Proposal/Contract no.: FP6-503186

DEMOHOUSE

Design and Management Options for improving the energy performance of Housing

SPECIFIC TARGETED RESEARCH OR INNOVATION PROJECT

Thematic Priority 6

Deliverable 23
Use of the Common Evaluation Protocol in the design phase

Due date of deliverable: October 18th, 2005
Actual submission date: December 1st, 2005

Start date of project: October 18th, 2005 Duration: 4 years

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Draft report

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Executive summary

This report evaluates the usability and applicability of the Common Evaluation Protocol that was used by all the design teams of the DEMOHOUSE project (TREN/04/FP6EN/S07.35744/503186). The Common Evaluation Protocol was developed in the start of the project, as a means to have a common basis for the evaluation of the environmental and energy performance of the buildings in the different countries.
The Common Evaluation Protocol considers all the subsystems of a building like the microclimate, the building envelope, the indoor environment, the building services and the control-management systems. It suggests the evaluation of the projects in terms of sustainability, energy and socio-economic aspects. The protocol is described in detail in deliverable 22 of Work Package 5 of the DEMOHOUSE project.

The evaluation of the use of the protocol was carried out using a questionnaire that was prepared by NKUA for the purposes of this analysis and was distributed to the partners. In total, the protocol was used for the Austrian project (IFZ), the Danish project (CENERGIA) the Greek project (NKUA), the Hungarian project (EMI) and the Spanish project (LABEIN).
In this way all buildings were evaluated in terms of sustainability, energy and socio-economic aspects using the questionnaires/tools that were defined in the protocol. The results were obtained in a homogenous format and the comparison of the projects in the different countries was feasible. Also, the final design of the buildings was compared to the initial targets and optimizations were carried out during the design phase in order to achieve the desired levels. In overall, the protocol was assessed as a concise and a detailed method for the evaluation of the buildings.

However, following the partners' remarks, the protocol can be subject for further improvements. Mainly these include reformation of its structure as it was noted that there is no balance between its different modules and some parts are emphasized, and adaptation of some of the defined national tools to the needs of the whole group of the DEMOHOUSE project.

The Common Evaluation Protocol suggests a holistic approach for the evaluation of the buildings. This is very interesting but something new for many EU markets and makes difficult its use in other projects apart from the DEMOHOUSE .
Summarizing, it can be concluded that the usefulness of the Common Evaluation Protocol depends on the peculiarities of each project.

Introduction

The present document is deliverable 23 that consists the second deliverable of Work package 5 of the EU project 'DEMOHOUSE' (TREN/04/FP6EN/S07.35744/503186). The aim of the project is to develop minimum standards and recommendations in connection to healthy, cost effective, energy efficient and sustainable rehabilitation of houses and to agree on actual quality agreements in this field. The renewal of the existing building stock is about 2% per year. This shows the enormous potential that exists for improving energy savings and introduction of renewable when rehabilitating existing building areas in Europe.
In four countries, within the time frame of the DEMOHOUSE project, existing housing went under renovation aiming at a low energy and sustainable design; in the case of Greece energy measures were implemented in a new to built complex.

In order to evaluate the success of the renovation of the various projects, during the design phase a Reference and a Pilot project were defined in a number of the participating countries. The reference project is a housing that represents the typical construction and is adapted to the energy performance standards of 2003 of each country. The pilot project is a housing that is renovated within the time frame of the DEMOHOUSE and aims at lower energy consumption by 30% compared to the reference project.

Additionally, at the beginning of the project, it was agreed among the partners the necessity of a common evaluation protocol as a means to have a common basis for the evaluation of the environmental and energy performance of the buildings in the different countries. The 'Common Evaluation Protocol' report (Deliverable 22, first deliverable of Work Package 5) is the common reporting format that was used by all partners for the evaluation of the reference and the pilot projects. The specific and global energy and environmental performance of the final design were calculated and compared to the initial targets according to this protocol. Additionally, the parameters and the tools to be used for the evaluation of the building projects were defined.
The protocol describes the methodology that was followed for the evaluation of the projects and includes all the questionnaires and tools that were used.

Objectives

The main objectives of work package 5 are to:
-Define the parameters for assessing the energy and sustainability performance of the reference and pilot projects.
-Define the tools for the energy and sustainability assessment of the projects.
-Calculate the energy and environmental performance of the final design of the building and compare it to initial targets, existing consumption data and classify the building according to national rating schemes.
-Demonstrate the use of the tools and enhance their availability and applicability for low energy and sustainable design.

The objectives of Work Package 5 are mainly covered in the Common Evaluation Protocol that was used by the partners in order to assess the energy and environmental performance of the reference and pilot projects.
The common evaluation protocol was used for the following projects:

- Austria,
- Denmark,
- Greece,
- Hungary and
- Spain

The aim of this report is to evaluate the usability and applicability of the Common Evaluation Protocol by the design teams that used the protocol during the different phases of the project.

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Project: Austria, Graz (Starhemberggasse 13/15)</td>
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Project: Denmark, Gyldenrisparken
(Amager, Copenhagen)</td>
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Project Greece (Building 1) Designer Village
(Dionysos, Athens)</td>
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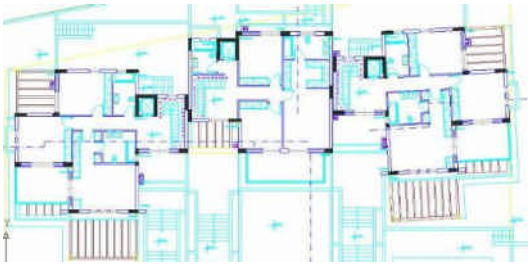
 **Project Greece (Building 4),** Designer Village(Dionysos, Athens)	
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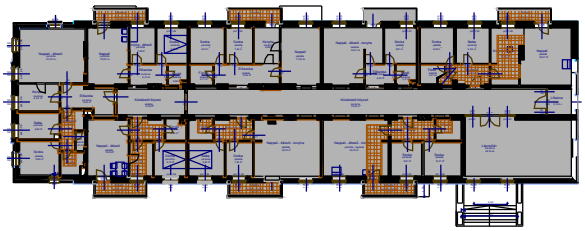
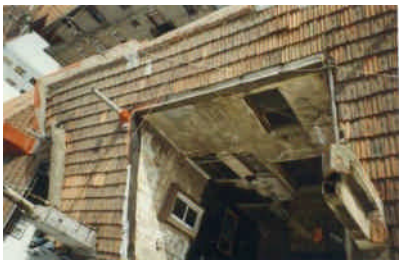
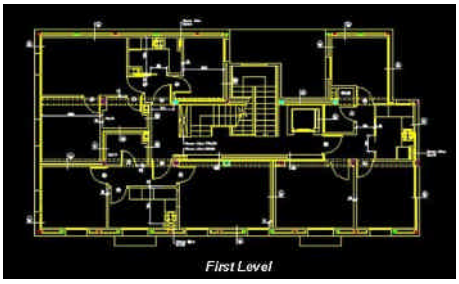
 **Project: Hungary** , Swallow house (Budapest, Blaha Lujza u. 9)	
 **Project: Spain,** Cortes 34 (Bilbao , Spain)	

Table 1: Information provided for the pilot projects according to the Common Evaluation Protocol

Overview of the Common Evaluation Protocol (deliverable 22)

The Common Evaluation Protocol considers all the subsystems of a building like the microclimate, the building envelope, the indoor environment, the building services and the control-management systems. It suggests the evaluation of the projects in terms of sustainability, energy and socio-economic aspects. Specifically it describes the methodology to be followed for the assessment of the projects during the design and the construction stage.
The Common Evaluation Protocol comprises a main body text with guidelines how to use the suggested tools. All the defined tools and questionnaires are attached to the main text of the protocol as appendixes.

The main body of the protocol comprises the following parts:
the *documentation part* that states and describes the project and the implemented energy measures during the design stage,
the *pre-evaluation part* that should take place during the design stage before the renovation works,
the evaluation part that should take place during the renovation,
the *post evaluation* that should take place after the end of the renovation works and
the *comparison part* between the results of the pre and post evaluation part.
The whole methodology suggests the use of theoretical analysis and simulation activities along with monitoring.

The defined tools to be used for the evaluation are based on existing protocols that have been used on other national and/or EU research projects. These are the following:

- The questionnaire on the documentation part that is used for the description of the projects in terms of the microclimate, their building envelope, the building systems (heating/cooling systems/lighting) and the control systems during the design phase
- the Simulation protocol that is used for the energy evaluation of the buildings via simulation activities during the design phase,
- the Green Build questionnaire that is used for the sustainability evaluation of the projects during the design phase. (More information on the Greenbuild questionnaire can be found in Deliverable 4: "Report on the Green Build Quality Process").
- the energy signature that is used for the energy evaluation of the projects via simulation and monitored values.

The methodology that is suggested for the post evaluation and includes the monitoring activities is based on validated tools and equipment of high specifications that are widely used in national and/or EU projects. The description of this equipment is included in D5 ‘Report on air tightness guidelines’, and in D8 Implementation and monitoring, First Part D8.1 Monitoring programme’
For the socio-economic evaluation, questionnaires were developed based on the needs of the ‘DEMOHOUSE’ project. The analysis of the questionnaires are given in detail in D11 ‘Interim report on State of the art management strategies and processes’.

All the questionnaires/tools that were used in the DEMOHOUSE project are included as appendixes in the Common Evaluation Protocol (D22). Additionally the tools are presented in the Decision Support Tool for further use by house owners, architects and construction companies in other projects.

Methodology

In order to assess the applicability of the Common Evaluation Protocol a questionnaire was developed and completed by the design teams. The questionnaire investigates the level of difficulty in using the protocol, its usefulness, its impact on the final design and suggestions for further improvements. Specifically the questionnaire investigates the following issues:

1. The structure of the common evaluation protocol in assessing both the reference and pilot projects in terms of sustainability, energy and socio-economic aspects
2. The encountered difficulties in using the common evaluation protocol
3. The usefulness of the different parts of the Common Evaluation Protocol (documentation part, pre-evaluation, post evaluation part, evaluation during the renovation)
4. The parts that were not very useful for the assessment of the project during the design phase
5. The impact of the Common Evaluation Protocol in the final design
6. The necessity of prescribing a standard software tool for the energy simulations
7. The difficulty in using the different questionnaires (simulation protocol, green build questionnaire, questionnaire of the documentation part, questionnaire to the tenants) that were defined in the protocol
8. Suggestions for improvement of the Common Evaluation Protocol
9. The use of the Common Evaluation Protocol in other national projects apart from the 'DEMOHOUSE' project

The answers from the partners to the questionnaire are given below. Four partners answered the questionnaire: CENERGIA (Denmark), IFZ (Austria), LABEIN (Spain) and NKUA (Greece).

Applicability of the Common Evaluation Protocol

- The first factor to be investigated concerns the structure of the Common Evaluation Protocol in assessing both the reference and pilot projects in terms of sustainability, energy and socio-economic aspects.

The classification of the protocol in sustainability, socio-economic and energy aspect is accepted by the partners and qualified as a detailed and concise method to be followed for the evaluation of the projects. Moreover, this method is assessed by CENERGIA, IFZ and NKUA appropriate to support the aims of the 'DEMOHOUSE' project. Both IFZ and NKUA note an overlapping in the sections concerning the energy evaluation of the projects; specifically the overlapping occurs between the Greenbuild questionnaire that was suggested by CENERGIA for the sustainability evaluation and the simulation protocol that was suggested by NKUA for the energy evaluation of the projects via simulation activities. In both tools similar information

is requested like energy consumption for heating, or details of construction and building materials, however this information is required in a different format leading to a probable misinterpretation of the data.
LABEIN commented that every part of the protocol is extensively considered through individual 'modules', although the importance for each of the parts (sustainability, energy, socio-economic aspects) is not balanced, as for example the energy part is particularly stressed.
CENERGIA commented that the Evaluation Protocol would be friendlier user if consisting of a guideline part and a part with the questionnaires/tools to be completed rather its current structure where the questionnaires and tools are included as an appendix of the main report.

- The second factor to be investigated concerns the level of difficulty in using the common evaluation protocol and also whether the methodology to be followed is adequately explained.

No difficulty was encountered by the partners (CENERGIA, IFZ, LABEIN and NKUA) in using the Common Evaluation Protocol.
However, CENERGIA pointed out that it was time consuming to understand the structure of the protocol.

- The third part of the questionnaire investigated which parts among the documentation-part, pre-evaluation, post evaluation and evaluation during the renovation were useful.

The Common Evaluation Protocol is assessed to give valuable support through all the project stages. According to IFZ quadrinomial structure follows the project stages in the common building practice and the Common Evaluation Protocol is a very good instrument for the comparison of the different alternative design solutions in order to find the best solution.
According to NKUA all parts are useful for the assessment of the projects to have clear results for the reference and pilot projects and to be able to make the comparison between a typical construction and the pilot project. Also the evaluation during the renovation works helps to detect any possible problems in an early stage of the construction. The use of the protocol during the design and the construction phase has several benefits because it helps to:
-Have clear and comparable results for the reference and pilot projects
-Carry out optimizations of alternative solutions during the design phase
-Control the renovation process via monitoring in order to meet the desired levels.
LABEIN commented that the clear definition of the data/results that are addressed in the different phases of the renovation make easy the data processing and the comparison between the reference and the pilot buildings. Additionally, the harmonized formats of the results for all the projects provide a systematic way of interpreting the outcome and enhance to achieve more easily understandable conclusions.
However CENERGIA commented that no parts are particularly useful for the evaluation of the projects.

- The fourth question investigates which parts among the documentation-part, pre-evaluation, post evaluation and evaluation during the renovation were <u>not</u> useful

CENERGIA would expect that most sections would be less detailed, although the usefulness of the different parts depends on the needs of the actual project.

The renovation part seemed to be less applicable for the case of Austria (IFZ) that commented that some parts are too general. They should expect information to be required on more aspects related to the renovation practice. Some questions of the tenant questionnaire are not really applicable to the Austrian situation. Additionally, most questions of the Greenbuild tool are dealing only with qualities, having no connection to quantities of the materials used. They noted that there is no place to fill in quantities.
For the case of NKUA, the part of the questions to the tenants (pre-evaluation part) was not applicable because the Greek project was a new to built construction and the physical presence of the tenants was not feasible.
For the case of LABEIN, the occupancy questionnaires were not applicable since the building was abandoned before the renovation and the occupation would occur at the end of the project. However, the socio-economic part was used as a reference document to take into account the social aspects of the renovation in terms of future operational costs and housing affordability.

- The fifth question investigates whether and how the Common Evaluation Protocol had an impact on the final result of the project

The partners agreed that the methodology suggested by the Common Evaluation Protocol can be used to support the design process.
IFZ commented that through this methodology it is easy to check the project throughout all the design and renovation stages. Also the methodology permits to check calculations and make optimizations when the results do not satisfy the desired/required levels.
According to LABEIN, the evaluation along the design phase permits to optimize many of the features of the building renovation. Monitoring of the building provides real data about its performance, which is useful for the validation of the implemented measures, further than the typical sustainable research activities where commonly only theoretical results are achieved.
According to NKUA the use of the protocol has an impact on the final design by checking the outcome throughout all the design and renovation stages and making optimizations when the results do not meet the target levels.
Also the monitoring phase during the construction works permits to check the outcome and quality of the renovation.

- The sixth question investigates whether a standard software tool for the energy simulations or just the format of the results should be described.

Most of the partners agree that presetting of a standard tool is not practical; as in different countries different tools are used. Using one standardized tool means disproportional huge efforts for the participants; and buying the software and learning to use this tool would be time consuming and a quite expensive procedure. Also the accuracy of the results is disputable when using software with which the partners are not familiar. Moreover, the tools that were used for the evaluation of the projects and the thermal simulations for the different projects during the design stage (i.e. TRNSYS, Energy Plus, ESP, AIOLOS) are validated for their accuracy.

Specifically, IFZ suggests that defining the format of the result seems to be is the best way.

On the other hand, CENERGIA suggests that the Common Evaluation Protocol should specify the very general requirements to the software tool to be used. Often national tools are available, and these sometimes are more adequate to be used.
According to NKUA the protocol should define just the format of the results because the partners are not familiar with the same software and it would be time consuming and not cost effective to learn the same software.
According to LABEIN nowadays there are many tools for building performance evaluation that are widely validated and used. Once the results are well defined, the way for obtaining them is not so relevant since software capabilities are quite equivalent. What it is really important is a good expertise in their use.

- The seventh question investigates the difficulty of using the questionnaires/tools that are included in the Common Evaluation Protocol.

In general all partners (CENERGIA, IFZ, LABEIN, NKUA) did not encounter any difficulty in using the suggested questionnaires.
Specifically, IFZ commented that some questions are based on the national situation and regulation system of the partner responsible for the tool, therefore no answers are possible. NKUA also noted that some parts are based on the national systems. For example, some questions regarding the green build questionnaire are based on the Danish regulations and market and some credits are given according to the situation in Denmark. For example in the section of energy, systems like the local district heating or the biomass based district heating that favor credits are widely used in other countries but they are not applicable in the case of Greece. Additionally, NKUA encountered a problem in using the excel spreadsheet that was suggested by CENERGIA for the calculation of the energy signature of the buildings based on simulation and monitored data. Currently the excel spreadsheet is adapted for climates with high heating loads and cannot calculate reduction of the cooling loads of buildings.
LABEIN commented that the green build questionnaire should be based on a percentage rating over a total rating corresponding to the maximum credits for applicable measures. Some of the 'indicators' included in the questionnaire may not be applicable in all the renovations. Therefore an extra item should be added to state if 'Applicable' or 'Not applicable'.

- The eighth question investigates suggestions for improvements of the Common Evaluation Protocol.

The comments from the partners include the following suggestions:
CENERGIA suggests that the different parts (main text and appendixes with the questionnaires/tools) could be formatted more homogenously. For example the Common Evaluation Protocol could comprise a guideline part and a part with the questionnaires.
IFZ suggest that:
- The information required regarding the cost data within the simulation protocol should be more specified (VAT included or not, what kind of costs, etc.)
- The questionnaires should give the possibilities to fill in quantities of materials that are used (for example amounts in m^2, or percentages); especially the greenbuild tool should require such information.
NKUA comments that

-The energy evaluation of the projects should be dealt either within the simulation protocol or the greenbuild questionnaire. Currently the two tools are overlapping each other requiring information on the energy consumption of the buildings but in a different format. Also the excel spreadsheet for the calculation of the energy signature of the projects (dealt within the comparison part) that is suggested by Denmark, cannot be used for climates with high cooling loads as it is adapted to the climates with high heating loads. Therefore, for the case of Greece, the energy signature of the buildings was calculated manually using the results of the simulations activities.

- The final question investigates whether the Common Evaluation Protocol can be used in other projects in the different countries apart from the DEMOHOUSE.

In the case of CENERGIA, currently there are no plans of using the Common Evaluation Protocol in specific projects.
Implementation to the Austrian situation is rather difficult, although there are some fitting parts. In the Austria market, approved tools like TQ and klima:aktivhaus are existing, and are developed especially for the Austrian situation, which makes the integration of new tools quite difficult. The holistic approach of the Common Evaluation Protocol (in terms of the technical, social, and economical aspects) is something new, and could be an interesting input for Austria.
According to NKUA, the Common Evaluation Protocol provides a complete and detailed evaluation of the 'DEMOHOUSE' project; however it is adjusted in the 'DEMOHOUSE' needs. It is not very easy to use the protocol in other projects, unless some modifications would be materialised. In general, the proposed methodology in the Common Evaluation Protocol is a new approach for the Greek Market however a very useful one for the assessment of the environmental and energy performance of buildings. Regarding the defined tools some of these can be easily applied, and some others should be adapted to the Greek standards like the Green Build questionnaire and the excel spreadsheet for the calculation of the energy signature.
For the case of Spain, it is not common to perform a building assessment as comprehensive as developed in the 'DEMOHOUSE' project. However, individual 'modules'/tools of the protocol will be likely used: socio-economic, sustainability, energy, monitoring.

Conclusions

In general, the Common Evaluation Protocol was used by all the design teams of the DEMOHOUSE participating countries, for both the reference and the pilot projects. In this way, all buildings were evaluated in terms of sustainability, energy and socio-economic aspects, and the results were obtained in a homogenous format that enhanced the comparison between the projects in the different countries, the comparison of the reference and the pilot project of each country, the distinction of the peculiarities of each project and the reference of the final design to the initial targets. Additionally, the protocol defined a methodology to be followed by all the design teams that enhanced the progress of the project and the synchronization of all partners.
In summary, the protocol was qualified by all partners as a detailed and concise method to be followed for the evaluation of the projects and appropriate to support the aims of the 'DEMOHOUSE' project. Moreover, the protocol described a methodology with which it was

easy to check the project throughout all the design and renovation stage and achieve the desired levels by making optimizations during the design phase.
Further remarks resulting from the use of the Common Evaluation Protocol included the following:
-Regarding the structure of the protocol, there is an overlapping between the energy and the sustainability evaluation of the projects; specifically the overlapping occurs between the Greenbuild questionnaire and the simulation protocol.
-There is no balance between the different parts of the protocol as the energy part is emphasized
- Some questions are based on the national situation and regulation system of the partner responsible for the tool, therefore no answers are possible for the other partners.
-The applicability of the parts of the protocol to the different projects is varying according to the specific characteristics of each building
- The questionnaires do not give the possibilities to fill in quantities of materials that were used
- The Common Evaluation Protocol suggests a holistic approach for the evaluation of the buildings. This is very interesting but something new for many EU markets and makes difficult its use in other projects apart from the DEMOHOUSE project. Sometimes, it would be easier to use the individual 'modules'/tools that are defined in the protocol: socio-economic, sustainability, energy, monitoring. However, in some countries national tools are preferable and more adequate to be used.

Summarizing, it can be concluded that the usefulness and the applicability of the common evaluation protocol depends on the peculiarities of each project.

Appendix - questionnaire

Questionnaire on the use and applicability of the Common Evaluation Protocol by all design teams (Deliverable 23)

(To be completed by the partners who have worked with the tools)

1. What do you think about the structure of the Common Evaluation Protocol in assessing both the pilot and demonstration projects in terms of sustainability, energy and socio-economic aspects ?

2. Did you encounter any difficulty in using the common evaluation protocol? Is the procedure for the assessment of the projects described well or would you like more explanation in some parts?

3. What parts were very useful to you (documentation part, pre-evaluation, post evaluation part, evaluation during the renovation)? Why?

4. What parts were not very useful to you (documentation part, pre-evaluation, post evaluation part, evaluation during the renovation)? Why?

5. Please comment whether and how the Common Evaluation Protocol had an impact on the final result of your project?

6. Do you think that the protocol should prescribe a standard software tool for the energy simulations or just the format of the results? Why?

7. Did you have any difficulty in using any of the questionnaires (simulation protocol, green build questionnaire, questionnaire of the documentation part, questionnaire to the tenants) described in the Common Evaluation Protocol? Why?

8. Any suggestion for improvements of the Common Evaluation Protocol

9. Will other projects in your country apart from the DEMOHOUSE project make use of the Common Evaluation Protocol?