quarter as a whole. Alternatively, district heating might improve the energy efficiency of the whole quarter and make it easier to reach CO_2 emissions targets by using renewable energy.

An example of how to integrate climate change mitigation issues with the preservation of historic buildings is the rehabilitation concept of the City of Kiel for the Elmschenhagen garden city. Here a new development plan meant changes to the historic quarter were strictly regulated while a model rehabilitation concept for the different types of buildings was developed, involving consultation with building owners and advice on implementing energy efficiency measures. Additionally, district heating using wood pellets was installed for parts of the quarter.

The BSR 2007–2013 partner project "Urb-Energy" (www.urbenergy.eu) developed urban development processes with a holistic approach for energy efficiency rehabilitation of housing stock which could also be used as a blueprint for processes that integrate heritage preservation issues.

In order to implement energy efficiency analysis in development plans and urban rehabilitation processes it is recommended that

- **National parliaments, governments and ministries** include energy efficiency solutions on district level in the national implementation of plans and procedures by formulating best practice for integrating energy efficiency matters in master plans and major renovation permits, considering the limitations of heritage preservation.
- **Regional parliaments, governments and administrations include** energy efficiency solutions on district level in their procedural guidelines.

3.2.5 Training and certification of those involved

Interdisciplinarity between the parties involved in the energy efficiency rehabilitation of a historic building, i.e. conservators; architects and energy consultants (planners); and craftsmen, is the key success factor for such a project. This entails more than just collaboration, since interdisciplinarity necessitates a minimum understanding of the work of the other professions on the part of all those involved.

Without it, planners could not develop a useful energy efficiency concept. Before they start to compile such a concept, they need to know what aspects of a building they can or cannot change. As not every detail can be determined beforehand, planners need enough understanding of heritage preservation to be able to assess by themselves during the creative process what can or cannot be done. If the planner had to ask the conservator about every idea, the process would become too cumbersome for both sides and too expensive for the owner. Knowledge of relevant heritage conventions and charters is the first step. An example of what can be assumed as minimum knowledge for planners is the curriculum for the German qualification "Energieberater für Baudenkmale" (Energy consultant for historic buildings). Conservators, on the other hand, need to know enough about energy efficiency rehabilitation. In most countries there is no formal education for conservators, meaning it is a post rather than a profession. Those holding the post of conservator come from various educational backgrounds. Besides architects or building engineers, they may be art historians or archaeologists, for example. The latter two groups will usually have learned nothing about the physics or energy efficiency of buildings in their studies, while these issues are often of only subsidiary importance in the training of architects and construction engineers. Even in the professions where building physics and energy efficiency are taught, the material studied usually concerns new buildings. This is regrettable because, in Germany at least, more than 50 percent of all construction work now involves existing buildings. Even these professions have a need for further training in the energy efficiency rehabilitation of historic buildings. In most cases, those concerned can only learn by doing, which requires a lot of experience and generally remains an unstructured learning process. It is not proposed that conservators should themselves develop energy efficiency concepts for the buildings, but they must be able to assess the energy rehabilitation plans that planning engineers have drawn up. Otherwise they will be easily deceived. They must be able to

recognise the snags and hitches in the concepts and make counter proposals if they are to become really involved with "their" historic buildings. Practical implementation by craftsmen of the jointly planned measures also requires a high level of professional know-how on the one hand and special awareness of the historic and cultural value of historic buildings on the other. Within the Co_2olBricks project, learning packages for various crafts aimed at professionals at several levels of planning, supervision and construction work were proposed and described. Additionally, examples of harmonised curricula for training modules for bricklayers, plasterers, drywall builders, carpenters and foremen were developed.

The reason for mandatory certification of those involved is that unskilled craftsmen and unskilled planners can do more harm than good. Especially in the long run, wrongly calculated and implemented measures can do tremendous damage to a building. Certification can be awarded on the basis of practical references or proof of appropriate further training. Requirements for the different crafts are set out in the Co_2olBricks publication "Economic Promotion".

To ensure that rehabilitation of heritage buildings is only carried out by educated and certified staff it is recommended that

- **Universities, universities of applied sciences, vocational training centres and education service providers** develop/implement these issues in their curricula.
- **Heritage protection departments** encourage their staff to take such further education courses.
- **The authorities and public bodies** (e.g. chambers of crafts) implement and operate a certification system.
- **Housing companies, housing associations and house owners** select only those companies which have this expertise.

3.2.6 Centres of excellence and expertise

As historic buildings have to be treated individually, both case studies about individual rehabilitation projects and practical information about specific techniques are very helpful. Therefore centres of excellence to provide owners of historic buildings, architects and energy auditors with advisory services and guidelines on maintaining and carefully upgrading their heritage

properties would be a great advantage; best practice examples are especially helpful in this context. An example is the info-room of Co_2olBricks Project Partner SRIK (Säästva Renoveerimise Infokeskus) in Tallinn, Estonia.

To implement support programmes it is recommended that

- **National, regional and local governments, in cooperation with NGOs and chambers of architects and crafts** install centres of excellence and cooperate with owners and service providers to develop general and best practice guidelines to improve the energy efficiency in buildings of historical value, taking into account the constraints of heritage preservation.

3.2.7 Financial support programmes

Preservation of cultural heritage is one of society's common tasks. Because the owners of historic buildings face higher costs and greater legal restrictions for the preservation of their properties than for other buildings, support programmes are common. They should be augmented by special programmes to support the energy efficiency qualification of historic buildings.

Public funding programmes are needed to offset heritage-related additional costs. Some key points should be considered, however. All funding programmes should include clearly defined specific objectives that must be met to qualify for a grant. In the case of energy efficiency measures, these should be specific targets for the energy consumption by the historic building after rehabilitation. But these target values have to be defined by each county or region individually with regard to specific conditions such as climate. Furthermore, due to the individual situation of each historic building it is very important to set overall energy consumption targets for the building as a whole and not targets for each part.
To achieve best results, grants should depend mandatorily on minimum qualification standards being met by the architects, engineers and energy consultants dealing with the historic building for which funding is sought. These standards could be special, certified further training (see recommendation 5). Making public funding dependent on certified training is a potential way of achieving quality management of energy efficiency

measures in historic buildings. An example of this approach is the German public funding programme "KfW Effizienzhaus Denkmal".

To implement support programmes it is recommended that

- **National, regional, local governments and foundations** develop special public funding programmes.

3.2.8 Further research

Although a lot is already known about energy efficiency, much remains vague or solutions have yet to be found. Many energy retrofitting measures are based on experience only and lack a scientific foundation. This often makes it difficult to calculate and hence predict correctly how certain techniques will function.

A major problem is that most technical solutions are designed for and directed at new buildings. Technical and organisational solutions for historic buildings and other existing building stock need to be improved by research.

The following possible research topics are recommended:

- User behaviour.
- Energy efficiency in historic buildings at a district or town level.
- Wall heating and internal insulation in different climates.
- Calculation tools: input data need to be improved and tools must become easier to handle so that they become more widely available and less expensive.
- Forgotten techniques: often old techniques have been forgotten and need to be made available to stakeholders once more.

To initiate further research it is recommended that

- **EU Directorates and national administrations** provide funding through the research framework programmes and other research funding programmes.
- **Universities, universities of applied sciences and companies** apply for funding and conduct research and development of appropriate technologies (including technological nodes) and techniques for the improvement of energy efficiency in historic buildings.

3.3 Further activities after the end of the project

As the activities and results of the Co_2olBricks project demonstrate, the process of reconciling the conservation of historic buildings and monuments with energy efficiency has been successfully stimulated in the recent years and a broad awareness of the topic has been achieved. In order to put the findings described in the recommendations into practice, follow-up projects or activities addressing the topics outlined below have to be conducted. For example:

- Basic research into building physics, e.g. to ascertain the effect of alternative heating systems on the building envelope; this is the precondition for the inclusion of new technologies in laws, standards and funding programmes.
- Basic research on user behaviour in historic residential buildings.
- Research and practically oriented support of the use of renewable energies in historic buildings: Production, distribution (smart grids) and storage.
- Practically oriented integration of energy efficiency rehabilitation of historic residential buildings into urban development processes.
- User-oriented development of specific energy analysis of historic buildings with the goal to enable the collection of information in sufficient depth and to take potential expenses into account.
- User-oriented development of specific practice-based guidelines to improve user behaviour with regard to energy consumption (technically, financially and socially incentive systems).
- Implementation of rules and regulations (laws, regulations, land-use plans, administrative orders, etc.) and funding programmes for energy efficiency rehabilitation measures in historic residential buildings.
- Implementation of competence and support centres.
- Introduction of multinational training standards (initial and further training for academics and craftsmen) for all those involved in the energy efficiency rehabilitation of historic residential buildings.
- Implementation of international university courses about energy efficiency in historic buildings.
- Organisation of commonly realised transnational refurbishment projects of historic buildings with the focus on technical issues and with partners from abroad actively involved on site.


CONTRIBUTING TO A FLAGSHIP PROJECT OF THE STRATEGY

› Material from the Project Partners was collected through questionnaires and compiled in reports or handbooks or through allocating resources among the partners or nations. ‹

4 The Co_2olBricks Work Packages

4.1 Work Package 3: Policy Development

/ THERESE SONEHAG, SWEDISH NATIONAL HERITAGE BOARD, WORK PACKAGE LEADER

4.1.1 The procedures

The starting-point for the work was the European Union's energy policy which affects existing buildings: Directives on energy supply, Energy Performance of Building Directives and Energy Efficiency Directive[2]. The investigation of policies that was performed among WP3 partners and stakeholders during period 1–2, pointed at some main problems and needs and focussed on the upcoming activities. Together with researchers and stakeholders and through different activities, knowledge and enhanced examples were developed within the prioritised areas – energy certificates, climate and environment action and development plans, methodology and standardisation, support programmes, competence and research.

Heritage in Vilnius, source: Therese Sonehag

Almost all 18 Project Partners participated in this Work Package. The team met twice every project period to present and evaluate partner's activities, other project work and the achieved results. The team chose to work in the workshop-format, discussions in smaller groups that were presented in the plenum afterwards. The Work Package Leader continuously compiled the work within the Work Package and informed about future work and activities. Material from the Project Partners was collected through questionnaires and compiled in reports or handbooks or through allocating resources among the partners or nations.

2 Directive (2006/32/EC) on energy end-use efficiency and energy services; EU Council Directive (93/76/EEC); EPBD Directive (2002/91/EC) and (2010/31/EU); Directive (2012/27/EU) on energy efficiency

Except for transnational events twice every half year when partners had the opportunity to learn from each other's examples and to spread the word on a regional basis through open conferences, there were a lot of activities conducted by each partner in their region or in collaboration with other partners on regional or national events. The events were of different character – from stakeholder meetings and expert seminars to demonstrations like the Black March "Styrofoam Monster" in Gdansk and the "Insulation concert" in Hamburg in 2011. To involve the coming generation, youth conferences were arranged in Kothla-Järve in 2011 and in Gdansk in 2012 with youths from Hamburg, Kaliningrad and Gdansk. During the last year of the project, several national collaborations have evolved through the project, like the network of governmental authorities in Sweden and Stockholm City Museum's travelling exhibition and the development of a National Strategy for Improving Energy Efficiency in Historical buildings in Estonia.

International Youth Conference in Gdansk, source: EFOZ

4.1.2 Main outputs

Major renovations and energy analysis

Work Package 3 conducted an investigation about the content of energy certificates and energy calculations, the competence of energy experts and the application of energy certificates and energy calculations in historic buildings. Even though all countries provide systems for the above mentioned actions in accordance with EU directives, the application and extent varies[3]. Through Co_2olBricks and similar projects' investigations

3 The report "Result of Survey on Energy Certificates in Historic Buildings" can be downloaded on Co_2olBricks homepage: *www.co2olbricks.eu/*

(research within Swedish project "Spara och Bevara"[4] and EU 7th Framework Programme project "3encult"[5]), it is obvious that traditional buildings show better results for energy efficiency in reality than the calculated value estimates. Therefore Work Package 3 insists on the importance of adapted methodology, models for cooperation in upgrading of historic buildings and real calculations – in the actual buildings – in the case of major renovations and energy analyses.

Balancing heritage preservation with climate change mitigation

The EPBD (Energy Performance of Buildings Directive 2010/31/EU) is implemented not only through building regulations but also 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 argues 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, as illustrated in four Co_2olBricks project cases – the projects in Hamburg and Kiel in Germany, in Malmö and Stockholm, in Sweden.

Standards and Guidelines

None of the partners in Co_2olBricks have 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. There is presently an 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 a definition of general solutions. It will show a harmonised, systematic approach to facilitate the best decision in each individual case.

4 The Swedish Energy Agency's research programme for energy efficiency in cultural heritage buildings:
www.sparaochbevara.se/

5 Project co-funded by European Union seventh framework programme:
www.3encult.eu/en/project/welcome/default.html

Education of expertise

The studies implemented during the project, requested the development of new curricula for architects, energy engineers, and other performers or stakeholders. Within Co_2olBricks Work Package 5, learning packages and lecture material was developed.

A lot of background knowledge is needed but also hands-on skills and experience are 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) of 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.

Discussion on the Kick Off Conference in Hamburg, source: Denkmalschutzamt Hamburg

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 the EPBD, every member country needs to have a national action plan for energy efficiency. Among the Co_2olBricks partners, only Sweden has a national research and development programme regarding energy efficiency in historic buildings – stated in the national action plan for energy efficiency[6].

6 Spara och Bevara, see footnote 4.

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 training of experts in energy efficiency of historic buildings, mostly energy experts. Training of conservation officers and conservators 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 like the regional programme "Backsteinfonds" which evolved in Hamburg during the project's time and the national German programme, KfW Denkmal which has existed about a year (in April 2013), both containing skills programmes as part of the quality management[7].

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, or in the final report of Co_2olBricks Work Package 3. Links to guidelines and other projects are available on the Co_2olBricks website *www.co2olbricks.eu*.

4.1.3 Key findings and lessons learned

Through the project, similarities between the partner countries have been clarified but also 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 and their approaches and each other during the project.
All the BSR countries have ratified international conventions such as those proposed by UNESCO, ICOMOS, the Venice Charter, etc., but make different interpretations of the content, which results in different approaches regarding conservation of cultural heritage. The countries also have very different conditions regarding, for example, the economy, energy goals and supply, the condition of buildings and historic background, etc. In countries spared from

7 Read more in Co_2olBricks work package 3 report "Integration of Climate Protection and Cultural Heritage aspects in policy and development plans" that can be downloaded at: *http://www.co2olbricks.eu/*

wars, authentic material and building elements are still left, which is a more precautious approach to reconstruction and changing of buildings' materials and elements can be explained.
At the first meeting there were discussions about whether or not brick buildings also include other stone buildings. The Project Partners talked about what a historic building or monument is. Some countries have a national list of buildings and the selection is made centrally. 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".

Workshop in Hamburg, source: Denkmalschutzamt Hamburg

In some countries there are no energy efficiency measures allowed at all in the protected buildings and therefore there are no discussions or issues about what to actually do. The same thing goes for energy certification, whereas both energy assessments and energy certificates are required in historic buildings in other countries.
The project's experience is that, at present, European Directives, national legislation and action plans for improving energy efficiency are shaped by new buildings or existing modern buildings and are focused on the energy saving measures which will be most cost effective. In the current climate, and in the 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 highlight either the

opportunities or the adjustments that must be made, or the specific expertise and processes needed in order 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 carried out within the project.

City Model in Helsinki: source Denkmalschutzamt Hamburg

Exceptions to this are the measures related to funding and labour skills in Germany ("KfW Denkmal") and the national research programme "Spara och Bevara" in Sweden. Furthermore, during the project, work began toward a European standard, CEN TC346/WG8 Energy efficiency of historic buildings, in which several Co_2olBricks partners were involved.
Sweden is, to our knowledge, the only EU country which, since 2012, demands energy certificates also for historic buildings when sold or rented out. Analyses of the risks for historic buildings were not included in the assessment report prompting the legislation change, nor was the current lack in the area of both the expertise and processes to secure the cultural heritage value of buildings. The utility of establishing energy certificates can be questioned because profits are low and the number of buildings is small in this context. Protections in the building regulations of existing buildings secure that no requirements that would unacceptably alter the building's character or appearance will be carried out. On the other hand, if energy certificates could be adapted to 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.

4.2 Work Package 4: Technical Solutions

/ DR. DANIELA SCHERZ, MINISTRY OF CULTURE, DEPARTMENT FOR HERITAGE PRESERVATION, HAMBURG, WORK PACKAGE LEADER

In the group Technical Solutions, 14 partners from 8 countries were involved and were working to achieve their goals in the following four main areas:

- Research
- Best practice example
- Technical solutions
- Pilot projects

There is a large variety of methods to retrofit existing buildings under consideration of energy efficiency measures. Therefore the aim of this working group was to identify and to compile examples concerning energy-saving weak points and best practice solutions for buildings with historical value. The results are published in brochures and on the Co_2olBricks website. In all four main areas, theory meets practice, meaning that the energy efficiency measures were identified and tested in existing buildings. The outcomes show a spectrum of commonly used but also of innovative methods. They are documented experiences collected in a selection and assessment process by the project partners themselves. When looking at these results it becomes clear that there are some similarities but also differences concerning the methods and their implementation in the participating countries, which comprise different climate zones and cultures.

During the project period, work group meetings, workshops, seminars and congresses were organised in every participating country. A special topic was selected for each event in order to work on the respective project goals. The idea was to solve specific problems and to provide appropriate solutions collectively by discussing and analysing various possible methods. In general the acquired results served as a good basis for the next project steps. It turned out that this mode of work was a good way to deal with such a complex topic with the involvement of so many different participants.

Detail of Värtan Gas Works area, Stockholm 2013, source: Dr. Daniela Scherz

4.2.1 Research Projects

Although EU-INTERREG projects are normally not intensive in research, Co_2olBricks has conducted some small research projects itself in order to address certain specific questions. These research projects had, for example, the objective to gather information about the thermal and moisture behaviour or the energy consumption of historic brick buildings, or to

analyse the effects of various internal insulation methods in different climates and different types of buildings. Innovative refurbishment techniques have been implemented in the pilot projects and measuring systems have been installed to gather various data. Most of the research projects were completed within the duration period of Co_2olBricks, but some of them will continue with the monitoring and data-evaluation. The results will be published on the Co_2olBricks website within the next two years.
Research was conducted in the following four countries:

- In Estonia, in the city of Kohtla-Järve, four different internal insulation materials were tested under the climate conditions of Estonia and an analysis was made of how they influenced the hygrothermal behaviour of the wall. Also in Estonia, in the city of Tartu, the energy consumption for 19 buildings was assessed using real consumption data. Afterwards two of these buildings were further investigated in detail.
- In Germany, in the city of Hamburg, four flats in a brick building were equipped with two different heating systems and one of them additionally with internal insulation. The hygrothermal behaviour of the wall was measured under the varying weather conditions.
- In Poland, a historic manor house was investigated and a concept was set up taking into consideration various energy efficiency measures for historic building in order to achieve considerable energy savings.
- In Sweden the economically feasible energy saving potential of different measures was calculated for a large former hospital.

4.2.2 Best Practice Examples

In addition to the research projects, the partners working in the Technical Solutions work group selected, described and published best practice examples of energy efficiency improvements in historic buildings in their countries. All the examples show common as well as new methods and the large variety of different approaches.
The aim was to illustrate how each participating country deals with the refurbishment of historically valuable buildings under the aspects of energy-saving and how this has been done so far in different types of buildings with different construction preconditions, ranging from a castle from the 16th century to a residential building from 1971. Therefore not all the examples are comparable amongst each other. Nevertheless, common findings, valid for many different situations, were also made. The fact that small measures, which can be implemented without having to touch the protected structure of the building, can already save a considerable amount of energy can be named in this regard.

Detail inside the Evangelical Lutheran Church, Vilnius 2012, source: Dr. Daniela Scherz

4.2.3 Technical Solutions

The task within the third main area was to find and demonstrate examples of technical solutions for improving the energy efficiency of historic brick buildings. The aim was to identify measures that simultaneously decrease the energy consumption and preserve the historical value of the buildings. In general this means the implementation of measures that do not alter the historic building itself, for example new heating systems, improvements of windows, and insulation of basements, or roofs. The following technical solutions were compiled and described by the project partners:

- Insulation of roof, ceilings and walls
- Improvement of windows, doors and shading systems
- Improvement of the air tightness and ventilation systems
- Improvement of the heat production or heating system
- Improvement of the electrical components

4.2.4 Pilot Projects

The four pilot projects within Co_2olBricks had the goal to implement, monitor and evaluate energy saving measures in historic brick buildings. Therefore the energy efficiency measures calculated beforehand were implemented and tested under real conditions in existing buildings. In one of the projects this was extended from one building to a whole quarter of 130 buildings, consisting of almost the same building-types, in the form of a conservation plan. Within all the pilot projects, some small research projects like those described above were also conducted. In order to document a wide variety of measures, commonly used methods as well as innovative methods were implemented. The different experiences made – the positive as well as the negative ones – were collected by the project partners during the complete process.

4.2.5 Lessons learnt …

… in regard to the project's topic:

The keyword 'sustainability' describes the main focal point of the project Co_2olBricks. All municipalities of historically evolved cities in Europe are faced with the major challenge of using energy more efficiently while still maintaining the quality of the historic structures. Those buildings should also be usable, either in their original purpose or in a modified or new function. Some of them may be preserved as monuments or kept as museums,

especially when they are listed or under special heritage protection. In respect of the cultural importance of historic buildings, the aim of the energy refurbishment should not be to save as much energy as technically thinkable but instead to implement as many measures as possible without destroying heritage values or, worse, damaging the historic structure. Therefore an often quoted maxim requires that the measures should, in principle, be preserving the historical elements or that they have to be reversible. This makes it clear that the rehabilitation and improvement of the energy efficiency of a historic building is much more complex than that of a 'normal' building.
One of the results of the Co_2olBricks work group Technical Solutions was the development of a method for the analysis of buildings for energy-saving measures, taking into account the conservation of historical value. Common experiences are summed up in the description of the analysis process which provides an iterative method of assessing the historical value and technical energy saving measures, with the goal of obtaining an optimal solution. This document has been designed as a guideline with recommendations for action in the project management process. Working on historic buildings always demands interdisciplinary collaboration of all the involved stakeholders. Together they have to define the core objectives and goals for the refurbishment process. To support this, the use of checklists can be very helpful, especially in the beginning of a project.
In this regard it is also important that only experts should be engaged who can prove that they have the specific expertise concerning energy efficiency in historic buildings. This requires that the energy auditors are educated in heritage preservation and, vice-versa, the conservators have to gain knowledge in the field of energy efficiency.
Besides the heritage and technical aspects of the rehabilitation of a historic building, the economic aspect is crucial as well. So it is always necessary to also examine the available funding schemes. To reduce the costs for the analysis process, more research is necessary on typical construction types and materials used in historic buildings. This would make it possible, for example, to provide a usable data base for the calculation and planning process.

… in regard to the project process:
One of the main difficulties was that a time period of three years is much too short to implement larger research or pilot projects, especially when working on such a complex topic with so many different aspects as the Co_2olBricks project covers.

Another difficulty was to work in a very heterogeneous group in which most of the participants have a different focus in their daily work. Therefore it was a big challenge to define the specific goals as well as to lead and control the project process, especially under consideration of the project management instruments provided within the EU-INTERREG program.
Furthermore, a big challenge was to define the same technical vocabulary for all project partners in order to have the same meaning in mind when using the same words. It took a lot of time and effort during the whole of the project period to define glossaries with terms of use.
It was a challenge as well as a benefit to work together with so many different partners from different cultural backgrounds. This was especially true when starting the aforementioned pilot or best practice projects regarding the specific history of buildings and their characteristics as well as the special regulations (in policy, standards and education) in the participating countries.

… in regard to future projects:
One of the points that could not be dealt with conclusively during the lifetime of Co_2olBricks was the question of whether or not an energy certificate for historic buildings is necessary and useful. Therefore it will be important to evaluate the experiences made in those countries which have such a certificate by law, for example in Sweden or Austria.
An essential element of the continuous work after the life-span of the Co_2olBricks project is the dissemination of the results, the lessons learnt, and the compiled state-of-the-art energy efficient technologies. The target group to focus on in doing this includes not only all stakeholders involved in the planning and implementation process but also people working in the fields of education, government and policy.

Kastellet, Stockholm 2013
source: Dr. Daniela Scherz

4.3 Work Package 5: Education and Economic Promotion

/ JURGIS ZAGORSKAS, VILNIUS GEDIMINAS TECHNICAL UNIVERSITY, WORK PACKAGE LEADER

4.3.1 The procedures

The educational goal of Work Package 5 was to prepare new teaching materials and key concepts in rehabilitations of historic brick buildings, to harmonise the teaching programmes and curricula. The economic promotion is achieved by raising the awareness of the problem and giving the guidelines to stakeholders.

The starting-point for the work was finding out the details about the system of certification in all BSR countries and institutions responsible for education of craftsmen, architects, conservators, constructors, engineers, energy auditors and other specialists and workers taking part in the process of rehabilitation of historic buildings. The investigation was performed among WP5 partners during period 1–4 and pointed out the main problems, needs and target groups for further work within WP5.

The educators, researchers and stakeholders developed knowledge through different activities, which resulted in carefully selected lecturing materials and recommendations with examples within the areas of education of craftsmen, architects, conservators, project managers, etc., in the rehabilitation of historic brick buildings.

Dr. Rudolph Plagge, TU Dresden, source: Denkmalschutzamt Hamburg

The Project Partners involved in WP5 worked together in the area of education and reaching out to target groups. Best practices were established and shared through the internet and guidance manuals. Project Partners participating in Work Package 5 "Education and Economic Promotion" are mostly educational organisations – vocational training centres, higher education institutions, universities.
The WP5 comprised researches, surveys and educational events performed by the partners. The WP5 partner group met twice every project period to present and evaluate their activities, to discuss the future plans and other project work and the results. The work during the meetings was usually done in workshops, discussions in the whole group and smaller groups. Results of the workshops and discussions were presented afterwards and further decisions were made based on these.
Various lecture materials were drafted, then presented and discussed at the Project Partner meetings and on-going on the web forum. The materials were further developed and changed according to expert findings.
The WP5 leader, supported by the Lead Partner has continuously coordinated the work within the WP5 and informed all Project Partners about the work tasks and deadlines. Material from the Project Partners was collected through questionnaires and compiled in reports or handbooks.
The partners, according to their expertise, also conducted individual work in their regions – organised educational events, conferences, collaborated with other partners, prepared the wide range of educational material from the basics up to special technical know-how.

4.3.2 Main outputs

Lecturing materials on historic building rehabilitation and innovative energy saving measures in historic buildings
The Project Partners developed new training course materials for architects, planners and energy auditors (15 different materials). The materials were used during educational events and in Project Partner educational institutions locally. In addition, the WP5 handbook was compiled as a basis for lecturers.
Lecture material for craftsmen (suitable for architects too) was also developed: Introduction into cultural heritage and specific lectures on, e.g., historic masonry, damage patterns of historic masonry construction, refurbishment of historic masonry and analysis of weak points.

The materials for technical solutions for improving building energy efficiency were collected from WP4 pilot projects and from academic research. The 10 most efficient methods for saving energy in historic buildings were pointed out by Co_2olBriks project experts. The methods and techniques were described in detail in 10 new training course materials. The materials were put on the internet and distributed to the project target groups.

Example of a walltempering system in Hamburg, source Denkmalschutzamt Hamburg

Harmonisation of training programmes and modules

The data about existing learning programmes of teaching institutions related to the project theme was collected by Project Partners from all BSR countries. Possibilities to change curricula, modules, etc., were discussed at the local level and internationally between partners.

The existing system of certificates for professionals working in the field of culture heritage and reconstruction of buildings was analysed and proposals for developing this system in order to create the need for education were given in a strategic paper.

Findings on specific knowledge that craftsmen should have and harmonised curricula for specialised craftsmen and experts at different levels were created. Contents of the teaching modules, consistency of the lectures, workshops and practice in institutions for craftsmen taking part in Co_2olBricks project were updated.

Educational events

A number of workshops and meetings were conducted for the different target groups: general public, house owners and stakeholders, students and craftsmen, architect, engineers and other professionals working in the field of rehabilitation of historic buildings.

4.3.3 Key findings and lessons learned

Education

The knowledge gaps in training programmes for architects, planners, conservators, engineers and energy auditors were found during the research done within the Co_2olBricks project. These gaps occur mainly because the current teaching programmes focus mostly on construction of new buildings. It was found that with increase of refurbishment works in older buildings (in some countries it takes up to 40% of construction market) the curricula and training programmes have to be adapted more to the rehabilitation of existing buildings with the focus on energy effectiveness.

Cavity wall insulation, source: Denkmalschutzamt Hamburg

Specialists working with rehabilitation of historic building have to

- be sensitive to heritage issues and know when to consult specialists;
- know about traditional insulation and decoration materials and methods;
- know where and under which conditions modern materials can be applied;
- know about heritage regulations and legislation;
- understand building physics;
- understand common risks of internal insulation and other measures for increasing energy effectiveness (mould, thermal bridges, moisture).

Economic promotion

For further economic promotion there is an urgent need of interdisciplinary collaboration on curriculum to solve the misunderstanding between specialists of conflicting professions related to art, history and technology.
A working system of cooperation between professionals and teachers has to be established. This way they come to good practice examples and create quality courses where workers can improve their skills and specialists such as architects, conservators, auditors, etc. can increase their knowledge.
A feedback system of quality of work and a list or database of qualified professionals would be a great help for Small and Medium sized Enterprises (SME), stakeholders and house owners.

4.4 Work Packages 1 & 2: Administration and Communication

JAN PRAHM, DEPARTMENT FOR HERITAGE PRESERVATION HAMBURG, PROJECT COORDINATOR

4.4.1 Management activities of Co_2olBricks

The content-driven Work Packages that are facing the problems and objectives that should be solved with the project's work have to be in the focus of the project activities. Nevertheless they could not exist without the cross-sectional management activities that control, document and communicate the project's work.
The management activities of Co_2olBricks took place on two levels: First the administrational, financial and communicational tasks of each Project Partner partly complemented by national coordination meetings. And second the central administration of the overall project by the Lead Partner (Department for Heritage Preservation Hamburg) that coordinates the activities and the finances of all 18 Project Partners as defined in the so called Project Data Form which is the working plan of the project approved by the BSR Programme 2007–2013.
The management activities can roughly be grouped in three sections:

Project Management
The first task of the Lead Partner who is responsible towards the BSR Programme 2007–2013 was to formally organise the contractual relationship between the 18 Project Partners. Therefore a Partnership Agreement had to be developed and amended in the case of approved changes.

International Conference in Gdansk, source: T. Filipkowski

On this basis, together with the up-to-date Project Data Form, the Lead Partner coordinated the project's work and organised, for example:

- Transnational Project Partner meetings.
- Transnational Work Package meetings.
- Work Package leader meetings to manage the exchange between the Work Packages.
- Steering Committee and Advisory Board meetings.
- The Kick Off-, Midterm- and Results- Conferences of Co_2olBricks.
- The controlling of the "Main Outputs" of the Co_2olBricks project.

Finances and Reporting

The most important formal part of the project management is the Financing and Reporting, because this is the basis for the financial relationship to the BSR Programme 2007–2013.

Therefore the Lead Partner together with an external financial manager had to, for example:

- Control the overall and the Project Partners' budgets regarding different budget lines and Work Packages.
- Compile the partner progress reports to an overall progress report every 6 months.
- Organise the first level control auditing.
- Organise the financial transactions between the EU and the Project Partners.
- Give advice concerning the financial regulations of the BSR Programme 2007–2013.

All Project Partners had to deal with these issues on an operational level too. They had, for example:

- To do the bookkeeping and documentation of all expenses.
- Compile partner progress reports every 6 months and auditing by first level controllers.
- Organise tenders ("bid at three") for external services.

Communication

To make the outputs of the project's work visible, an intensive and coordinated dissemination of the project's results was very important.

The Lead Partner together with an external communication manager carried out various activities, among other things:

- Develop a communication plan for the whole project and the project's lifetime.

- Develop a common Corporate Identity (CI) for the external communication.
- Develop and update the project's website (www.coolbricks.eu) which is the central communication platform for the project's internal and external affairs.
- Compile and disseminate regular project newsletters.
- Develop project leaflets with basic information.
- Compile, draft layout and print the project's main publications.
- Organise public relations activities, e.g. press releases, interviews of journalists.
- Present the project at conferences, fairs and other events.

Each Project Partner had to organise their national, regional and local communication activities in the framework of Co_2olBricks.

4.4.2 Experiences and lessons learned

Administration and communication of a project like Co_2olBricks starts at the moment you have the first idea for such a project and it takes years from the first idea until the realisation of the idea. So, like in every project, you have the problem that you have to write down today what you plan to do in 5 years. 5 years is about the time that lies between the first sketches of the Co_2olBricks project idea and the implementation of the final activities. Administration during this time means that one has to constantly level out the differences between the planned steps and what is actually possible and happening. This becomes especially challenging when one working group or a next step depends on the results of another working group. As in every project, especially when you develop something new, nothing ever happens exactly as you have planned it. This is especially true in an international project with so many diverse Project Partners, languages, political cultures, levels of knowledge, geographical distances, technical communication infrastructure, etc.
But at the same time this is also the interesting part: To still achieve the intended goal although things have developed differently. So, administering the processes is one thing. Moreover everything has to be communicated with the various stakeholders. These are, in projects like Co_2olBricks, primarily the Project Partners, the members of the Steering Committee and Advisory Board, the Joint Technical Secretariat, the own organisation and, last but not least, the public. On all levels it is about managing expectations. The original project plan creates certain expectations. Some are realistic and

some are not. So as project coordinator one is always confronted with these expectations and life becomes challenging when people get the feeling that their expectations are not fulfilled.
Communication in such a project is much more difficult than you would expect. A major obstacle is the language. The common language is English, but only because it is the most common language. The problem is that not everybody speaks perfect Oxford English. So everyday vocabulary cannot be expected from everybody, not to speak of expert vocabulary. Many discussions were eventually actually not about the topic as such but more about what each of the participants understood by a certain vocabulary. This was sometimes only the direct meaning of a word, but just as often a whole culture stood behind a word and that meant that one was also discussing the differences in these cultures. So it took us about one year until we had identified all these differences and had clarified some of them. Towards the end of the project, all partners found out the value of international conventions. Their advantage is that first of all they contain definitions and, secondly, they are formulated in more or less Oxford English so one can be sure that the text is correct. And third, these conventions have been discussed and interpreted in the signatory countries so the respective experts have the chance to know what they mean. This creates a level starting point, although it still leaves a lot of room for differing interpretations and ways of implementation. But nevertheless the international conventions, norms and standards save a lot of time and struggles.

Conference in Minsk, source: RCTT

So the communication has to use simple and almost universally understandable metaphors and formulations without specific cultural connotations.

One of the major communication tasks was the Joint Declaration, because there is no blueprint how to write down the overall opinion of all Project Partners. At the beginning we had no idea what a joint declaration might contain. But after several meetings in which the same statements repeatedly where mentioned it became clear where the common line might be. So the Lead Partner wrote down these statements and tested them in a Project Partner discussion. In the first round there was a big discussion about many items, the structure, the target group and certain words. Some of the discussion points we could clarify in the meeting right away, to many more points we got written comments afterwards. The problem here was that some of them contradicted each other, so it became difficult to know how to find a common ground. And for one item, the "Energy Analysis", a whole additional document was created to explain what was meant by it, but only after a workshop with several work groups and a plenary discussion of the suggestions. An important factor for the development of a strong document are partners with a strong opinion because only if people are fighting for their point of view they will promote the result afterwards with the same verve. Therefore it is important to meld the different points of view rather than try to suppress them. Only if every partner feels represented in the resulting document it will have a political impact. So, one should be willing to go through the tiring discussion process. In a second and third Project Partner discussion the comments were discussed and most of the differing points of view could be levelled out, still leaving a few points. But after admittedly lengthy discussions we found compromises about those points too. This actual discussion process took about nine months and many hours of discussions, telephone calls and e-mails. But eventually we achieved consensus, which now means that 18 partners are commonly promoting the Joint Declaration. This gives every partner much more strength than if he or she would be on his/her own, because one can always claim that 17 other expert organisations across the Baltic Sea are standing behind the Joint Declaration.

› The following examples give an impression about the wide range of different activities that took place within the three years of the project's lifetime. ‹

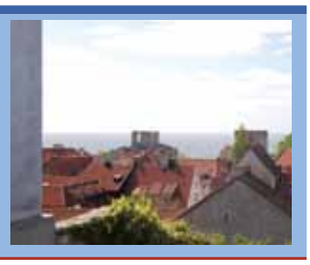
5 The Co_2olBricks Events

The main aim of the Co_2olBricks project was to push forward the process of balancing the different interests of climate change mitigation and heritage preservation. Therefore Co_2olBricks organised or participated in several events on transnational, national, regional and local level with the following objectives:

- Joint work on practical issues concerning technical, political and educational topics.
- Forward the discussion with stakeholders.
- Knowledge exchange and transfer of experts.
- Presenting the project's issues to a broader public.

The following examples give an impression about the wide range of different activities that took place within the three years of the project's lifetime.

2011



31 March/1 April	Kick-off Expert Conference with over 120 international participants comprising architects, engineers, housing societies, representatives of public authorities dealing with building permissions, city planning and energy conservation in **Hamburg, Germany**.
10–11 May	Project presentation on workgroup meeting for Associated Partner SuHiTo – Sustainable Historic Towns, **Oslo, Norway.**
17 May	Project presentation for all personnel on Swedish National Heritage Board internal meeting, **Stockholm, Sweden.**
24/25 May	Project Partner meeting including information about the Swedish national research programme "spara och bevara", **Visby, Sweden**.
1–4 June	International Youth Conference on "Climate Change, Cultural Heritage and Energy Efficient Monuments" in **Kohtla-Järve, Estonia.**
23 August	Joint excursion of the Heritage Department and the Vocational Training Centre to show bad and good examples of brick-refurbishments, **Hamburg, Germany.**

2011



2 September	Presentation of Co_2olBricks within the Conference "Energy Autonomy of a house, district, community and region", **Wroclaw, Poland**.
25 September	Consulting with house owners at the stand of the model project Elmschenhagen at the consumer fair of the trade and industry association, **Kiel, Germany**.
12 October	International Seminar to discuss the previous project results with external experts, architects and planners in **Helsinki, Finland**.
13 October	Seminar on "energy efficiency in historical brick buildings", **Riga, Latvia**.
13 October	WP3 and WP4 issues discuss on XIV Conservators Forum "Preservation against moisture and applied technologies", **Torun, Poland.**
18–21 October	Presentation of Co_2olBricks at the "Environment and Energy" trade fair at the Riga Technical University, **Riga, Latvia**.
25 October	Public seminar and lectures together with the Swedish Association for Building Preservation organised by the Stockholm City Museum, **Stockholm, Sweden**.
15 November	Co_2olBricks is presented at the exhibition of the Belarusian Innovation Week "Intelligence, Initiative, Innovations", **Minsk, Belarus**.
16/17 November	Presentation of Co_2olBricks during the trade fair "Stadt-Land-Umwelt", **Kiel, Germany**.
18 November	Session "Innovation technologies for improving the energy efficiency in historic buildings" in the context of the "3rd Belarusian Innovation Forum", **Minsk, Belarus**.
18 November	Awarding of winners and laureates of the Contest of Innovative Projects in the nomination "Best Innovative Project (Technology) for Restoration of Historical Buildings", **Minsk, Belarus**.

2011

30 November	Regional seminar in Kalmar together with the Swedish Building Care Association, **Kalmar, Sweden**.
1 December	A delegation from the Stockholm City Real Estate Department visits the research project Passierzettel in **Hamburg, Germany**.
8 December	Workshop with the association of house owners (BFW Bundesverband Freier Immobilien- und Wohnungsunternehmen e.V.) about energy efficiency in historical buildings in **Hamburg, Germany**.
14 December	Official Co_2olBricks Seminar in **Malmö, Sweden** with focus on "Internal Insulation" and the preplanning of "Guidelines for improving energy efficiency of architecturally, culturally or historically valuable buildings" by the European Committee for Standardisation (CEN).

2012

30 January	Regional conference for owners of historical buildings with participants from South Estonia**, Tartu, Estonia.**
1 February	National coordination meeting and expert seminar on energy efficiency in historical buildings with participants from all over Sweden, **Stockholm, Sweden**.
20–23 February	Joint Project Partner meeting and international seminar with more than 50 participants in **Veliky Novgorod, Russia**.
28 February	Workshop for Swedish national authorities: "Energy efficiency in historical buildings, means of control, guidelines, competence and methodology", at Boverket (The Swedish National Board of Housing, Building and Planning), **Karlskrona, Sweden.**
29 February	Project Co2oLBricks presented at the 5th International Conference "Energy efficient construction in the Republic of Belarus", **Minsk, Belarus**.
7 March	Workshop for Swedish national authorities: "Energy efficiency in historical buildings, means of control, guidelines, competence and methodology" at University of Gotland, **Visby, Sweden**.
22 March	Workshop on redevelopment of "The old gas works area" with historic valuable brick gasholders, **Stockholm, Sweden**.
23 March	Seminar for Climate Commission of Kronoberg Region for politicians, municipal officers and representatives from private companies, **Ljungby, Sweden**.
26 March	Workshop with the association "Freunde der Denkmalpflege e. V." in **Hamburg, Germany**.
3 April	Workshop for Swedish national authorities: "Energy efficiency in historical buildings, means of control, guidelines, competence and methodology", at Energy Agency and Swedish National Property Board, **Stockholm, Sweden.**

2012



12–13 April	Co_2olBricks workshop on Education and Economic promotion, **Vilnius, Lithuania**.
16 April	International Conference on Monuments Protection and Energy Efficiency to present the recent results of Co_2olBricks to Polish specialists, conservators, architects, energy auditors, officials and representatives of professional associations, **Gdansk, Poland**.
24 April	Co_2olBricks project presentation on associated partner SuHiTo – Sustainable Historic Towns- conference in **Tartu, Estonia.**
9 May	Open National Seminar "Sustainable refurbishments and historic buildings" with focus on inner climate and building physics, **Helsinki, Finland**.
21–23 May	Project Partners, Steering Committee and Advisory Board Members Meeting and international seminar in Tallinn and a joint onsite investigation of the historic school building in **Kohtla-Järve, Estonia**.
24 May	3rd Conference "Reconstruction and Restoration of Buildings: Modern Technologies and Energy Effective Solutions", **Minsk, Belarus**.
18-21 June	Workshop of Educational Group for Youths from Kaliningrad and Gdansk, **Kaliningrad, Russia.**
27 June	Participation of Co_2olBricks on the round table meeting of Cluster Energy for Green Growth in **Brussels, Belgium**.
26 June	Joint event and project presentation with 7th framework project 3encult workshop in **Copenhagen, Denmark.**
28 June	Co_2olBricks Workshop "Energetische Gebäudesanierung mit Innendämmung" (Energy refurbishment with internal insulation), **Kiel, Germany**.
2–6 July	Presentation of Co_2olBricks with an exhibition at the political week in Almedalen, **Visby, Sweden**.

2012

31 July	Three Co_2olBricks excursions during the Hamburg "Summer of Architecture" to show an example where the historic brick façade was not touched but the total heating energy consumption was reduced by 2/3, **Hamburg, Germany**.
23–24 August	Workshop about "Policies in energy efficiency in cultural heritage buildings" for national governmental authorities, **Visby, Sweden**.
11 September	Presentation of Co_2olBricks at the conference "Energy efficiency in traditional buildings of Historic Scotland", **Edinburgh, Scotland**.
12–14 September	Co_2ol Bricks at the Second Urban Regeneration Congress, **Cracow, Poland**.
15–16 September	Ökomäss Fair organised by Co_2olBricks Project Partner SRIK, **Tallinn, Estonia**.
17 September	Co_2olBricks Midterm Conference with presentation and discussion of the interim results of the project with numerous participants and members of the partner project CLICC in **Malmö, Sweden**.
18–19 September	Project Partner Meeting including a visit of the best practise example Matarialgaard and a presentation of the 7th framework project 3encult, **Copenhagen, Denmark**.
19–20 September	Presentation of Co_2olBricks issues at the BSSSC Annual Conference on, **Lilleström, Norway.**
21 September	Kohtla-Järve Co_2olBricks stakeholders visit Tartu stakeholders to share project research experiences in both cities, **Tartu, Estonia**.
18 October	Co_2olBricks issues discussed at the XV Conservators Forum, **Torun, Poland.**
19 October	Presentation of Co_2olBricks at the METREX conference in **Vienna, Austria**.
26 October	Co_2olBricks presentation at Pomeranian Energy Days, **Gdansk, Poland.**

2012



27 October	Co_2olBricks Swedish exhibition on Energy Convent, **Ystad, Sweden.**
29 October–2 November	Co_2olBricks staff exchange – Tomas Örn from the Stockholm Museum spends one week job shadowing with the Hamburg Heritage Department, **Hamburg, Germany**.
5–7 November	Transnational Co_2olBricks Project Partner Meeting at Vilnius Gediminas Technical University, **Vilnius, Lithuania**.
6–8 November	Co_2olBricks Swedish exhibition on Swedish National Heritage Board annual Autumn Meeting**, Malmö Sweden.**
21 November	Stakeholder meeting "Energy efficiency in historical buildings as tool for sustainable development", **Riga, Latvia**.
22 November	German Deputy Ambassador to Belarus visits Co_2olBricks Project Partner RCTT, **Minsk, Belarus**.
22–24 November	Co_2olBricks stand at Fair and Conference "Denkmal 2012" with participation of Project Partners from Finland and Estonia, **Leipzig, Germany**.
11 December	Co_2olBricks at the local partners meeting of SERPENTE project, **Katowice, Poland.**
15 December	Co_2olBricks presented their activities at the VI Annual Lithuanian Urban Forum organised by the Ministry of Environment in **Vilnius, Lithuania**.
19 December	Co_2olBricks stakeholders' seminar, kick off of the development process of National Action Plan to Improve of Energy Efficiency in Historical Buildings, **Tallinn, Estonia**.

2013

11–13 February	Transnational Co_2olBricks Project Partner Meeting at Riga Town Hall, **Riga, Latvia**.
14 February	Co_2olBricks house owner's seminar, of the National Action Plan to Improve of Energy Efficiency in Historical Buildings development process, **Tartu, Estonia**.
15 March	Meeting of the Belarusian Advisory Board on Energy Efficiency in Buildings, **Minsk, Belarus**.
19 March	Joint Regional Workshop of Swedish National Heritage Board, Stockholm Museum, Malmö Stad and Energy Agency for Southeast of Sweden for consultants, energy experts and building conservators, **Växjö, Sweden**.
26 March	Seminar/workshop on behaviour related questions for final energy use in buildings – Energy Agency for Southeast Sweden, **Växjö, Sweden.**
4 April	Co_2olBricks presentation at Information Seminar on the current European Cross-Border Cooperation Programme, **Gdansk, Poland.**
5 April	National seminar of KIINKO with 50 participants in **Tampere, Finland**.
10 April	Presentation of Co_2olBricks at the Hamburg Council for Heritage Preservation, **Hamburg, Germany**.
12/13 April	Co_2olBricks lecture at the International Conference for internal insulation in **Dresden, Germany**.
18–19 April	Co_2olBricks workshop on Policy Paper and Joint Declaration, **Stockholm, Sweden**.
22–24 April	Kiinko Real Estate Education organises a Finnish excursion to Stockholm, **Helsinki, Finland – Stockholm, Sweden**.
22–26 April	Co_2olBricks staff exchange – Daniela Scherz from the Hamburg Heritage Department spends one week job shadowing with the Stockholm Museum, **Stockholm, Sweden**.

2013



22 April	International seminar "Renovation and usage of historical manors and parks" in **Toila, Estonia**.
23 April	Seminar/workshop on practical approach to relevant energy efficiency measures in existing building – Energy Agency for Southeast Sweden, **Växjö, Sweden.**
2–6 May	Visit of an Estonian delegation of Co_2olBricks Partner 12 to Haugesund city planners and conservators to expand Co_2olBricks achievements, **Haugesund, Norway.**
29 May	Visit of a Swedish delegation of urban planners and conservators to **Hamburg, Germany**.
29 May	Specialised training for energy auditors how to carry out an energy audit in historical building, **Tallinn, Estonia**.
3–5 June	Public seminar and Co_2olBricks Project Partner Meeting including a visit to the pilot project area in Elmschenhagen, **Kiel, Germany**.
6 June	Excursion with Project Partners from Estonia, Poland and Belarus to the research project Passierzettel in **Hamburg, Germany**.
12–14 June	International workshop about ventilation and energy efficiency in historically valuable houses, **Tallinn, Estonia**.
1 July	Travelling exhibition about Co_2ol Bricks developed by the Stockholm City Museum presented at the Almedalen Week, **Visby, Sweden**.
2 July	Co_2olBricks-seminar "The energy certificate – **caution is the exception**?" held by the Swedish National Heritage Board together with Uppsala University at the political week, **Visby, Sweden**.
23–24 July	International Seminar about "New technologies in construction and energy saving methods in refurbishment of historical buildings", **Kohtla-Jarve, Estonia**.

2013



2–4 September	Co_2olBricks workshop on Technical Solutions, **Minsk, Belarus**.
16–18 September	Transnational Co_2olBricks Project Partner and Steering Committee Meeting, **Gdansk, Poland**.
17 September	Seminar "Problems of Energy Efficiency of Historic Buildings", **Minsk, Belarus**.
20–22 September	Ökomäss Fair organised by Co_2olBricks Project Partner SRIK, **Tallinn, Estonia**.
3 October	Energy section, Co_2olBricks program at building conservation convention in **Mariestad, Sweden.**
10 October	Specialised training for owners of historical buildings with practical exercise on how to develop terms of reference, **Kohtla-Järve, Estonia**.
6–8 November	Co_2olBricks Swedish exhibition on Swedish National Heritage Board annual Autumn Meeting, **Solna, Sweden.**
8 November	International seminar „External appearance of historical buildings and their energy efficiency" of the Town Government of Kohtla-Järve in cooperation with SRIK and the National Heritage Board of Estonia, **Kohtla-Järve, Estonia**.
12 November	Co_2olBricks Information Event, **Brussels, Belgium**.
12 November	Closing the project, final conference of all stakeholders, presenting project research results, draft National Action Plan and plans for future, **Tallinn, Estonia.**
3 December	International Co_2olBricks Results Conference and Signing of the project's Joint Declaration, **Hamburg, Germany**.

See more detailed information about Co_2olBricks and related events in the "News" section of the Co_2olBricks website: *www.co2olbricks.eu*.


CONTRIBUTING TO A FLAGSHIP PROJECT OF THE STRATEGY

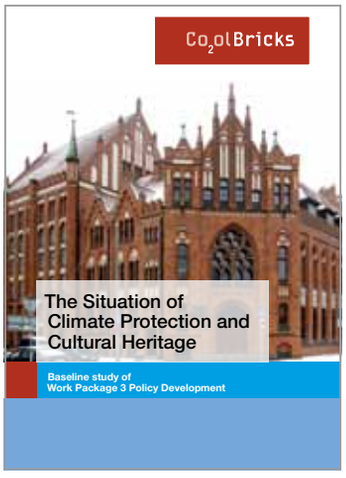
› All publications and documents are available as downloads on the Co_2olBricks Website (*www.co2olbricks.eu*). The printed publications can be ordered from the Lead Partner ‹

6 The Co_2olBricks Publications and Documents

The Co_2olBricks project produced several publications and working documents for different purposes and with different target groups. The printed publications are the compilations of the project's main results. The reports and surveys about researches, best practise examples or technical solutions are documentations of single refurbishment projects or specific technical issues. The educational material focusses on architects, engineers, conservators and craftsmen and will provide support in the preparation of lectures. It consists of single presentations as well as comprehensive programmes about climate change mitigation and heritage preservation issues. Additionally, the final chapter contains links to further information gathered on the Co_2olBricks website.

All publications and documents are available as downloads on the Co_2olBricks Website (*www.co2olbricks.eu*). The printed publications can be ordered from the Lead Partner (for contact data see the imprint on the last page).

6.1 Printed Publications

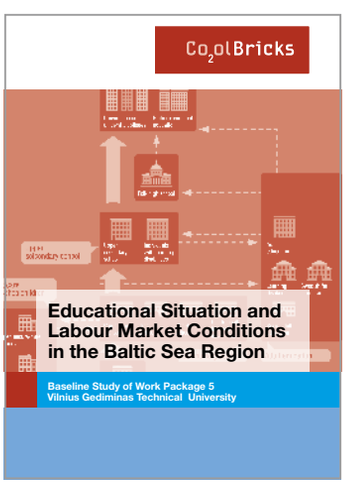


Brochure 01

"The situation of Climate Protection and Cultural Heritage – Baseline Study of Work Package 3 'Policy Development'" (2012)
The baseline study is an inventory of the administrative and legislative situation regarding the management of cultural heritage and energy efficiency questions in each participating country as collected by the Project Partners. The objective of the baseline study is to identify issues and topics that need to be brought forward in the Project Partners' stakeholder groups and roundtable meetings in order to fulfil the main aim of Work Package 3: 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.

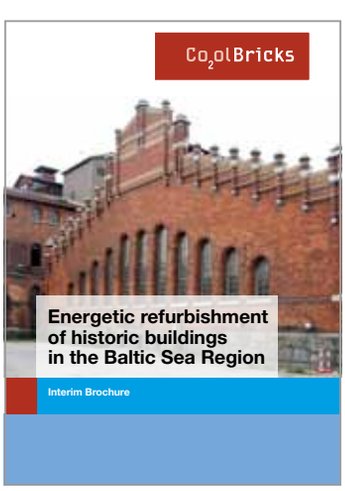
Brochure 02

"Refurbishment for the energy efficiency of historic buildings in member states of the Baltic Sea Region – A handbook of the most common methods for improvements in energy efficiency" (2012)
The aim of the handbook is to shine a light on the current methods used for refurbishment for energy efficiency in historic brick buildings in the Baltic Sea Region. It serves as an exchange for various experiences and shows the different standards in the participating countries. Therefore the handbook consists of different examples of refurbishment for energy efficiency in Denmark, Estonia, Germany, Latvia, Lithuania, Poland and Sweden.



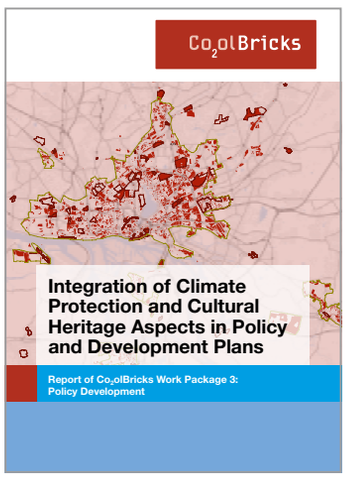
Brochure 03

"Educational situation and labour market conditions in the Baltic Sea Region – Baseline Study of Work Package 5 'Education and Economic Promotion'" (2012)
The main aim of this baseline study is to collect and present descriptive information and comparable data to understand the specifics and necessities of each project country, to know the complexity of the labour market and the education system in the Baltic Sea Region and to name the main problems which can be met within the Co₂olBricks project in the education and economic promotion section.



Brochure 04

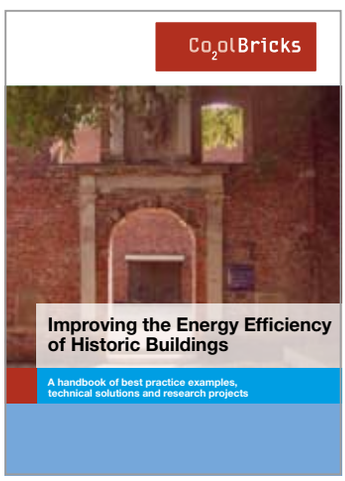
"Energetic refurbishment of historic buildings in the Baltic Sea Region – Interim Brochure of the Co₂olBricks project" (2012)
The interim brochure gives an overview of the results of the project work gained until summer 2012. It consists of information about the Work Packages "political development", "technical innovation" and "education and economic promotion" and shows the interdependencies of these topics. Further on, information is given about contact persons or organisations, as well as extant guidelines, documentations and other useful publications in the field of energy refurbishments of historic buildings.



Brochure 05

"Integration of Climate Protection and Cultural Heritage Aspects in Policy and Development Plans – Report of Co₂olBricks Work Package 3: Policy Development" (2013)

The main aim of this report 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. Therefore examples for several instruments to balance heritage preservation with climate protection are given, e.g., concerning laws, urban development, public funding, standards.



Brochure 06

"Improving the Energy Efficiency of Historic Buildings – A handbook of best practice examples, technical solutions and research projects" (2013)

The handbook gives an overview of the results that have been gained by the Co₂olBricks work group Technical Solutions. The aim was to compile examples and results concerning energy-saving weak points and potentials of buildings with historical value. In all the topics theory meets practice, meaning that the calculated energy efficiency rehabilitation measures were identified and tested under real conditions in existing buildings. The outcome is this handbook of commonly used and innovative methods which documents the experiences collected by the Project Partners during the selection and assessment process.

Brochure 07

"Improving the energy efficiency of historic buildings – The four pilot projects of Co₂olBricks" (2013)

The brochure documents the planning, the implementation and the results of the four pilot projects in Kiel, Hamburg, Riga and Kohtla-Järve. Additionally, the example of a concept for a historic quarter in the case of Kiel-Elmschenhagen is presented.

6.2 Researches, best practice examples or technical solutions

"Report about the Refurbishment of Faestningens Materialgaard", Copenhagen, Denmark (2011)
This report documents a refurbishment process starting with an energy analysis of the building and the development of possible solution by an interdisciplinary workgroup consisting of the building's owners, authorities, architect and engineers.

"Upgrading the energy performance of Elmehuset in the Old People's Town", Copenhagen, Denmark (2012)
This report compiles the overall conclusions and describes the interdisciplinary challenges, possible and actual solutions for upgrading the energy performance of older multi-storey brick buildings.

"Upgrading the energy performance at Kavalergården", Copenhagen, Denmark (2012)
The report presents an energy upgrade of the building complex Kavalergården and primarily demonstrates measures for the improvement of the thermal insulation. The energy upgrade of Kavalergården is a good example of best-practise energy upgrade of old preserved buildings using state-of-the-art measures to improve the energy performance.

"Analysis of existing buildings for energy-saving measures taking into account the conservation of historical value", Hamburg, Germany (2013)
This document has been prepared as a guide with recommendations for action in terms of project management. The step-by-step guide reflects both the basic steps of the project as well as the depth of the research and planning content.

"Study of energy efficient measures – a life cycle perspective", Malmö/ Lund, Sweden (2013)
The purpose of this study is to analyse the efficiency of different measures and opportunities to enhance the energy performance of existing buildings built before the 1940s. The study object has been a building that earlier was a hospital and a psychiatric ward built in the 1930s and located in the Sege park area of Malmö.

"Study of the brick and stone buildings in Tartu", Tallinn, Estonia (2012)
This analysis was conducted to determine the energy performance value (EPV) of the brick and stone buildings in Tartu which are located in milieu valuable areas or are part of the architectural heritage. The research included 19 buildings and, in addition, the report also studies the heat and electricity consumption of the buildings and compares them to the average characteristics of another 64 buildings in Tartu.

"Study of the indoor climate and air leakages in brick and stone buildings in Tartu", Tallinn, Estonia (2013)
Based on EPV study the indoor climate was studied in depth (continuous monitoring and thermography) in two buildings over two years in Tartu. Based on the results of the study detailed recommendations were prepared for house owners and service providers.

„Study of Energy audit of historical manor Studzienka", Gdansk, Poland (2013)
The manor house is a protected building dated between XVII and XVIII century. The purpose of energy audit was to examine existing energy efficiency for all elements of the building (walls, floor, doors, windows and roof) and the existing heating appliances, hot water and ventilation systems to suggest methods and materials which gives satisfactory thermal performance of renovated building according to renovation project.

„Study about the thermo modernization of the BHP Hall", Gdansk, Poland (2012)
This study is an ex post analysis of the thermo modernization of BHP Hall in Gdansk Shipyard. The implemented measures are examined and also suggestions for some further improvement are given.

"Study of 2 heating systems with and without internal insulation in the multi-storey building 'Passierzettel'", Hamburg (2013)
The study describes the research on four different variations of combinations of heating system and insulation in a residential building from the 1920s. The main aim was to find out how the walls behave under the different conditions created by the different energy efficiency concepts.

"Wall tempering systems – overview and current discussion", Hamburg, Germany (2013)
This study conducted by the Technical University of Braunschweig gives an overview about the building physics; research projects the current status of discussion concerning wall tempering systems.

"Survey on Energy certificates in the BSR", Visby Sweden (2013)
Swedish National Heritage Board conducted a survey in March 2013 about the different systems of energy audits/certificates based on questionnaires to the 18 project partners from the participating 9 European countries – Sweden, Finland, Estonia, Latvia, Lithuania, Belarus, Poland, Germany and Denmark.

Surveys about technical solutions of energy efficiency improvements
With focus on specific technical issues, the following surveys were conducted in 2013:

- "Examples of Measures to improve the thermal envelope of brick Buildings", Denmark.
- "Shading Systems", Minsk, Belarus.
- "Ventilation", Tallinn, Estonia.
- "Heating Systems", Kiel, Germany.
- "Technical devices for energy saving", Malmö, Sweden.

Guidelines and Recommendations

- "Energy conservation in cultural heritage brick/stone buildings. Recommendations", Tartu, Estonia.
- 10 steps for sustainable energy refurbishment in historical buildings (guideline for owners), Tallinn, Estonia.
- Recommendations for sustainable rehabilitation of historical buildings (for service providers), Tallinn, Estonia.

6.3 Educational material

"Handbook of Energy Consumption in Historical Buildings – Training material for specialists: planners, engineers, architects", Riga, Latvia (2013)
Riga Technical University prepared a handbook, tested and adjusted it in a three-day training course. Participants of this training represented several target groups, from architects and consultants to craftsmen.

"Bricks and Brick buildings – History, Weaknesses and Potentials", Hamburg, Germany (2013)
This was a one-day training course in the framework of the "Consultant for Brick Facades" further education programme organised by the Hamburg Chamber of Architects. The training programme was already practically proofed two times in 2012 and 2013.

Guideline "Training and education of craftsmen within the energy-saving refurbishment of historical buildings"
The guideline proposes and describes learning packages addressing professionals at several levels of planning, supervision and construction work and might be suitable for different target groups. This selection of topics and learning contents covers the most crucial issues.

A Guideline for housing companies and property owners how to assign the best suitable craftsmen for the energy saving refurbishment of historic building
In order to promote the learning packages presented in the Guideline "Training and education of craftsmen within the energy-saving refurbishment of historical buildings" there are certain steps that need to be taken towards creating demand for them in the construction industry. This report will describe how such demand can be generated.

Certification scheme for craftsmen
This report will give examples for the learning contents of vocational education and training as well as the advanced education of craftsmen. To launch a certification scheme a catalogue of criteria of knowledge, skills, and experience is needed that professionals respectively craftsmen have to fulfil before they are allowed to work on historic buildings.

Lecture material for architects, planners, energy auditors and specialised craftsmen

Within the Co_2olBricks project a number of materials were developed with the purpose of supporting the preparation of specific lectures for architects, planners, energy auditors and specialised craftsmen:

General lectures

- Introduction to Cultural Heritage
- Historic Brickwork
- The history of brick masonry constructions in the Baltic Sea Region
- Damages of historic masonry
- Refurbishment measures of historic masonry construction
- Analysis of weak points
- Calculation of thermal conductivity and moisture regimes in historical buildings
- Lifecycle analysis of a building
- Innovative heating systems and their usage in historic buildings
- Management stages of construction projects, planning of the refurbishment process
- Public procurement in the construction market
- Evaluation of rationality of investment
- Analysis of the Lithuanian construction market
- Construction ware and products used for renewal of historical buildings
- Usage of local construction material in Lithuania
- Requirements for building energy efficiency in Lithuania
- Energy Saving in Buildings – a question of behaviour

Technical lectures

- Post-insulation of sloped ceilings
- Internal post-insulation of outer walls
- Post insulation of cellar ceiling and cellar walls
- Radiant heating, convection heating systems, wall tempering
- Improving heat production/boiler
- Heat pumps
- Ventilation system
- Improving building air tightness
- Electrical components
- Shading the windows
- New windows, energy efficient secondary glazing on windows

6.4 Further Publications and Information

"Collection of international guidelines, studies and publications"
This is a collection of international guidelines, studies and other useful publications of how to deal with energy efficiency issues in historic buildings that can be downloaded in the "Knowledge Base" area of the Co_2olBricks website.

"Merge of relevant results of several similar projects and networks"
The aim of this paper is to give a brief overview about other projects and networks dealing with similar issues. Although the main focus of these projects is different from Co_2olBricks there are some results useful for the work of the Project Partners but also interesting for stakeholders working in the field of heritage preservation and climate protection.

"Seminar report on Policy development"
Report "Varsam energieffektivisering" from seminar with governmental authorities responsible within energy, building and heritage sector raising issues from research and Co_2olBricks baseline study of Work Package 3, discussing policy development. Report was compiled by Swedish National Heritage Board.

7 Glossary

Conservation – is defined in the European Norm EN 15898 as "measures and actions aimed at safeguarding cultural heritage while respecting its significance, including its accessibility to present and future generations", UNI EN 15898:2012, 3.3.1

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

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

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.

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.

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.

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.

Protected building – in the sense of this publication is a building which can only be changed with the approval of the conservator and/or the relevant authority.

Rehabilitation – is defined in the European Norm EN 15898 as "interventions on an immovable object in order to recover an inferred earlier functionality, to adapt it to a different function or to standards of comfort, safety and access". UNI EN 15898:2012, 3.5.8.

Photographs

The pictures in Chapter 5 on page 57 et sqq. are taken by Jan Prahm, Daniela Scherz, Jelena Dulneva, Therese Sonehag, Denkmalschutzamt Hamburg, Stockholm Museum and Republican Centre for Technology Transfer (RCTT).

Imprint

Editor:

Co_2olBricks – Climate Change, Cultural Heritage and Energy Efficient Monuments | www.co2olbricks.eu

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

This report should be referenced to as follows:

Co_2olBricks —Energy Refurbishment of Historic Buildings in the Baltic Sea Region – Final Report

Authors:

Co_2olBricks Project Partners, Therese Sonehag, Dr. Daniela Scherz, Jurgis Zagorskas, Jan Prahm, Dirk Humfeldt

Compiled by Leadpartner, Dirk Humfeldt, Department for Heritage Preservation Hamburg

Typeset + Layout:

farbton Kommunikation | K.-P. Staudinger · J. Steil, Hamburg | www.farbton.de

November 2013

Baltic Sea Region
Programme 2007–2013

Part-financed by the European Union
(European Regional Development Fund
and European Neighbourhood and
Partnership Instrument)

CONTRIBUTING TO A FLAGSHIP PROJECT OF THE STRATEGY

Brochure 08 — Final Report

ISBN: 978-3-9815446-7-1

Co_2olBricks