



## Summary of project context and objectives

### THE CHALLENGE

Historic buildings are the hallmark of numerous European cities, towns and villages: historic quarters give uniqueness to our cities, they are a **living symbol of Europe's rich cultural heritage** and reflect society's identity.

However, it is clear that these buildings are not energy efficient and are substantial contributors to greenhouse gas (GHG) emissions and rising energy bills. At a time when **climate change** poses a real and urgent threat to humanity and its infrastructure, it is vital to initiate an improved approach to the refurbishment of historic buildings, which in many cases are in danger themselves.

### PROJECT OBJECTIVES

The project **3ENCULT bridges the gap** between conservation of historic buildings and climate protection, which is not an antagonism at all: Historic buildings will only survive if maintained as living space. Energy efficient retrofit is useful for structural protection as well as for comfort reasons – comfort for users and “comfort” for heritage collections.

3ENCULT will demonstrate the feasibility of “**Factor 4**” to “**Factor 10**” reduction in energy demand, depending on the case and the heritage value.

### METHODOLOGY

The joint task of conservation and energy efficient retrofit is highly **interdisciplinary**. The 3ENCULT partnership thus includes conservation, technical and urban development experts, industry partners, implementation experts and stakeholder associations. Furthermore, **Local Case Study Teams** bring together those individuals with hands on experience: building owners, architects and local offices for the protection of monuments.

Starting in WP2 with an analysis of the challenge and the needs for comprehensive **diagnosis**, WP3 and WP4 will investigate **technical solutions** for the energy enhancement as well as **smart monitoring and control**. WP5 will allow the **demonstration** of the developed solutions, while **eight case studies** in WP6 will give (i) stimulus for the solution development and (ii) successively feedback. WP7 gathers the development of **design tools**, quality assurance as well as contributions to **standards** and knowledge transfer. WP8 is focused on the dissemination of results to a wide range of stakeholders.

### EXPECTED RESULTS

Based on the developed solutions and proposed approach 3ENCULT will provide

- a **handbook** with design guidelines and a pool of technical solutions for planners
- new or enhanced **products** (interior insulation, windows, lighting, ventilation and solar integration but also wireless monitoring and BMS)
- university & professional **training**
- guides for & involvement of **local governments**
- position papers & support for **standards** development (EPBD, CEN TC346)

Channels for dissemination are apart the website ([www.3encult.eu](http://www.3encult.eu) with FAQ platform and e-Newsletter), the presentation at conferences & fairs and publications in journals, organisation of workshops and study tours and a video news release.



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## Work performed since beginning of the project and the main results achieved so far

Within this first year of the project (total duration 10/2010 to 03/2014) a common understanding among disciplines has been established: conservation parties have formulated expectations and constraints, engineers have presented existing solutions, further development need has been defined in interdisciplinary discussion and coordinated with activities at the case studies.

Development of active and passive energy efficiency solution has been started, as also of smart monitoring and management systems. At the case studies the period was characterised by intensive diagnosis of the status pre-intervention, installation of the monitoring systems as well as calculation and simulation of the energy demand. To this aim an updated version of PHPP has been developed, experiences from the case studies in applying the tool will help to further enhance it.

All public information and deliverables are published on the project website ([www.3encult.eu](http://www.3encult.eu)) which reflects the progress and results of the project, including for easy update the news carousel on the main page as well as all a dedicated section with all news as well as the newsletter.

Specifically the following activities and achievements are pointed out:

- From the conservation side a **demand analysis and historic building classification** covering the different aspects of demand (conservation, comfort and economics), describing the preservation criteria and presenting a task-oriented classification system has been presented to partners and is publicly available for download at the project website
- From the engineering side a comprehensive report on the **state of the art of energy efficiency solutions** for historic buildings has been prepared and is publicly available for download on the website.
- In cooperation of WP2 and WP3 a draft version of the position paper on criteria for the **assessment of energy efficiency measures regarding their compatibility with conservation** issues was presented and discussed at the “**multidisciplinary workshop** on the challenge to be solved” (March 2011, whole consortium) and is after inclusion of the results available to the consortium for application and test within the project.

As regards the active and passive energy efficiency solutions on a number of the defined research and development themes considerable steps forward have already been reached:

- New filling mortar formulations for **interior insulation** have been developed by REMMERS and tested by TUD and first prototypes of foamglas and aerogel panels for internal insulation developed and tested by REMMERS.
- A device for **airtightness** measurements at **beam ends** has been prepared at PHI and measurements for the different solutions can start soon. A 3D-model for **hygro-thermal transport** phenomena for moisture transport problems at beam ends based on COMSOL Multiphysics was set up and validated as published by UIBK.

### AT A GLANCE

**Title:**  
Efficient ENergy for EU Cultural Heritage

**Instrument:**  
FP7, Collaborative Project

**Total Cost:** 6,643,959.20

**EC Contribution:** 4,990,475.00

**Duration:** 42 months

**Start Date:** October 1<sup>st</sup>, 2010

**Consortium:**  
22 partners from 10 countries

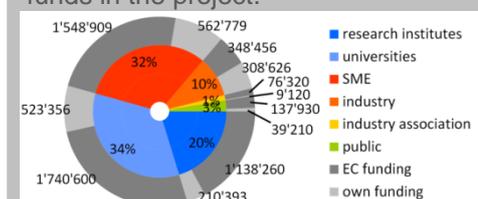
**Project Coordinator:**  
Alexandra Troi from EURAC

**Project Web Site:** [www.3encult.eu](http://www.3encult.eu)

**Key Words:** historic building, energy efficiency, urban development, factor 10, active & passive heating and cooling, RES, lighting, integrated monitoring and control, IEQ, simulation, EPBD

#### SME & industry relevance:

40% of EU funding goes to SMEs, industry and industry associations, while there again those partners invest nearly 0.9 million € of own funds in the project.



- A **casement** and a **coupled window**, designed for listed historic buildings, were developed by ANDRE and proven with thermal-flow calculations by PHI. The first prototype was shown and discussed with partners at the **workshop** on windows in August 2011 in Bolzano.
- A **workshop** about **daylight** and **artificial light** performed at BLL gave a good overview of the needs of historic buildings based on case studies' experiences. Work on customizing some **LED** products by GELBISON. Furthermore BLL in close collaboration with UIBK and ARUP is investigating integrated shading and/or daylight redirection devices.
- Draft "**Guideline on Wall Integration of Ventilation Systems**" available to project consortium
- A first **wireless sensor network (WSN)** has been installed in CS3 "Palazzina della Viola", Bologna; based on the experiences sensors drivers were developed, standalone data logger mote device firmware released and WSN radio protocol and stack framework defined.
- Architecture, specification and software environment for the **Building Management systems (BMS)** have been defined, suitable existing hardware, to implement the middleware, the interfaces, the external connections, the data bases has been selected and controlling algorithms, HVAC, lighting, RE integration & energy quantification services developed. Link with CS4 in Copenhagen for possible implementation, other CSs possible.
- Coordination and **crosslink of research, development and implementation** at case studies was strengthened at a dedicated **Workshop** (30<sup>th</sup> of September 2011, whole consortium), the **questionnaire** about "Renewable Energy Systems Integration in Cultural Heritage Buildings" for the Case Studies supports establishment of links.

For the case studies a variety of activities were brought forward:

- **Diagnosis of pre-intervention status** at case studies covered a wide range of techniques as e.g. geometric and dimensional survey integration, window frames survey, crack pattern survey, IR thermography, radar, U-value measurements, Blower Door, daylight and artificial light measurement, tracer gas measurement for night ventilation. Partners referred to this aim also to the draft report on **methodology and checklist for a comprehensive diagnosis** of historic buildings, including not only a review of pertinent international documents agreements and charta but also a chapter dedicated to NDT methods.
- **Energy demand** before intervention was **calculated** with an version of PHPP updated for the project in order to cover refurbishment issues. To this aim training and support provided by PHI, experiences with the tool are fed back to PHI. In parallel PHI is elaborating "**Certification criteria and procedures**", for which a draft to be tested on case studies is available.
- **Monitoring systems** have been installed in most case studies (Copenhagen to be concluded by the end of 2011) taking into account the guideline provided by WP4 and the specific needs (and research questions) of the single case studies.

Also in terms of dissemination and implementation the consortium has been working actively:

- TNO has outlined the on the relation between historic buildings, the EPBD and the most important EPBD CEN Standards, publicly available for download at the website. EURAC is bringing forward the link to an initiative investigating a possible specific standard on energy efficiency in historic buildings.
- The project **website** for 3ENCULT was published on 27<sup>th</sup> of December 2010 with the address [www.3encult.eu](http://www.3encult.eu) and includes news section as well as the possibility to subscribe for the **newsletter** (online September 2011). The newsletter was sent in November 2011 and is available also for download in a dedicated archive.
- First scenes for the **Video News Release** were taken at three case studies
- ICLEI has **announced** the organisation of the **workshops** for local governments and the **study tours** in the news section of the website. Interested people can subscribe, in order to be informed. The first study tour will take place presumable June 2012 in Copenhagen.
- The project and first research results have been presented at **four scientific conferences** with publication of **seven related papers** in proceedings – most of them available for download on the website. Furthermore the project was presented with a poster and leaflets at **four fairs and similar public presentations/events**

## Expected final results and their potential impact and use

### EXPECTED RESULTS

3ENCULT will demonstrate the feasibility of “Factor 4” to “Factor 10” reduction in energy demand, depending on the case and the heritage value.

3ENCULT will develop necessary solutions, both **adapting existing** solutions to the specific issues of historic buildings and **developing new** solutions and products – the latter specifically include (i) **high performance** capillary active **internal insulation**, (ii) a new heritage compatible highly efficient **window**, (iii) a **wall integrated ventilation** and heat recovery system, (iv) low impact **solar solutions** and (v) high efficiency **lighting** solutions.

A **handbook with design guidelines for planners**, together with the online available virtual library for solutions will allow for widespread dissemination of best practice examples, the developed solutions and the **postulated multidisciplinary approach**. The proposed range of solutions is therefore completed with guiding a **comprehensive diagnosis** and **integrated monitoring and control** concepts, including integration of energy issues with “comfort” – for people and cultural heritage – but also WSN and BMS.

**Training** material is elaborated and disseminated for both **university** and **professional** education. **Local governments** and end users are involved in **workshops** and **guided tours** and the general interested **public** is targeted with an attractive and informative **website** and last but not least the **VNR**.

### EXPECTED IMPACT

#### 3ENCULT triggers significant energy saving in historic buildings

The project builds upon experience and solutions based on already market available products further developing them for the use in historic buildings. The demand side is fostered with ICLEI, involving a network of engaged municipalities, the supply side is prepared addressing REHVA’s associated enterprises and construction sector.

#### 3ENCULT leads to substantial CO<sub>2</sub> reduction

In the European Union 14% of buildings were constructed before 1919, 26% before 1945. Although only a certain amount of these buildings are protected (listed), they have historical significance and should still be treated with care. By reducing the buildings’ energy demand (~1’400 TWh) by Factor 4 (i.e. 75%), more than 180 Mt of CO<sub>2</sub> could be saved (3.6% of EU-27 emissions in 1990).

#### 3ENCULT improves living conditions within historic urban areas

Energy savings achieved with retrofit measures to improve indoor comfort for the occupants (perceived temperature, avoided air draught, daylight ...) and reduce energy bills.

#### 3ENCULT leads to improved quality management of historic cities

ICLEI works with committed local governments (Cities for Climate Protection – CCP campaign) on replicable factors to be fed back to the Leipzig charter process. Furthermore the project helps implement the EU Environmental Impact Assessment Directives when applied to historic buildings, introducing energy issues and more detailed standard references and thresholds in a well framed methodological approach (SUIT).

#### 3ENCULT fosters sustainable renovation and long term conservation of our built heritage

As the FACH vision highlights, real protection of Cultural Heritage can be achieved by its integration in everyday life. Similar to that within the EU project SUIT the concept of “active conservation” was introduced, which has an enlarged and more complex view of urban built heritage conservation problems. Comprehensive diagnosis guarantees sustainable conservation and the selection of compatible (or even beneficial) measures.

#### 3ENCULT contributes to Europe’s Economic Recovery

The project triggers “smart investment” as formulated in the European Recovery Plan in relation by both supporting the implementation of “energy efficient systems and material in [...] renovated buildings to reduce radically their energy consumption and CO<sub>2</sub> emissions (Action 9)” and setting demanding targets (Action 6)”. On the one hand side, demonstration and guidelines, how to use existing products and materials will address a large number of construction enterprises across Europe. On the other hand side with innovative European enterprises very specific solutions are developed