3encult

EFFICIENT ENERGY FOR EU CULTURAL HERITAGE

D2.4 Position paper EIA method

The 3ENCULT methodology – FINAL

EUROPEAN COMMISSION

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SEVENTH FRAMEWORK PROGRAMME

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Project Coordinator	Alexandra Troi EURAC research, Viale Druso 1, 39100 Bolzano/Italy Alexandra.troi@eurac.edu
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Author(s)	Torben Dahl (KA), Christoffer Pilgaard (KA), Ola Wedebrunn (KA)
Co-author(s)	-
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1 Abstract

This position paper on EIA method discusses Environmental Assessments and presents the 3ENCULT methodology to ensure a process, which incorporates cultural and architectural considerations and argumentations along with technical, social, economical and functional parameters, when decisions are taken for energy saving interventions in built heritage.

Starting with Environmental Assessment methods this deliverable implements principles from EIA on historical buildings' energy retrofit. Thus the 3ENCULT method is a practical guideline to assess and balance energy and culture of built heritage.

The method is developed to be operative and comparable. It is based on inquiries, experiences and existing methodologies. It refers to standards and norms as well as to directives and conventions, and it relates to and utilizes existing methods and processes. The 3ENCULT method is a practical scheme to support and guide the assessment process.

The method is developed to support a process to survey, assess and guide decision-making to meet the requirements for energy retrofit of built heritage. Its target is to support and coordinate the argumentation for the process, and to establish comparable references and a shared language when it comes to argue for the balance of energy and culture.

The 3ENCULT method minimises the negative impacts on cultural values here and now. At the same time it maximises the value of the historic building in a long-term perspective.

2 Introduction

Environmental assessment is a procedure developed to ensure that environmental implications are taken into account before the decisions are made. Deliverable 2.4 is a position paper on EIA method. It is an investigation into the applicability of EIA method on historic buildings' energy retrofit based on experiences from the LCS teams as described in Task 2.3, Evaluation of impact analysis approaches.

"Starting from the SUIT project's experiences with the application of Environmental Impact Assessment directive (EIA - Council Directive 85/337/EEC) as well as the Strategic Environmental Assessment directive (SEA - Directive 2001/42/EC) in the context of cultural heritage within, integrating it with the building energy issue and elaborating respective standards and thresholds, an enhanced methodology will be prepared for application and testing in WP6 case studies (where applicable, considering the different time schedule of the latter). The evaluation will be based on experiences of the Local Case Study teams, involving public authorities, conservation institutions and other stakeholders. This is well in line with the Århus Convention of public participation and the SUIT proposal of advisory panels for active conservation and monitoring. Inputs from each case study contributor about demands and praxis for energy use, renovation and conservation will be submitted and analyzed as source to make an argumentation for a methodology. The argumentation will have a broad target of technical, aesthetic as well social defined facts, with reference to possible scientific processes and terms of references to be defined and requested from the case study contributors. The aim of the evaluation is to develop a methodology that addresses different approach to conservation policies as well as policies of energy consumption and the means it takes to meet urban sustainability concepts such as the Aalborg Charter and Aalborg Commitments on Sustainable European Cities. The there defined Local Case Study teams, involving public authorities, conservation institutions and other stakeholders seam to be well in line with the SUIT proposal of advisory panels for active conservation and monitoring." (3ENCULT, Annex 1, Description of work, p 9).

The experiences from the SUIT and EIA methods have been used to gather information of experiences done by LCS teams up to M18. The information from the LCS teams is the result of a questionnaire based on an EIA method following EC directives as suggested by the research report of the SUIT project. The answers from LCS teams confirm the need for a methodology on how processes can take place, from the early initiative and formulation of the programme, through involvement of experts and public participation processes to the final product and its anchoring in daily use. It is obvious that a project which includes major interventions in historic buildings in urban areas will lead to a broader involvement of actors and the public and will have impact on the cultural environment as well as the exact energy consumption.

It has been important for Deliverable 2.4 of 3ENCULT to elaborate on existing methods on environment impact assessment, not merely for listed building's energy retrofit, but as an assessment method in general for refurbishment projects which includes built heritage aspects. In the perspective of Cultural Assessment the case may unfold possible further impact, as a statement of balance and as integration and production of values as a consequence of bridging energy and culture.

3 Environmental Assessment

Part of the objective of D2.4 (Task 2.3) is to analyse existing environmental assessment methods and procedures such as EIA, SEA and SUIT in order to evaluate their relevance and applicability towards energy retrofit projects in historic buildings.

Obviously these existing assessment methods could involve a risk of “over inclusion” or “over kill” for a single energy retrofit project, as the methods normally are used for i.e. large public infrastructure projects or environmental project. So in the end the objective is to develop a methodology, which is suited for facilitating the processes and problems connected to projects in the majority of European built heritage in urban areas.

In these cases the main objective is to ‘bridge the gab between conservation of historic buildings and climate protection’. Therefore the assessment of cultural values and energy conservation is important in the process of refurbishment of built heritage.

3.1 EIA / SEA / SUIT

Environmental Impact Assessment, **EIA**, and Strategic Environmental Assessment, **SEA**, are world wide used assessment procedures and as such sources for European directives with concern for environmental policy. Whereas the SEA directive addresses plans and programs, the EIA directive addresses industrial and infrastructural projects, and SUIT addresses urban historical areas, there is at present no specific assessment procedure related to historic buildings, cultural heritage and energy retrofit.

Below are the overall assessments systems briefly described in order to see their relevance for the evaluation of single listed buildings, represented by the case studies in 3ENCULT.

3.1.1 EIA

The Council Directive 85/337/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment, as amended, known as the "EIA" (environmental impact assessment) Directive, requires that an environmental assessment to be carried out by the competent national authority for certain projects which are likely to have significant effects on the environment by virtue, inter alia, of their nature, size or location, before development consent is given. The projects may be proposed by a public or private person.

An **assessment is obligatory** for projects listed in **Annex I** of the Directive, which are considered as having significant effects on the environment. These projects include for example: long-distance railway lines, airports with a basic runaway length of 2 100 m or more, motorways, express roads, roads of four lanes or more (of at least 10 km), waste disposal installations for hazardous waste, waste disposal installations for non hazardous waste (with a capacity of more then 100 tonnes per day), waste water treatment plants (with a capacity exceeding 150 000 population equivalent).

Other projects, listed in **Annex II** of the Directive, are not automatically assessed: Member States can decide to subject them to an environmental impact assessment on a case-by-case basis or according to thresholds or criteria (for example size), location (sensitive ecological areas in particular) and potential impact (surface affected, duration). The process of determining whether an environmental impact assessment is required for a project listed in Annex II is called screening. This particularly concerns for example the following projects: construction of railways and roads not included in Annex I, waste disposal installations and water treatment plants not including in Annex I, urban development projects, inland waterways, canalization and flood-relief works, changes or extensions of Annex I and II projects that may have adverse environmental effects2.

3.1.2 SEA

Strategic Environmental Assessment directive (SEA - 2001/42/EC).

The objective of this Directive is to provide for a high level of protection of the environment and to contribute to the integration of environmental considerations into the preparation and adoption of plans and programmes with a view to promoting sustainable development, by ensuring that, in accordance with this Directive, an environmental assessment is carried out of certain plans and programmes which are likely to have significant effects on the environment.

3.1.3 SUIT

The main objective of the **SUIT** project, (Sustainable development of Urban historical areas for an active Integration within Towns) of the EU 5th framework programme has been to promote the use of Environmental Impact Assessment and Strategic Environmental Assessment procedures as a way to foster a long-term active conservation of urban fragments.

Conservation of urban heritage requires a different approach to the one used for monumental built heritage. Conservation and changes in urban historical areas have to take the living city, the flow and life of its population, its infrastructure and its socioeconomic development into consideration, which means involving third parties such as members of the wider public and special interest groups.

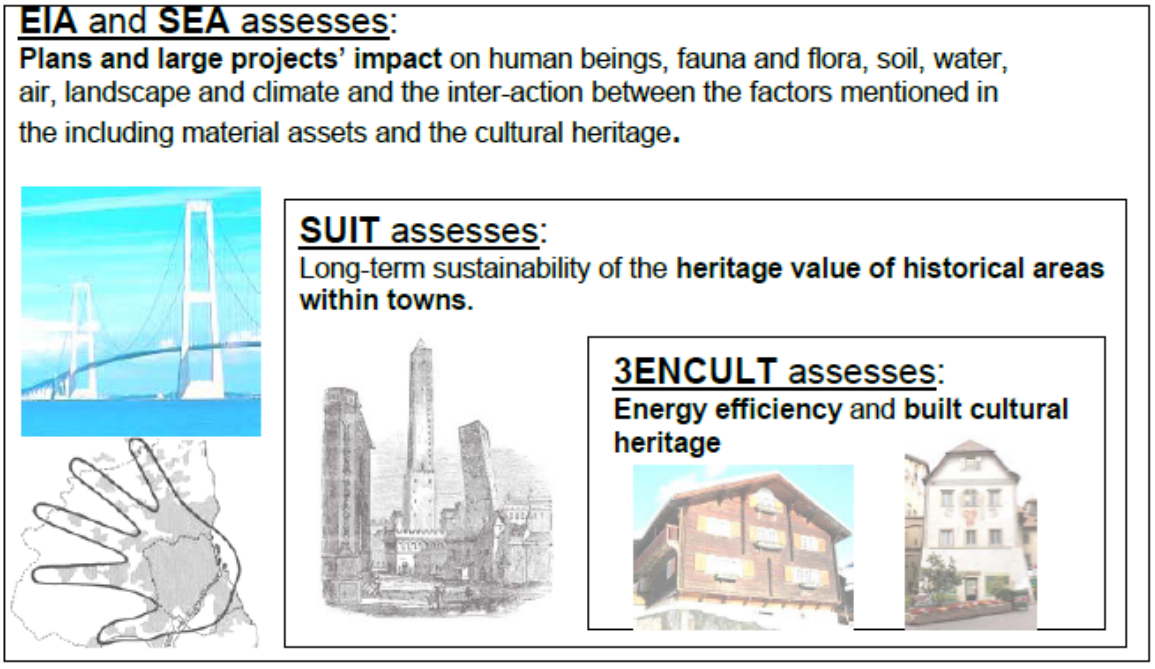

Figure 1. Scale relation between EIA/SEA, SUIT and 3ENCULT Assessments

3.1.4 Discussion

SEA, EIA and SUIT can be seen as frameworks and guidelines for plans, programmes and projects on a higher planning level and more comprehensive than the energy retrofit of a single listed building and its surroundings. Furthermore - despite the environmental focus in these assessment methods - there is no special focus on energy efficiency in supply and consumption, which is the main focus area of the 3ENCULT project.

It is on the other hand obvious that principles and procedures from i.e. EIA and SUIT can successfully be transferred or modified to enrich the development of a methodology for improving the energy efficiency of historic buildings. This is particularly evident in the description of the different stages of an EA found in the final report for the SUIT project:

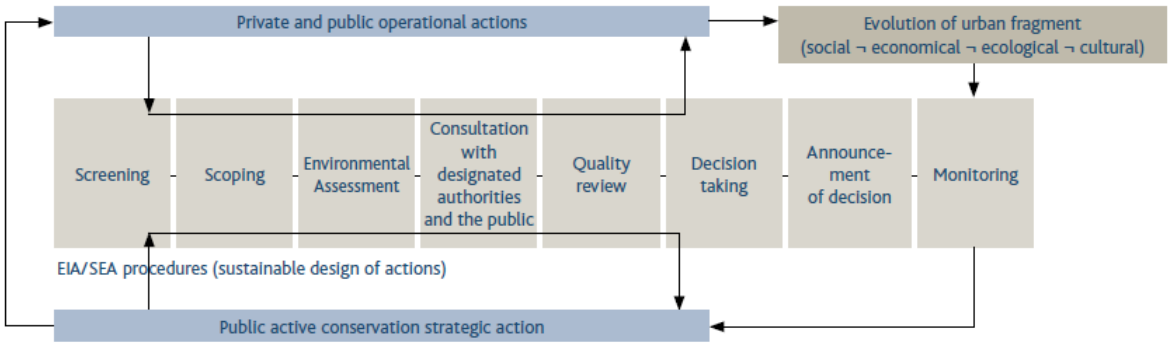

Figure 2. EIA and SEA Procedures

This procedure involves the following actions and stages during an EA:

Firstly, a proposal for a **project is prepared** or a proposal for **a plan or programme is prepared.** During the **Screening** stage, which is a quick stage, the Competent Authority determines the need for submitting the proposal to a complete EA. The **Scoping** stage is aimed at establishing the programme for the environmental assessment. The **Environmental Report** is prepared by the designated environmental experts. **Consultations** are then usually organised with designated authorities and the public, on the basis of the Environmental Report. During the **Decision-taking** stage, the Competent Authority takes the final decision about the proposed plan, programme or project. The final **decision is announced** by the Competent Authority. The **Monitoring** and post-evaluation stage is a long-term stage during which the actual effects of the plan, programme or project are monitored.

This process have been subject to an inquiry among the 3ENCULT case study responsible teams, and - as mentioned earlier – there are procedures and stages in this process worthy of being transferred to a specific process for energy retrofit in historic buildings.

The objectives of **3ENCULT**, WP2, D2.4 are to pursue and develop the argumentation for application of an enhanced methodology on historic buildings.

3.2 Charters, Commitments and Conventions

The assessment methods EIA, SEA and SUIT are international methods developed with due respect to overall international agreements dealing with conservation of built environment. Relevant agreements concerning energy and refurbishment are *Aalborg Charter & Commitments* – setting up principles for development of European Cities and Towns Towards Sustainability – and *Aarhus Convention* - Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters.

3.3 Energy Directives and Tools

The overall aim of 3ENCULT is ‘bridging the gab between conservation of historic buildings and climate protection’, which implies not only assessment of cultural and architectural values but also the assessment of energy supply, production and consumption.

Both new and historic buildings are guided by the European Directive 2010/31/EU on the energy performance of Buildings (EPBD). According to EPBD every member state or region is obliged to apply a calculation methodology for energy simulation.
During the 3ENCULT project the Passive House Planning Package (PHPP) has been developed to be used as a tool for calculation and certification of refurbishment projects and will be specifically adapted for the requirements of historic buildings, but the national or regional applied calculation methodology can substitute the use of PHPP. (EPBD, Article 3).

4 The 3ENCULT Methodology

Through the EU research project 3ENCULT a methodology based on EIA, environmental impact assessment, is developed, based on the experiences of the eight case studies of 3ENCULT. Buildings which in a broad sense represent qualities of European built heritage. The case studies are situated in urban areas and in the countryside, in cold and warm climates, in humid lowlands and in dry mountain areas.

The aim of the methodology is to provide an approach and a process that makes it possible to identify and integrate values of culture and energy in conservation works of built heritage. It addresses the social and political environment of decision-making. Thus the methodology becomes an instrument that identifies interests of stakeholders, involves public participation, and supports the process of decision-making.

Throughout the survey, the assessment process and the decision-making the 3ENCULT methodology is a guiding methodology that identifies and balances culture and energy values, referring to cultural charters and conventions as well as to energy standards and directives. Through the 3ENCULT methodology, the survey and the assessment is processed to match local and even universal values of the environment. The identified values are integrated in scenarios and setups to support the democratic process, public hearings and decision-making. Scenarios will include passive and active energy retrofit solutions and evaluated in multidisciplinary decision forum.

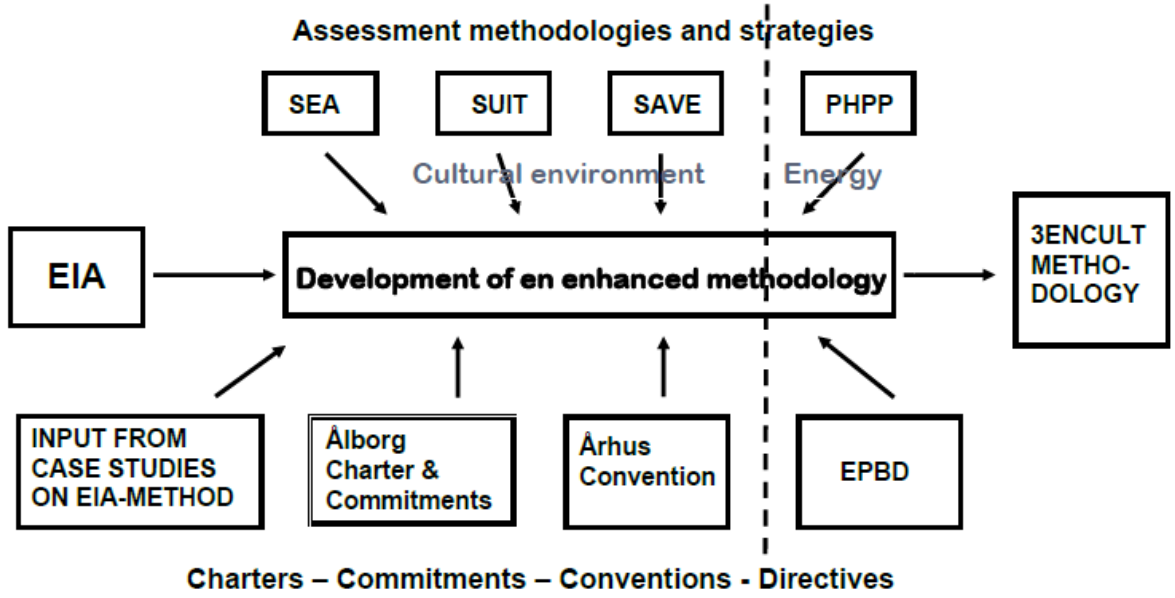

Figure 3. Methods and guidelines for the development of an ENHANCED METHODOLOGY based on an application of EIA method on historic buildings' energy retrofit.

As the developed 3ENCULT methodology of EIA is implemented on the eight case studies, energy and culture is surveyed, assessed and balanced as effect of impact on the environment. Thus the implementation of the 3ENCULT methodology is tested to become a generic tool for a process that includes energy and culture in environmental impact assessment.

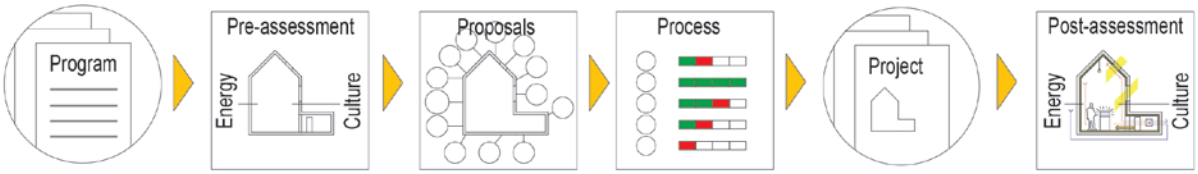

Figure 4. The 3ENCULT methodology not only pay attention to the balance of energy and culture, it is also an active source to assess impact on the environment. It supports decision making and direct attention to qualities of heritage and sustainability.

4.1 Programme

The building owner or client will normally have a concept for interventions in a historic building. This concept will in an elaborated form make the basis for developing a building programme, which is a coordinated encapsulation of the wishes and demands of the owner for the building project.

In a 3ENCULT context this programme will include goals for decreasing the energy consumption of the building as well as demands for conservation of essential cultural and architectural values.

4.2 Pre-assessment of Energy and Culture

A precondition for evaluating the possibilities for appropriate interventions is a careful and comprehensive assessment of existing energy conditions and consumption as well as a thorough assessment of existing heritage conditions, including environmental, historical and architectural values.

4.2.1 Energy Assessment

In principle the energy assessment can be done both pre and post intervention as actually measured and as simulated consumption.

3ENCULT has set up plans for developing tools and methodologies for both measuring/monitoring and for calculation/simulation with a special focus on retrofitting of historic or listed buildings.

On the overall level both new and historic buildings are guided by the European Directive 2010/31/EU on the energy performance of Buildings (EPBD), which in Article 3 states:

"*Member States shall apply a methodology for calculating the energy performance of buildings in accordance with the common general framework set out in Annex I.*
This methodology shall be adopted at national or regional level."
In Article 4.1 the minimum energy performance requirements are set:
"Member States shall take the necessary measures to ensure that minimum energy performance requirements for buildings or building units are set with a view to achieving cost-optimal levels. The energy performance shall be calculated in accordance with the methodology referred to in Article 3. Cost-optimal levels shall be calculated in accordance with the comparative methodology framework referred to in Article 5 once the framework is in place.

In Article 4.3 the special conditions for listed buildings:
Member States may decide not to set or apply the requirements referred to in paragraph 1 to the following categories of buildings:

(a) buildings officially protected as part of a designated environment or because of their special architectural or historical merit, in so far as compliance with certain minimum energy performance requirements would unacceptably alter their character or appearance;

This means two relevant conditions for a 3ENCULT methodology:

- Every member state or region is obliged to apply a calculation methodology for energy simulation.
- Energy refurbishment of listed buildings is negotiable, so that the 3ENCULT intention to bridge the gab between conservation of historic buildings and climate protection can depend on the quality of argumentation and documentation in negotiations between authority and building owner(s representatives), which emphasizes the importance of the results from the 3ENCULT project.

4.2.1.1 Calculation/Simulation

PHPP will during 3ENCULT be developed to be used as a tool for calculation and certification of refurbishment projects and will be specially adapted for the requirements of historic buildings.

The adapted PHPP for historic buildings can provide pre and post intervention simulations and calculations for energy retrofit of historic or listed buildings.

The national or regional applied calculation methodology can substitute the use of PHPP. (EPBD, Article 3)

For further information see Work Package Description and deliverables from 3ENCULT, WP7 Design Tools & Quality Assurance.

4.2.1.2 Monitoring

In 3ENCULT the development of the monitoring concept has the overall objective to produce low-cost passive and active monitoring and control systems for diagnosis, management and assessment of the building-plant system optimising the energy demand and user comfort.

Among several other parameters monitoring can provide actual pre and post intervention energy consumption data.

For further information see Work Package Description and deliverables from 3ENCULT, WP4 Monitoring and Control.

4.2.2 Cultural Assessment

It is important that the cultural assessment process concentrate on identification of essential conservation values for a single building land in urban context, thus opening possibilities and space for interventions without harming these values.

Within the 3ENCULT context – historic buildings in urban areas – the national assessment methods for cultural and architectural values should be applied.

4.2.2.1 Urban Context

The Danish registration and evaluation system called SAVE (Survey of Architectural Values in the Environment) method has been an important tool as a basis for designation of landmark buildings and urban environments in Denmark.
SAVE is basically addressing a total registration of the built environment in a municipality for the purpose to produce a preservation atlas for the municipality.
But it could as well be applied for registration and survey of a group of buildings or a single building and its surroundings.
The description comes in most parts from the booklet "InterSAVE" by the Danish Ministry of Environment and Energy. Further information can be found at:
http://www.kulturstyrelsen.dk/fileadmin/user_upload/kulturarv/publikationer/emneopdelt/kommuner/Kulturarvstyrelsen_SAVE_print.pdf
http://www.sns.dk/byer-byg/Netpub/INTRSAVE/TEKST/CONTENTS.HTM

The initial drive for developing the system was the signing in 1985 of the Granada Convention where the term "architectural heritage" was defined more widely than before, especially as "Groups of buildings". The convention imposed the signatories to maintain inventories and prepare appropriate documentation for the purpose of precise identification of the monuments, groups of buildings and sites to be protected.

SAVE Process

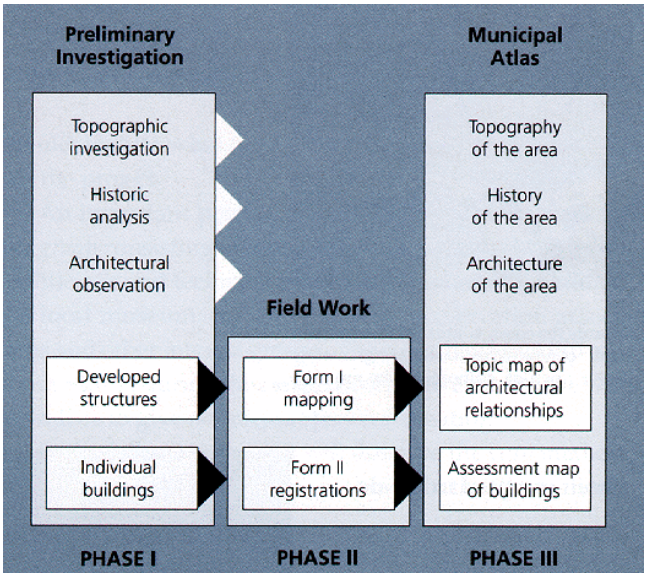

Figure 5. Outline of the phases in SAVE

The whole process is divided into 3 phases to be carried out in three times three months. For a single building or building complex it could be carried out in a few weeks.
An important point is setting up of a local consultative group consisting of representatives of the local authority (politicians and technical employees), the central authority, the local museum, the local archive, preservation associations and other interest groups. The consultative group should be informed and consulted before and during the project in order to evaluate the work as well as to give supplementary information.

Phase I, Preliminary investigation
In this phase the consultant collects and adapts available information on the topographical, historical and architectural characteristics of the area. He also carries out some preliminary registrations in order to verify the general information collected. This information is presented in a report under the headings corresponding to the headings in the final report. An important element is a tentative list of the developed structures described in the following phase. The report is presented to the local group for final approval as a programme for the following process and as a tool for further work for the consultant.

Phase II. The field work
In this Phase the architectural features are described in two different ways: 1) Developed structures and 2) Individual buildings. For both there is a form with blanks to be filled out.

Developed structures
Developed structures are coherent entities (townscapes) and are evaluated as such. They can comprise anything from a few buildings to entire streets, squares, districts and even whole towns. Developed structures are divided into 3 categories: a) Dominant architectural features, b) Building patterns and c) Selected urban elements.

Individual buildings
Individual Buildings are identified by existing national identification systems. Basic information such as age, materials, number of storeys and square meters as well as a more detailed description is given in a number of blanks with room for code indication. The most important part of the description form is the evaluation, which is composed of 5 different assessments:
• Architectural value (proportions, harmony of the composition, outstanding work of a certain architect)
• Cultural-historical value (evidence of social functions, evidence of evolution in craftsmanship or technology)
• Environmental value (degree of harmony with the environment)
• Originality (degree of original exterior preserved, possibility of rehabilitation)
• Technical state (whether in good or bad repair)

For the evaluations is used a 9-step scale (1 is the highest step). For properties with a number of buildings a general layout of their position is drawn. Lastly one or two photographs are taken.
The evaluation of the preservation value of an individual building is difficult, since most people have their personal opinion about architecture. So a common standard is needed. That is why the registrars should be given a short training (1 week) in how to evaluate buildings. Registrars should be professionals, architects, art historians or people with some experience in building registration, preferably familiar with the regional or local building tradition.
It would be useful, if a selection of different types of local architecture together with a short commentary is procured. The results of the field work are directly applicable in the local administration, planning and allocation of building permissions. Also it provides a platform for preventive maintenance.

Phase III. The preservation atlas
The work ends with the publication of a preservation atlas which is an illustrated summary of the preliminary investigation and the mapping and registration of the field work.
The purpose of an atlas is to make the most important results readily accessible to the local community, creating in this way a common point of reference for the local authorities and the local

population. The atlas ought to be considered as a continuous project to survey and assess urban areas. They are possible sources for policy-making to maintain and develop cultural values.

4.2.2.2 Urban Sections

The environment assessment will include references to value and performance of built heritage balanced with energy. The efficiency of this balance will depend on continuity and innovation of artefacts, building and urban area. It includes context and tradition as well as climate and ability to change and preserve.

The assessment method is a guide that identifies and makes public participation possible, it include relevant references for the existing building and context, it assesses possible positive and negative impacts of intervention and the decision of multidisciplinary expertise.

The integration of the project in the context provides the possibilities of an assessment of large scale and in an overall frame. It can include various functions of spaces, interior and exterior, within the built heritage and within the historic area. Thus it will refer to and balance with environment and climate as such. For this work plans and sections are valuable sources to balance energy and culture as a variety of aspects.

The following sections are produced to illustrate the interdependence between the 3ENCULT case studies and their urban or rural environment. Interior and exterior temperature, wind and light depend to a high degree on this relationship. The sections are all of 160 meter and displayed in app. 1:1000 scale.

Figure 6. CS1, Waagehaus, Bolzano; The Waagehus is situated in between dense city with arch streets and the open space, Die Kornplatz, with direct relation between the function, space and construction of the building and the historic area. Section and plan could be used for shadow and wind simulations and as indication of dynamics of context.

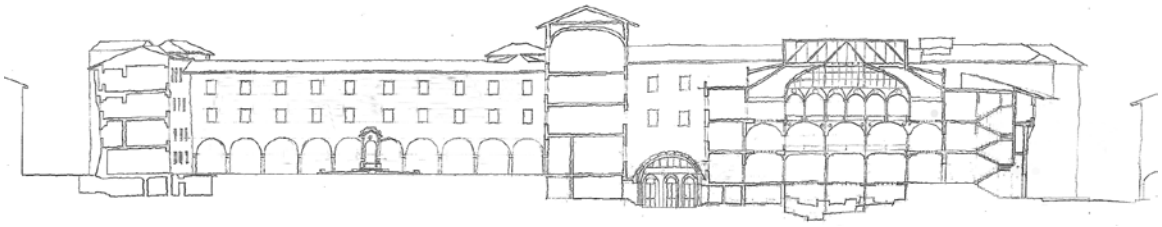

Figure 7. CS2, Palazzo Accurzio, Bologna; The municipio of Bologna, palazzo Accurzio is a historic development of structures and spaces of varying use. It is public spaces with certain demand for comfort as well as it is individual working spaces, museum and artifices with special needs. Indoor climate, courtyards, arcades and natural climate makes palazzo Accurzio a complex condition and context of energy and culture.

Figure 8. CS3, Palazzina Viola, Bologna; The section of palazzina Viola identifies the building as a solitaire of a garden space. The environmental assessment would involve and integrate the balance of energy and culture in the surrounding. Trees and landscape architecture could be important argument that would have an effect on the built heritage.

Figure 9. CS4, Material Court, Copenhagen; The section identifies the position and scale of the building within the urban area. It indicate qualities such as the enclosed courtyard in contrast with the surrounding, a certain character that makes the relation of context and built heritage. The 3ENCULT methodology including assessment of possible positive and negative impacts of the environment can be performed with studies of section, plan and dynamic models of energy and culture.

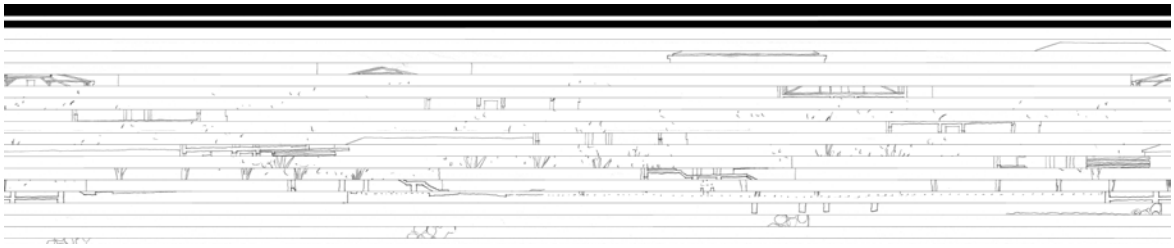

Figure 10. CS5 Höttinger Schule, Innspruck; The school in Innspruck has a close relation to context. Original surrounding are displayed as school yard, and open air, windows and entrance/reception are all space s where energy and culture/architecture is a conscious balance of function. Environment and climate is obvious close related to construction as access paths along river.

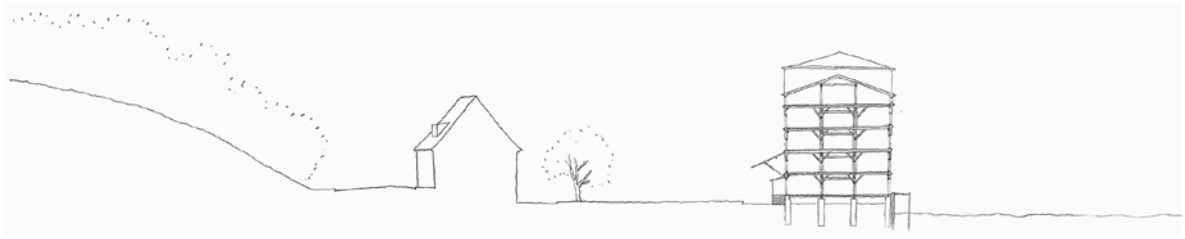

Figure 11. CS6, Schinkelspeicher, Potsdam; The section places the building on the waterfront, original to provide accessed to the Speicher/warehouse by boats. The building in between the hill and the water is a special climate condition. The original state of the building is a refined control of ventilation. Thus damage of humidity on the stored goods can be avoided. The building involves no thermal control.

Figure 12. CS7, Technical Engineering School, Bejar; the environment analyse and assessment is important for the consideration of building physics and energy of this building. There could be no doubt that sun orientation and shading curtain wall facing west is a part of the concept of this recent heritage construction. Simulation of light and airflow can be provided from studies of section and dynamic flow.

Figure 13. CS8, Strickbau, Ausserodhen; This building type is typical for the landscape around Ausserodhen in kanton Appenzell. It is a typology that from detail and matter to disposition as construction in landscape, function and the organic dependence and balance of climate, growth, livestock and man maintain tradition and high quality products. Living with climate, energy and culture is strongly dependent on a close relation to change of season.

4.2.2.3 Building Level

For a comprehensive and thorough analysis of architectural and cultural values in a single building a detailed investigation system or tool is needed.

An example, which may have many similar editions in European countries, and which would fit into the purpose of 3ENCULT, could be the Guidelines for evaluating heritage values. The methodology is developed by the Danish Agency for Culture, which is an agency in the Danish Ministry of Culture. The methodology is developed as a tool for a thorough examination of all Danish listed buildings in order to describe and valuate heritage values.

Guidelines for valuating heritage values

The environmental, cultural, historical and architectural valuation must be knowledge-based, well-argued and position-oriented. As far as possible the overall impression should be assessed rather than structural details. The assessment of conservation values should not be a listing of individual elements or details; as such listing does not say anything valuable in itself. If you highlight detail, these should have special well-founded significance and value.

Essential conservation values

Essential conservation values constitute the essence of the environmental, cultural, historical and architectural/tectonic valuations - in short, building unique and inalienable values. The essential conservation values must be visible and tangible building elements, and they must be formulated so that they can serve as a guiding message to the owners and consultants who will work with the building for 10, 20 or 30 years. This means that the essential conservation values would be a listing of building inalienable elements.

The supporting conservation values should not be a long list, but rather gather and summarize the most important and unique elements of the building.

It is important to describe the essential conservation values as general wholes and not go into detail. If the essential conservation values include details, they must be described as very special and described individually.

Basic information

Basic information can include: Inspection date, inspected by - full name and the institution of the person or persons making the inspection, the address of the listed building, municipality where the listed building is situated, the building's called name, if available.

Building description

Building description should be short and concise, and should linguistically be understandable for both stakeholders and people who are not professionals. Building description must be built up to form the basis for valuation. This means that the description provides primarily what is essential for the environmental, cultural, historical and architectural value in general terms. The description should comprise volume, type of construction, materials and surfaces, details, interior and current function.

Building history

Building history describes the building's physical development history from construction to the present day, with emphasis on key alterations and extensions. In the building's history, it is also possible to write about the cultural history associated with the building, but which is not physically present in the building. The history should include: ownership, process history and changes over time, culture and operation history not physically anchored in the building, symbolic value.

Environmental value

Environmental value can be attached to group of buildings, where only one building is listed, or to a courtyard, a garden, a course of streets, a tree or a landscape, which is associated with the building, and which is important for conservation. The description could include the building's importance for the environment, the building's use of the environment/the landscape and the building's links with other buildings.

Cultural value

Cultural and historical value is attributed to structural components, which can be seen or experienced physical. This means that cultural history must be attached to the building or to traces of this before it can be described as a conservation value. The description can include: history of function, style and epoch, representative or unique, materials, construction and workmanship, traces and history of function, originality and symbolic value.

Architectural value

Architectural value can include a descriptive part and subsequently an interpretive part of how the elements work. This can be done step by step, detail for detail through the valuation.

In the architectural valuation it is important also to assess the overall impressions and experiences rather than selected constructional details, so that the valuation does not become a quantitative enumeration. The description could include: overall valuation of the scheme, form, expression, space, materiality, materials, conceptuality, originality, and detailing.

Essential conservation values

Essential conservation values constitute the essence of the environmental, cultural, historical and architectural/ tectonic valuations - in short: building unique and inalienable values. The essential conservation values must be visible and tangible building elements including: entirety and surroundings, form and expression, facades, gables and roofs, plan, outline and sequence of spaces, exterior and interior detailing and decoration, material attitude and originality.

4.2.3 Structural Investigations

Comprehensive diagnosis including analysis of structure, building surfaces, building physics, materials and building services of the built heritage have to be carried through. The air tightness of the building should have special attention due to the important consequences for humidity, condensation, ventilation and energy consumption. Air tightness is tested by a blower door test.

The investigation results can be compiled and shared among stakeholders in an inventory system ("Raumbuch")

For further information see Work Package Description WP2 and deliverable D2.5.

4.3 Energy Intervention – Proposals

Energy saving measures are proposed, listed and assessed to find possible means and interventions for energy savings in historic buildings

Initially a comprehensive list of energy-saving interventions can be produced.
Within the 3ENCULT-project WP3 the following general proposals are elaborated:

1. Internal insulation
2. Air tightness
3. Moisture transport problems / beam ends
4. Windows
5. Integration of shading system within window/glazing system
6. Integration of space saving ventilation systems with heat recovery
7. Analysis of the cost effectiveness of automatic air flow volume balancing heat recovery ventilation
8. Day lighting
9. Artificial lighting
10. Passive heating and cooling
11. Active energy efficiency solutions
12. RES integration

In order not in advance to exclude possible interventions and solutions, the list of proposals can be prepared without regarding the building's architecture and conservation value, as well as the proposals preliminary do not have to take into account location, concrete building physical conditions or function that immediately would make the proposals impossible. The list of proposals for possible interventions is made as broadly as possible.

The proposal list can then be subject to a series of processes where the stakeholders of the project argue pro and against the proposals. The argumentation can be qualified by parallel simulation of the single intervention's impact on energy consumption as well as by argumentations for the impact on cultural values. The output of the process can be integrated in the final report and project.

4.4 Multidisciplinary Process – Evaluation and Report

To meet requests and demands raised by energy retrofit of historic buildings it is appropriate to involve a broad forum of cultural and technical competencies in the evaluation and decision process. In heritage buildings and building complexes in urban areas with significant public interest a public hearing is relevant and desirable. According to the Aarhus Convention it is recognized that the quality of decisions can be improved through the active involvement of the public concerned.

This calls for the development of a multidisciplinary process, which ensures that decisions are made on a

4.4.1 Multidisciplinary Process - Material Court, Copenhagen

The work can be carried out in a process in a group of important stakeholders in a project. The work can begin with the establishment of a list of proposals for single potential energy saving measures. Each stakeholder with their own skills rates the many proposals for energy-saving measures. The list

of proposals will during the process be reduced to a final solution to every single energy saving measure.

Client
The client's role is to make an assessment of the specific proposals from an owner's point of view. The proposals' impact on rental opportunities and operational and maintenance conditions can be evaluated, among other items. Finally can the owner make more general assessments.

Heritage Agency/Authority
Heritage Agency's task is to assess the individual measures, from a conservation point of view. It is desirable that the assessments are supplemented by a more general assessment based on building typology as far as it is possible.
Architect
Architect's task is to assess the actions from an architectural viewpoint. Among other things, form, appearance, functionality and interior design items have to be evaluated. This can be further supplemented with more general assessments / attitudes.

Structural Engineer
The structural engineer can make assessment ratings from a building physical and a construction standpoint. The interventions and their effect on the existing constructions can be risk assessed specifically in relation to moisture balances etc.
Locally this can be supplemented by a more general assessment / attitude references to relevant literature.

Engineer in Climate and Energy
The climate and energy engineer's role is to make an assessment, based on a concrete level from an energy and climate point of view. The interventions and their effect on room temperature, and the energy saving effect can be assessed particularly critical. Locally this can be supplemented by a more general assessment /attitude with reference to relevant literature.

Nr.	Energitiltag	V1	V2	V3	V4	Beskrivelse af fravalg
Vinduer og solafskærmning						
01a	Udskiftning af vinduer til nye superlavenergi vinduer					Fredning og arkitektur respekteres ikke
01b	Nye superlavenergi vinduer i nye vindueshuller					Fredning og arkitektur respekteres ikke
02	Nye energiforsatsglas + solafskærmende udvendigt glas					Udvendige glas kan ikke udskiftes pga. arkitektur og fredning
02a	Nye energiforsatsglas i eksist. forsatsrammer					
02b	Nye solafskærmende forsatsglas					Farven på glassene er for markant
03	Nye vinduer med indvendig solafskærmning					Fredning og arkitektur respekteres ikke
04	Udvendig solafskærmning					Fredning og arkitektur respekteres ikke
Isolering og bygningstæthed						
05	Indvendig efterisolering af ydervægge					Fredning og arkitektur respekteres ikke
06	Udvendig efterisolering af ydervægge					Fredning og arkitektur respekteres ikke
07	Efterisolering af skrålofter					Tiltaget har ikke stor nok effekt
08	Efterisolering af terrændæk					Ikke CO2 rentabel
09	Brug af isoleringstypen "supertynd"					Kvaliteten af isoleringstypen er usikker og effekten ikke stor nok
10	Etablering af bygningstæthed					
Ventilation						
11	Naturlig ventilering - via åbning af vinduer					
12	Natkøling, ventilation - indtag i klimaskærm og udtag i tag					Friskluftindtag gennem klimaskærm ikke mulig.
13	Hybrid ventilation, indtag i klimaskærm og udsugning via varmepumpe					Friskluftindtag gennem klimaskærm ikke mulig.
14	Traditionel mekanisk ventilation via ventilationssystem					Tiltaget udgår pga. økonomi
15	Friskluftindtag via solvægge, aktive glaspartier					Fredning og arkitektur respekteres ikke
Varme, vand og køl						
16	Køling via mekanisk recirkulering af luft i rum					
17	Passiv køling af rum via nedkølet loft eller væg					Fredning og arkitektur respekteres ikke
18	Køling hvor overskudsvarmen afsættes til luften ude					
19	Køling via jordslanger					Kølebehov er ikke tilstrækkelig
20	Køling via varmepumpe til grund/havvand					Kølebehov er ikke tilstrækkelig
21	Radiatoropvarmning					Radiatorer placeres kun i rum hvor der ikke er et kølebehov.
22	Gulvvarme					Ny gulv opbygning kun mulig i stueetagen
23	Central brugsvandsproduktion					Ikke CO2 rentabel
24	Decentral brugsvandsproduktion					
28	Opsamling af regnvand					Begrænset vandforbrug
El						
25	Energibesparende lyskilder					
26	Dagslysstyring					
27	Centralstyring af el forbrugskomponenter					
Solfanger og solceller						
29	Solfanger til varmtvandsproduktion					Fredning og arkitektur respekteres ikke
30	Solfanger tilopvarmning					Fredning og arkitektur respekteres ikke
31	Solceller					Fredning og arkitektur respekteres ikke
Adfærd og indretning						
32	Flytning af varmeafgivende udstyr fra kontor til fælles serverrum					Kræver at krav til lejers udstyr/rutiner bliver defineret præcist.
33	Fælleskantine					
34	Fælles møde- og konferencefaciliteter					
35	Vindfang ved hovedadgangsvej					Fredning og arkitektur respekteres ikke

Figure 14. Decision process from CS4 – The material court of the fortress in Copenhagen. Green means proposal is accepted in 1st, 2nd, 3rd or 4th meeting. Red means rejected. To the right is explanation for rejection.

The table in figure 15 is a listing of all possible energy interventions starting with seven proposals concerning windows and shading, where only one proposal (new energy glass in the interior part of the box window) was positively assessed through the whole meeting sequence of 4. Similarly proposals for insulation and tightness, ventilation, heat, water and cooling, electricity, PVs and sun collectors, user behaviour and interior design are evaluated.

4.4.2 Bridging Culture and Energy

Energy savings and cultural heritage are incomparable as values. Never the less this balance in the decision process is a core issue in energy retrofit in historic buildings.

Below are two examples on how to get closer to a quantification or gradation of these values. There are surely other European methods with the same objectives.

The DuMo changeability index operates with the two values Du (dutch for sustainability) and Mo which is the monumental value.

The Danish Architecture and Energy Refurbishment refers to the SAVE system for evaluating architectural values.

4.4.2.1 DuMo Experiences

Short explanation of the DuMo methodology **(***based on Input document to CEN 346, wg8 on The historic building context in the energy performance benchmark*)

There are several reasons for making an energy evaluation of a historic building. For some of them looking in isolation at the energy performance might be justified, e.g. when you want an indication of the potential energy costs of a building. However, when it comes to evaluate what measures are optimal or whether everything within reason is done to make the building as energy efficient as possible, this is only possible if the cultural heritage context is taken into account.

It is not evident how to rate the cultural heritage value, let alone how to link this to the evaluation of energy saving. A possibility, at least to consider, is the methodology developed and used to quantitatively rate the sustainability of cultural heritage before and after renovation: the so called DuMo method (Du = (Dutch for) sustainable and Mo = monument). Besides the fact that the method is used in practice in the Netherlands and therefore is more than a theoretical approach, one of the 3ENCULT external evaluators advised to look into the method. This short explanation is written to explain the idea behind the method, how it works, what pros and cons are and how we might use it within 3ENCULT to advise CEN TC 346, wg 8 about using it in a guideline or common approach.

The idea behind DuMo:

The DuMo method links quantitative rating of a sustainable value (Du) with a quantitative rating of a monumental value (Mo) of a historic building. In this document we'll focus on the Mo-value and the link between Du and Mo.

Mo-value: The idea behind the Mo-value is that it is an indication for how far we can go with changing the building or parts of the building without changing the cultural heritage value of the building. So, it is not a measure of the cultural heritage value itself. Therefore we call it the touchableness or changeableness of the building. The Mo-value is defined in such a way that a high value means a low changeableness of the building, so the higher the Mo-value, the less changes to the building are possible without changing the cultural heritage value.

The DuMo value on its turn is determined by multiplying the Du and de Mo value: DuMo = Du x Mo. Note that in our case the Du-value might be an energy performance level. The idea about the simple multiplication is that a building can get a high (= 'good') DuMo level by a high Du or a high Mo value, meaning that a lover Du-level (or a worse energy performance level in our case), can be compensated by a high Mo-level. Or in other words: a historic building with a high Mo-value and a low Du-value can have a comparable DuMo-value as a non-historic building with a low Mo-value and a high Du-value, so the high Mo-value makes up for the fact that only so much can be done in the historic building compared to the non-historic building in terms of energy saving measures. Of course this asks for a good tuning of Du and Mo.

The prescribed procedure to determine Mo:

The Mo-value is determined by two building or architectural historians, who independently rate the Mo-value based on a prescribed procedure and together come to a combined consensus on the value. For this, the experts inspect the building on the inside and outside and use existing building historical information about the building. To guarantee a complete inspection, the inspection is done via a working sheet based on the inspection method normally used with monumental buildings in the Netherlands. This method might be replaced by a national or regional know method, or by the Raumbuch method which is suggested in 3ENCULT and which is a globally comparable inspection scheme. However, the scheme used for assessing the Mo-value is a simplified version of the usual inspection protocol, taking into account that the assessment of the DuMo-value will only be an *indication* of the possibilities related to the energy performance and not a too precise method. The inspection for the DuMo assessment focuses on the envelope, the ground floor, all facades, windows, roofs, roof constructions, of which the touchableness is judged on the inside and outside: The inspection focuses on the building parts and elements were the changes due to energy saving measures can be expected.

Pros and cons:

The nature of the Mo-value and the DuMo multiplication determines some of the characteristics of the method:

- The Mo-value will never be completely objective. This makes it invalid as basis for setting minimum legal energy performance requirement levels and not suitable for setting financial schemes on a large scale. However, probably no rating of whatever cultural heritage value of a building will be objective and fit for these purposes without a case to case evaluation.
- What will be possible is using the value as a means of communication among experts and professionals of different backgrounds. And as an instrument used to harmonize the evaluation of the possibilities for energy efficient or sustainable renovation of historical buildings among experts.
- Every building can get a Mo-value, not only officially listed buildings. This way also for not listed buildings it is possible to show why it might be valid not to take all energy saving measures that normally would be expected of a building.
- The rating of the Mo-value will probably differ among countries or regions. This doesn't need to be a problem, especially since the energy performance evaluation of buildings also differs per county or region and climate and cultural differences (among other things) make complete harmonization in energy performance evaluation not evident even in the future. Tuning of Du on Mo (or energy performance on Mo) is clearly also a national or regional task. But although the DuMo evaluation procedure needs to be worked out on national or regional level, the general methodology can be determined on European level (e.g. on CEN level), as is done with the energy performance methodology already.

4.4.2.2 Architecture and Energy Refurbishment Experiences

Buildings and built environment with a SAVE value from 1 to 3 normally have exception from Danish Building Regulation's energy requirements, when refurbished. Whereas Buildings with a SAVE value from 4 to 9 have to comply with the requirements, which means that a majority of the traditional building stock (mostly built in brick) is threatened by cultural and architectural losses related to energy interventions connected to refurbishment

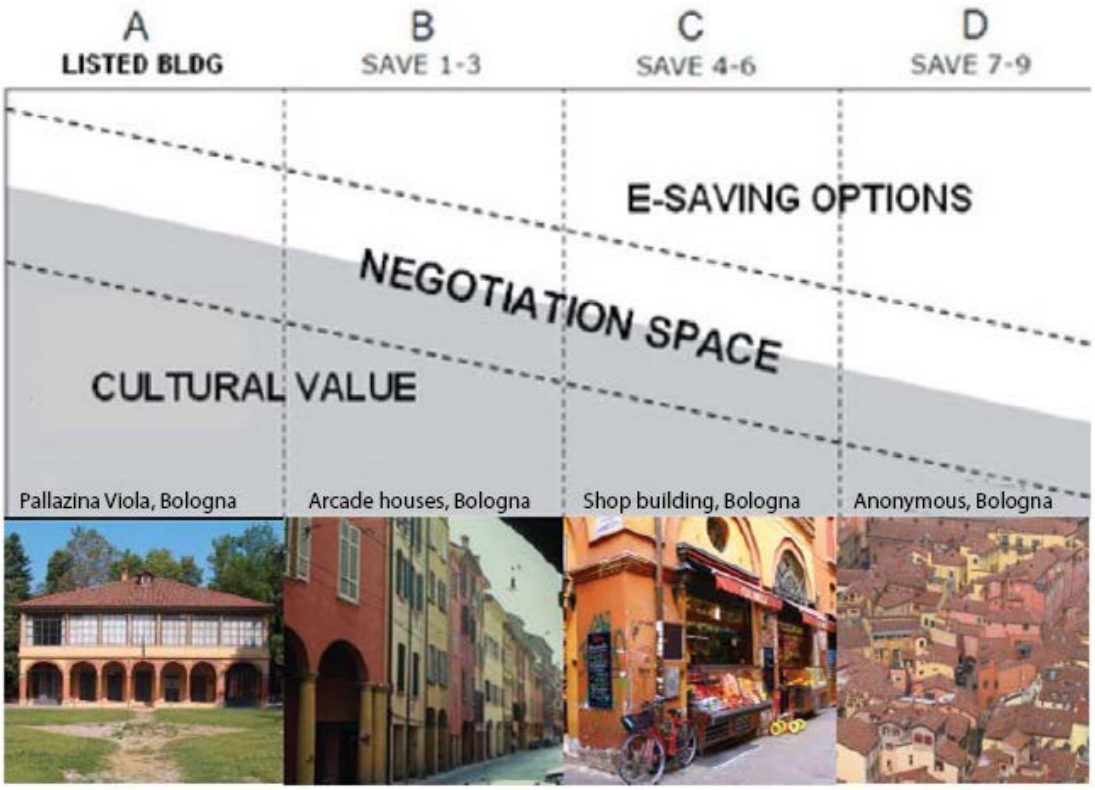

Figure 15. Classification - Four classes of cultural value based on the SAVE categories 1–9 with different options for saving energy.

Four categories of cultural and architectural value were defined from Listed Buildings through SAVE category 1-3, SAVE category 4-6 to SAVE category 7-9.

All of these categories have cultural value as well as they all have potentials for E-savings but to a variable degree from A to D. This categorisation also leaves the buildings with a “Space for Negotiation” between the building authority and the building owner to indicate that special and local conditions could be taken into consideration, when decisions are taken regarding the degree of interventions of energy savings.

To illustrate the potentials of the “the negotiation space” a reference building was chosen. This building could hypothetically be placed in all categories from A to D with different potentials for energy savings.

In the illustration below the possible savings in the four categories are indicated.

It should be emphasized that these interventions are highly hypothetical, but they can indicate a way to develop a more appropriate method and process for the balancing cultural value with E-savings in the decision process.

POSSIBLE SAVINGS – REFERENCE BUILDING

Energibesparelse i procent ift. reference.	Fredede bygninger og bygninger med høj bevaringsværdi	Bevaringsværdige bygninger	Bygninger med enkeltstående arkitektoniske kvaliteter	Anonyme bygninger
Vinduer og solafskærmning				
Forsatsrammer med energiglas, U = 1,7	-	5 %	-	-
Lavenergi vinduer, U = 1,4	-	-	11 %	-
Superlavenergi vinduer, U = 1	-	-	-	14 %
Isolering og tæthed				
Hulmursisolering - gavle, 75 mm	4 %	4 %	-	-
Delvis udvendig efterisolering af ydervægge, gavle. 200 mm + hulmursisolering 75 mm	-	-	8 %	-
Nye højisolerede kviste, 200 mm i vægge og 250 mm i tag	-	-	2 %	-
Total udvendig efterisolering af ydervægge + hulmursisolering, 75 mm + 200 mm	-	-	-	26 %
Tagetage efterisoleres u. ombygning: 200 mm på loft, 100 mm i skunke, 75 mm i skråvægge	16 %	16 %	16 %	-
Tagetage efterisoleres inkl. ombygning: 400 mm på loft, 250 mm i skunke, 200 mm i skråvægge - inkl. nye kviste	-	-	-	22 %
Tæthed, 0,4 h-1	-	3 %	-	-
Tæthed, 0,3 h-1	-	-	6 %	-
Tæthed, 0,1 h-1	-	-	-	12 %
Ventilation				
Kontroludluftning	- 2 %	- 2 %	-	-
Central ventilation	-	-	7 %	-
Decentral ventilation	-	-	-	9 %
Varme- og vandinstallationer				
Ny varmecentral, inkl. efterisolering af rør i kælder	13 %	13 %	13 %	13 %
Energibesparelse				
Samlet energibesparelse ift. reference ved udførelse af de markerede tiltag	30 %	35 %	50 %	75 %

Figure 16. Energy savings in a reference building according to class of cultural value.

4.4.3 Evaluation and Report

The main outcome of this stage of the 3ENCULT methodology is a report gathering and analysing all the evaluations, arguments and decisions from the multidisciplinary process and comments from the designated authorities concerning the different alternatives and their possible effects. This report should also include all the information about the people who participated, the content of their responses, their suggestions etc. should be recorded. This should help decision-makers in taking the final decision. This document should also describe how consultation processes were organised and their detailed arrangements.

4.5 Project

The Project is the summarizing of all plans and decisions to be carried out and built as a final physical reality. The project reflects the results of the methodology from programme to decision making and thus it exposes the selected energy interventions selected with respect to the architectural or historic values of the building.

The projects should also displays the results of negotiations with the local building authority in the before mentioned “negotiation space” concerning compliance with building codes and energy regulations in balance with the cultural values of the building.

4.6 Post-Intervention assessment

Post intervention assessment for energy retrofit in heritage buildings must evaluate the architectural and cultural impact of the interventions of the project as well as the achieved reductions in energy consumption. At the same time it is convenient to control building physical parameters as temperature, humidity, airflows and daylight.

As for the cultural and architectural evaluation one can apply the methods from chapter 4.2.2. in this document.

Likewise one can use the methods described in chapter 4.2.1.1. and 4.2.1.2. for calculating and measuring energy consumption post interventions.

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