

**PEP**

**Promotion of European Passive Houses**

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**Final Report WP 3.4 PassivHaus Certification**

**- with national foreword for Norway-**

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Chris Beedel  
Richard Phillips  
Gavin Hodgson

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## Executive summary

This final report of WP3.4 sets out the PEP partners' proposals for certification of PassivHaus dwellings. The report identifies the benefits of a 'supply chain' approach for certification, which involves certification, and hence the control of quality, of the design process, the construction process, and the post construction inspection and testing of a PassivHaus. However, the PEP partners recognise that with the current state of the PassivHaus market, it would be difficult to introduce such a 'supply chain' approach in many countries. The PEP partners have, therefore, also proposed a simpler scheme for the current emerging market scenario. This scheme involves the verification of the 'as built' design in accordance with the Passive House Planning Package (PHPP) by a competent PEP partner and confirmation of the airtightness of the completed building by a fan pressurization test performed in accordance with EN 13829 by an accredited organisation or an organisation recognised as competent by the PEP partner.

This report recommends that the supply chain certification approach should be used if possible and when the market becomes sufficiently developed. This approach, if adopted, would allow any certification body with an interest in certification of PassivHaus dwellings to gain accreditation for these activities. This will provide an open market and competition for certification services, while enhancing security and the management of risk for all those involved.

## National Foreword

### Norway

## Norsk forord til rapporten

Av Inger Andresen og Tor Helge Dokka, SINTEF

### Kort sammendrag av rapporten

I EU-prosjektet PEP (Promotion of European Passivehouses, [www.europeanpassivehouses.org](http://www.europeanpassivehouses.org)) som SINTEF Byggforsk deltar i, og som ENOVA delfinansierer, arbeides det med å spre passivhus-konseptet i Europa. Et av delprosjektene i PEP omhandler sertifisering av passivhus. Rapporten "PassivHaus Certification, Work Package 3.4", oppsummerer synspunkter og etablert praksis og standarder mht sertifisering som er samlet inn i de ulike landene som deltar i PEP-prosjektet.

### Passivhus-sertifisering i Norge

Interessen for lavenergiboliger og passivhus i Norge er de siste årene blitt relativt stor. Det er nå anslått at det er ca. 10 000 boliger som er oppført, under oppføring eller under planlegging (de fleste er fortsatt på planstadiet). For at begrepene lavenergibolig (LE-bolig) og passivhus (PH) fortsatt skal forbindes med boliger som har en kvalitet betydelig utover forskriftsnivået, er det behov for å få på plass klare definisjoner og krav for at en bolig skal kunne kalles LE-bolig og PH.

I Tyskland har passivhusinstituttet i nesten 15 år nå hatt en klar definisjon av- og sertifiseringsordning for passivhus. Dette har vært en avgjørende faktor for at PH har fått så stor spredning og suksess i Tyskland, men også i Østerrike og etter hvert en rekke andre europeiske land. Stramme krav til utførelse og prosjektering har i disse landene ført til at passivhus oppfattes som miljøvennlige boliger med meget høy kvalitet, med godt inneklima og ekstremt lavt energibehov.

Det er i PEP-projektet laget en europeisk definisjon av passivhus, på basis av den tyske definisjonen, men denne er såpass åpen at det er behov for mer nøyaktige nasjonale definisjoner.

På grunn av forskjeller i klima, konstruksjonsløsninger og byggeskikk er det heller ikke ønskelig å adoptere den tyske passivhus-definisjonen til Norge, uten tilpasninger.

I Norge arbeides det med følgende forhold knyttet til passivhus-sertifisering

- Krav til normert beregnet oppvarmingsbehov, etter gitte beregningsstandarder eller sertifiserte/validerte beregningsprogrammer.
- Eventuelt justert krav ifht. ekstremt kaldt klima
- Krav til en form for vektet levert energi, eller tilsvarende.
- Krav til minimum varmetapstall (for å sikre robuste konsepter).
- Krav til inneklima, og særlig sommerkomfort
- Aktuelle komponent/systemkrav:
  - Krav til dokumenterte kuldebroer (termografering v. ferdig bygg)

- Krav til lekkasjetall (trykktesting ved ferdig bygg)
- Minstekrav til U-verdi vinduer
- Minstekrav til U-verdier for opake konstruksjoner
- Minstekrav til varmegjenvinning
- Minstekrav til elektrisk effektivitet for vifter (SFP)
- Krav til rapportering og dokumentasjon av resultater (minimum dokumentasjonskrav)

Det vurderes også å utarbeide separate sertifiseringskrav for enkelte komponenter:

- Vinduer
- Dører
- Ventilasjonsaggregater, event. kompaktaggregater
- Annet

Det bør også gjøres en vurdering om det skal være et kompetansekrav til de som skal sertifisere passivhus.

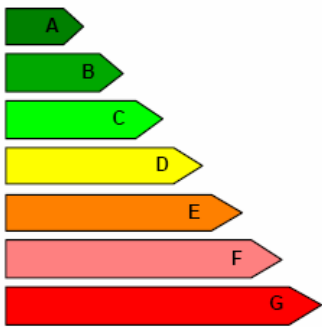
En eventuell Norsk standard for sertifisering av lavenergiboliger og passivhus kan være aktuelt. Forslag til sertifisering bør så langt som mulig være kompatibelt med nye energirammer i forskriftene, kommende energimerkeordning og ny energiberegningsstandard NS 3031. Byggforsk og SINTEF har på oppdrag fra NVE utredet energimerking av boliger og næringsbygg (Pettersen et al 2005). Boligrapporten beskriver en metode som tilfredsstiller kravene til energiattest satt i EU-direktivet, og er basert på CEN-standarder<sup>1</sup> som er under utvikling. I rapporten anbefales det å ta i bruk to ulike energimerker:

- Hovedmerket i energiattesten settes ut fra *vektet tilført energi* til bygget. Dette tar hensyn til bygningens varmetekniske egenskaper, effektiviteten til bygningens tekniske installasjoner og bygningens energiforsyning. Vektingssystemet for ulike energikilder er basert på samfunnsmessige miljøkostnader for ulike kilder.
- Sekundærmerket i energiattesten settes ut i fra byggets *spesifikke varmetapskoeffisient* som tar hensyn til byggets transmisjonstap, infiltrasjonstap og ventilasjonstap.

Passivhusstandard tilfredsstiller klasse A i forslaget til energimerkeordning.

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<sup>1</sup> CEN er den europeiske standardiseringsorganisasjonen.

Energimerke for boliger	Svært energieffektivt  Lite energieffektivt		Vektet tilført energibehov <div style="border: 1px solid black; width: 50px; height: 50px; margin: 0 auto; display: flex; align-items: center; justify-content: center;">C</div>
	Spesifikk varmetapskoeffisient		D
	Beregnet tilført energi:		..... kWh/m <sup>2</sup>
	Målt energibruk:		..... kWh/m <sup>2</sup>
	Oppvarmingsanlegg, inkl. energikilden(e):		
	Bygningens oppvarmede areal:		..... m <sup>2</sup>
	Kort om brukeradferd som kan ha betydning på energibruken		
	Administrative data		
	Adresse: Bygningstype: Dato for utstedelse av merket: Energisertifisør:		

*Mulig layout for energimerke for nye boliger*

Skalinndeling energimerkeordning for småhus og leilighetsbygg, forslag til ny energimerkeordning. Fra: Pettersen TD, Myhre L, Wigenstad T, Dokka TH, "Energimerking av boliger", Prosjektnr. O 20461, Juni 2005. [www.bygningsenergidirektivet.no](http://www.bygningsenergidirektivet.no)

Energiklasse	Varmetapskoeffisient		Vektet tilført energi	
	Småhus W/K per m <sup>2</sup>	Boligblokker W/K per m <sup>2</sup>	Småhus kWh/m <sup>2</sup>	Boligblokker kWh/m <sup>2</sup>
<b>A</b>	= 0.45	= 0.35	= 75	= 65
<b>B</b>	0.46 – 0.70	0.36 – 0.55	76 – 115	66 – 100
<b>C</b>	0.71 – 0.95	0.56 – 0.75	115 – 150	101 – 130
<b>D</b>	0.96 – 1.30	0.76 – 1.10	151 – 190	131 – 175
<b>E</b>	1.31 – 1.65	1.11 – 1.50	191 – 230	176 – 215
<b>F</b>	1.66 – 2.45	1.51 – 2.20	231 – 345	216 – 325
<b>G</b>	> 2.45	> 2.20	> 345	> 325

## A Norwegian perspective on linking EPBD with PassivHaus certification.

### PEP briefing note

Produced by Inger Andresen and Tor Helge Dokka, 24<sup>th</sup> Feb, 2006

### Background

In Norway, building regulations are the responsibility of the National Office of Building Technology and Administration, [www.be.no](http://www.be.no). However, it is the Norwegian Water Resources and Energy Directorate (NVE) that has the responsibility for the energy labelling part of the EPBD implementation, [www.nve.no](http://www.nve.no).

The full content and layout of the Norwegian energy labelling system has not been decided yet, but a recommendation has been proposed by SINTEF based on a project commissioned by the NVE. The recommendation includes:

- Dwellings are given two energy labels, both rated on a scale from A to G, see table below. The main energy label is “total weighted delivered energy” in kWh/m<sup>2</sup>/yr. The secondary energy label is “specific heat loss coefficient” in W/K per m<sup>2</sup>.
- Dwellings are divided into two main types: detached houses/row houses and apartment buildings, which are assigned separate scales.
- The energy label should be calculated based on standardized weather data, i.e. Oslo climate. However, it is recommended that the energy certificate also should contain the corresponding values for the actual climate where the building is located.
- For A-labelled buildings, an additional requirement is recommended: measurement of the air leakage number by blower door testing.



Energiklasse	Varmetapskoeffisient		Vektet tilført energi	
	Småhus W/K per m <sup>2</sup>	Boligblokker W/K per m <sup>2</sup>	Småhus kWh/m <sup>2</sup>	Boligblokker kWh/m <sup>2</sup>
<b>A</b>	= 0.45	= 0.35	= 75	= 65
<b>B</b>	0.46 – 0.70	0.36 – 0.55	76 – 115	66 – 100
<b>C</b>	0.71 – 0.95	0.56 – 0.75	115 – 150	101 – 130
<b>D</b>	0.96 – 1.30	0.76 – 1.10	151 – 190	131 – 175
<b>E</b>	1.31 – 1.65	1.11 – 1.50	191 – 230	176 – 215
<b>F</b>	1.66 – 2.45	1.51 – 2.20	231 – 345	216 – 325
<b>G</b>	> 2.45	> 2.20	> 345	> 325

Energy classes recommended by SINTEF ([www.bygningsenergidirektivet.no](http://www.bygningsenergidirektivet.no)).

Translation: Småhus = detached dwellings and row houses. Boligblokker = apartment buildings, Varmetapskoeffisient = heat loss coefficient, Vektet tilført energi = weighted delivered energy.

### Linking the PassivHaus standard with Norwegian energy performance certification

A PassivHaus will correspond to the A-class or better in the proposed energy labelling system. Thus, in principle, it should not be a problem to link the PassivHaus classification to the EPBD classification. However, issues of internal loads and passive house requirements for cold climates need to be resolved. These questions will be further discussed in our paper: "Passive Houses in Cold Norwegian Climates" that is in preparation for the 10<sup>th</sup> international passive house conference (abstract is attached).

No specific calculation method for the EPBD classification has been specified yet, but it will probably be based on the new EPBD CEN standards under development. It is not likely that the PHPP will be adopted in the Norwegian EPBD calculation procedure. However, a Norwegian version of the PHPP may be an option for passive house calculations.

It may be an option to get passive house calculations included in the training/accreditation programs that will be introduced for the EPBD calculations.

## Introduction

This final report builds on information which was presented, discussed and agreed during the PEP Partners meetings in Gent (October 2005), in London (March 2006) and in Petten (October 2006)

It sets out separate certification schemes for three elements of the supply chain for design, construction and post construction final inspection and testing of a PassivHaus. The draft final report which was presented in March 2006 raised a number of questions and issues at each stage of the certification process. The views of the partners were sought on these issues using a second questionnaire and are included in this final report.

However, at the meeting in Petten, the PEP partners recognised that with the current state of the PassivHaus market, it would be difficult to introduce such a 'supply chain' approach in many countries. This report, therefore, also proposes a simpler scheme for the current emerging market scenario. This scheme involves the verification of the 'as built' design in accordance with the Passive House Planning Package (PHPP) by a competent PEP partner and confirmation of the airtightness of the completed building by a fan pressurization test performed in accordance with EN 13829 by an accredited organisation or an organisation recognised as competent by the PEP partner.

The report also considers the implementation of the Energy Performance of Buildings Directive and the views of the partners on the possible relationship between these certification schemes and the Directive.

It should be noted that the PassivHaus Planning Package 2004 (PHPP) sets out the calculation methodologies to evaluate the design for space heating and total primary energy demand. The PHPP is a scheme operated by the PassivHaus Institute to verify the design of a building and to provide certificates for individual projects. The PHPP report states that 'Additional quality assurance of the construction process is useful, especially if the construction management and / or the contractor do not have previous experiences with building PassivHaus dwellings'. This is an important element and one that has been addressed in this report under the proposed certification scheme for the 'The Construction process'.

For certification of the design and certification of Passive Houses, it is the algorithms implemented in the PHPP which must be used, where the PHPP itself serves as the (documentation) master for the algorithms.

The report was compiled by BRE Certification Ltd for the BRE Environment Division.

# 1 Background and description of the project

BRE was awarded Work Package WP3 – PassivHaus Concept and Technologies Certification in relation to Energy Performance Certification by the work package leader. The project was reported as item 4.2.3 on page 13 of document EIE-2003-30 titled Promotion of PassivHaus dwellings.

Project overview (extract from document EIE-2003-30).

Description of the work, Outcomes and Deliverables		
Activities on the national level		Activities on the international level
3.2 Translation Adaptation to national building technologies , standards and codes Adaptation to national methods of EPC	◀	3.1 Define criteria for certification of PassivHaus dwellings, based on the PassivHaus Projektierungs Paket (English version) and EU-directive on Energy Performance Certification
		▲
	▶	3.3 Evaluation and feed back (all participants)
▼		
3.4 National PassivHaus Certification System		
3.6 Translation Adaptation to national building technologies , standards and codes Adaptation to national methods of certification of building technologies and building products	◀	3.5 Define criteria for certification of PassivHaus technologies, based on the outcomes of Work package 2
		▲
	▶	3.7 Evaluation and feed back (all participants)
▼		
3.8 National PassivHaus Technologies Certification System		

The description of work is broken into activities on both a National and International level. On a National level the project is looking at the local conditions within participating Countries with regard to Building Regulations, the implementation of the Energy Performance of Buildings Directive and attitude to third party certification. It also considers the market conditions and any existing certification and approval systems. On an International level the project is looking at developing a PassivHaus certification scheme that can be adopted across the participating countries allowing for variations at a National level for location and climatic conditions.

This project is interlinked with other work packages however the outcomes from work package 2 “PassivHaus Concepts and Technologies” were not available to the time of this final report being submitted.

The aim of this work package is to establish an International mechanism for the certification of PassivHaus dwellings such that each participating Country can operate to the same certification processes and criteria. This will add credibility to the PassivHaus programme and help to differentiate PassivHaus dwellings from traditional construction.

## 2 Consultation and Findings

The initial findings and a draft report were presented to the Partners in Gent in October 2005. They were based on a questionnaire, which was developed to gather information on the market conditions and the desire and need for a third party certification scheme for PassivHaus dwellings. This questionnaire was developed by BRE Certification for completion by the other members of the PEP Working Group. The questionnaire also considered national requirements, regulations and the introduction of the EPBD.

The purpose of this questionnaire was to obtain preliminary information on PassivHaus certification through identification of:

- the level of demand for PassivHaus construction across Europe
- the timeframe for the introduction of third party certification schemes
- the expertise required to conduct assessments
- the PassivHaus market
- national requirements, regulations and the introduction of the EPBD
- barriers to the uptake of PassivHaus construction
- the marketing opportunities
- need and opportunity for third party certification
- central database information

The questionnaire listed 14 questions and asked whether a certification scheme was generally a good idea and if so how should / could it be implemented and promoted. Responses were received from:

Country	Names(s)	Organisation(s)
Austria	Ernst Blumel	AEE INTEC
Belgium	Erwin Mlecnik	Passiefhuisplatform.be
Denmark	Klaus Ellehauge	Ellehauge & Kildemoes
Finland	Jyri Nieminen	VTT
Germany	Jurgen Schnieders	PassivHaus Institut
	Anke Unverzagt	proKlima
Netherlands	Isolda Strom, Chiel Boonstra, Bart de Boer, Henk Kaan	DHV ECN
Norway	Inger Andresen	SINTEF
United Kingdom	Gavin Hodgson	BRE

The type and extent of information that was received varied with each organisation. Some of the questions were phrased such that a simple yes / no answer could be given whereas other questions asked for a description of a system or condition within a Country.

The majority of respondents to the questionnaire were in favour of third party certification schemes and agreed that there were several stages at which certification schemes could play a vital role in the PassivHaus supply chain. Based on the responses to the questionnaire and inline with item 3.1 from the work package programme (WP3) three elements of the supply chain were identified for certification schemes at the following stages:

- Design stage
- The Construction Process
- As built – final inspection - including post construction testing – Airtightness.

These initial findings and recommendations were presented to the meeting in a report. A separate document was also tabled setting out the responses to the questionnaire from each Country. At the end of the discussions we were instructed by the Partners to work up the certification schemes and to prepare a draft final paper for review at the Partners meeting in March 2006.

A draft report was circulated to all Partners two weeks prior to the meeting on 21 March in London. At the meeting, the Partners were given a presentation on the proposed certification schemes and each of the questions and issues was discussed in full. The Partners were then split up into two groups to discuss these issues in detail and also to complete a questionnaire giving their own views on the issues and their thoughts on implementation.

The questionnaires were then collected and tabulated. Responses were received from the 9 countries with 14 responses overall.

The proposed schemes and the responses to the questions and issues posed to the Partners on 20 March are set out in Section 5 of this report.

Two general questions within the questionnaire related to the draft final report. The questions and answers are as follows:

Q.	Do you agree with the recommendation of the draft final report for three certification schemes to be established to create a supply chain approach to PassivHaus construction?
A.	11 of the respondees said 'yes', they agreed with the recommendations. Three said that they agreed with the approach but did not want the certification scheme to include the construction process element.
Q.	Do you think that your Country would be in favour of adopting the proposed certification system for PassivHaus?
A.	8 agreed that their Country would be in favour of adopting the certification schemes. 2 said 'no' as it appeared to be complicated and expensive, 2 were not sure.

At the meeting in Petten it became clear that, although the partners recognised the value of the supply chain approach proposed in the draft final report, they considered that the PassivHaus market was very small in most countries and that the number and type of companies involved in PassivHaus design and construction would make it difficult to introduce all of the certification elements proposed. The PEP partners have, therefore, also proposed a simpler scheme for the current emerging market scenario. This scheme involves the verification of the design in accordance with the Passive House Planning Package (PHPP) and confirmation of the airtightness of the completed building.

### 3 Emerging market scenario - Certification of individual PassivHaus dwellings by National PEP Organisations

#### *Introduction*

The PEP partners have proposed that during the period that the PassivHaus market is developing it would be difficult to introduce a supply chain certification scheme as described in Section 5 of this report. A simpler scheme for the certification of individual PassivHaus dwellings is therefore described in this section.

#### *Objective*

This certification scheme aims to ensure that the design of a particular PassivHaus can deliver the specific energy requirements in accordance with the Passive House Planning Package (PHPP) and confirm the airtightness of the completed building. It must be recognized that, although the airtightness of the building gives some indication of the quality of the construction, it does not give assurance that the construction has been completed in accordance with the design, especially with respect to the requirements for insulation and the avoidance of thermal bridges.

#### *Scope*

This certification scheme involves the verification of the 'as built' design in accordance with the Passive House Planning Package (PHPP) by a competent PEP partner and confirmation of the airtightness of the completed building by a fan pressurization test performed in accordance with EN 13829 by an accredited organisation or an organisation recognised as competent by the PEP partner undertaking the certification.

#### *Assessment Criteria*

The following shall be met for the for the PassivHaus design when assessed in accordance with the PassivHaus Planning Package (PHPP). This assessment shall be made on completion of the building using the 'as built' design details (i.e. that reflect the actual construction, incorporating any modifications made during construction):

- the total energy demand for space heating and cooling:  $q_H \leq 15 \text{ kWh (m}^2 \text{ a)}^{-1}$
- the total primary energy requirement for all appliances, domestic hot water and space heating and cooling:  $Q_P \leq 120 \text{ kWh (m}^2 \text{ a)}^{-1}$

Note: The possibility of adjusting these values, by agreement with the PEP partners, to suit latitudes above 60° was agreed in Petten but no specific values were agreed.

The following shall be achieved when the air permeability of the building is measured in accordance with EN 13829:2000 on the completed building:

- Air change rate at  $\pm 50 \text{ Pa}$ :  $n_{50} \leq 0.6 \text{ h}^{-1}$

#### *Further assessment recommendations*

Since the above assessment criteria apply to the 'as built' design details and the completed building, there is a significant risk that any non compliances due to fundamental errors will be difficult to correct when the building is complete. It is therefore recommended that the following procedures are also followed:

- The design is checked against the PHPP before construction is started to confirm that the criteria for the specific heating and primary energy requirements are met;
- The construction on site should be checked to ensure that the dwelling design has been realised;
- Air permeability measurements are made during the construction process so that air

leakage problems can be identified and remedied while access to the membranes etc is still available.

Since the actual performance of the building will be very dependent on the correct operation and maintenance by the occupant, it is recommended that adequate written information and instructions are provided to the occupants, at the time when the certificate is issued.

## 4 Certification for a developed PassivHaus market

### 4.1 Certification scheme for the design process

#### *Introduction*

There are many steps in the process to achieve a PassivHaus, however the most critical element is the actual design.

#### *Objective*

This third party certification design scheme will evaluate the management systems and competence of designers of PassivHaus dwellings.

#### *Scope*

This certification scheme can be approached in two ways. These are:

1. assessment of an individuals competence to design PassivHaus dwellings
2. assessment of an organisations management systems to design PassivHaus dwellings.

In both cases the certification body is evaluating the design capabilities however the first approach is for an individual or a 'sole trader' working in a small practice or for themselves. The second is for a company who wishes to have the design capability for PassivHaus dwellings.

Approach 1. is considered 'Personnel Certification' and the certification scheme is intended for 'Accreditation' to the International accreditation standard ISO 17024. Approach 2. is 'Product Certification' (the product being the final design of the building), and the certification scheme is intended for 'Accreditation' to EN 45011.

The following tables set out some of the advantages and disadvantages of the two systems:

<b>Approach 1: Individuals / personnel certification</b>	
<b>Pros</b>	<b>Cons</b>
Assessment proves the competence of an individual to work to specific standards and specifications through observation and questioning.	Assessment is specific to that piece of work and may not reflect the level and quality of work on an ongoing basis
Provides mobility as certificated individuals can work for others under subcontract.	The accreditation standard ISO 17024 for personnel certification requires a re-assessment every three years.



<b>Approach 2: Companies</b>	
Pros	Cons
Assessment of the management systems the Company employs to demonstrate how the design process is managed. This provides confidence that systems and procedures exist. The actual assessment of design activities then confirms how these policies and practices are implemented and managed for individual projects.	Can lead to longer assessment time as concentrating on systems and overall capability to undertake the work rather than the actual work itself
Company specific capability using any staff that they deem competent through their own training systems	
The product is the design itself and this is why many certification schemes are Company based and the certification bodies accredited to EN45011	
Can be linked to other stages of the supply chain such as construction and final inspection and testing.	

These two types of certification schemes already exist in Europe for a variety of construction activities and specifically in the UK for Competent Persons Schemes to satisfy the Building Regulations. In many cases certification schemes are a combination of product and personnel certification with the Company gaining the certification capability but using named individuals that have been assessed as part of the certification process.

### ***Application and entry level***

The company or individuals complete and submit an application form to their chosen certification body for review. The review establishes that the certification body has the capability to deliver the service. This has been discussed in both the initial WP3 questionnaire as well as the meeting in Gent and a satisfactory solution is needed to determine the level and mix of qualifications and experience that are needed by the designer as well as the Certification Bodies.

A proposal / quotation is developed by the certification body setting out the assessment requirements such as the PassivHaus design standard (PHPP) the assessment criteria and the elements for management systems certification. Proposals also set out the duration and costs for the assessment and provide details of how and when certification is granted and how it is maintained.



## **Assessment**

Once an application is accepted the assessment activities are undertaken. Assessment is an objective examination of the Company and or individual to against a specified standard and criteria. Elements of Assessment typically include:

- Assessment of the applicant company

This assessment would consider the management systems and procedures the Company adopts to undertake and deliver the design process to meet the national codes and the appropriate use of the PassivHaus Planning Package (2004). It would also include an element of personnel certification through the review and assessment of work for individual designers, their ability to follow the design brief and the company's management systems and operation procedures. A management system is a documented system, which meets the requirements set down in the certification scheme document. Typically this is achieved through ISO 9001: 2000 "Quality Management Systems" or a system of Factory production control which is similar to ISO 9001 but can be geared more specifically to the actual product.

- Assessment of individual designers

This assessment would look at the capability and competences of the individual designers to deliver the designs and their knowledge and use of the PassivHaus Planning Package (2004) including the correct specification and use of materials and systems in the final design specification.

We have identified two further options to assess the competence of individuals. Both options can also be combined into a single scheme requirement for an examination followed by an assessment. The views of the Partners were sought to determine which approach is preferred and which will provide the best delivery of certification.

### **1. Examination of individuals**

This system is as the name suggests is a structured examination of the subject to test the knowledge and understanding of the designer. It is also possible for examinations to be conducted in two parts. The first being a theory examination conducted under examination conditions and the second part is a completion of a test examination based on a scenario (design brief) with certain elements and information provided or to provide solutions to design situations. A combination of these types of examination allows the certification body to test knowledge, theory and practice. The second aspect could also be the conducted as 2. below:

### **2. Assessment of individuals**

This system is based on an assessment of completed designs and work in progress. Through, observation and questioning, the assessor asks the designer to demonstrate how the design was put together based on the design brief, the PassivHaus Planning Package (2004) and any of the applicable National and International codes.

Both approaches are valid forms of assessment. As stated above it is possible to combine them into a single certification scheme.

## **Assessment criteria**

This report and the proposed design scheme refer to the PassivHaus Planning Package PHPP (2004) for the design and assessment criteria for PassivHaus dwellings. The calculation methodologies and assumptions and the appropriateness of the PHPP have not been evaluated as part of this work package.

The selection of materials and products is subject to a separate report from Work Package 3, due to be published in July 2006 setting out the certification schemes for the PassivHaus technologies.

It is recommended that designs are verified and signed off in accordance with documented procedures.

### ***Certification***

Upon successful completion of all of the assessment requirements a certificate is issued to the Company or individual setting out the requirements that were used as part of the evaluation. It is usual for certificates to be valid for three years. Certificates are issued and held in force through satisfactory completion of certification maintenance requirements. A supplementary certificate may also be issued for the management system / FPC systems assessment.

### ***Maintenance of certification***

Certification is generally maintained through surveillance visits to determine that the designer / company meet and continue to meet the certification scheme requirements. It is proposed that these visits are made to the design offices to evaluate completed and in process PassivHaus designs.

The frequency and duration of maintenance visits is a decision for the certification body and is dependent upon the type and extent of the work that is available to review and the complexity of the management system / FPC.

Typically maintenance visits are at least annual and take between 1 and 2 days.

### ***Duration for initial assessment activities***

The following is an illustration only of the typical assessment durations for this type of scheme and activity. It should only be used as a guide, however it is important for certification bodies to ensure that sufficient time is allocated to the planning and assessment activities such that a level playing field exists.

Activity	Duration (days)
Application review and proposal generation	0.5
Pre-assessment (optional)	1
Assessment:	
1. Company	2
2. Individual	1.5
Close out and certificate issue	0.5

This table does not include travel time or duration for partial or full re-assessment where non-compliances with the assessment requirements are identified.

**Benefits of this scheme**

PassivHaus designs are completed by Companies / individuals who are independently certificated to confirm that they have the systems and competence to produce PassivHaus designs.

This approach to certification for design differs from that detailed in the PassivHaus Planning Package (PHPP) which requires that each completed design is submitted to the PassivHaus Institute or an authorised certifier. This scheme seeks to confirm through third party assessment that the designer (company / individual) is competent to use the PassivHaus Planning Package and to produce designs, which meet the design brief.

**Next steps**

Whilst the design scheme will establish that the design elements are in accordance with the PassivHaus design standards it is important that a supply chain is established to ensure that what is actually built meets the designs. This is why it is important to also apply third party assessment activities to the construction and final inspection stages.

The outputs from this design stage are as follows

- Site plans
- Design drawings
- Mechanical plans
- Details of the thermal bridge free junctions of the thermal building envelope
- Specifications for glazing, ventilation system, space heating, DHW systems, plumbing, ducts and any other heating systems such as subsoil heat exchanges (where specified). All specifications to include the product, manufacturer, insulation values and solar transmittance values (where applicable).
- A specification for the household electricity consumption including household appliances.
- Calculation of the primary energy requirement
- Calculation of the specific heating requirement.

**Qualifications, Skills and Experience**

The initial questionnaire asked for comments of the minimum skills, qualifications and experience needed for each of the stages of this supply chain certification scheme. The views and responses were mixed and some countries questioned whether any one person would have all of the necessary attributes.

Whilst it may prove very difficult to agree and set down these criteria, there is an alternative approach. This is to state that the applicants for the design scheme must have satisfactorily completed a training course recognised by the certification body. This means that the certification body has evidence of training and knowledge for the subject.

For certification bodies the process for deciding the mix of qualifications experience and skills is an essential part of the management systems to meet the accreditation standard(s).

**Summary table of Design scheme issues discussed and agreed by the PassivHaus partners on 20 March 2006:**

Q.	Should the scheme operate at a company or individual level?
A.	This question received mixed responses with 6 stating that it should be both, 5 stating that it should be Company and 3 stating that it should be a scheme for individuals. In the proposal it was noted that a joined up approach was possible with the sponsoring company and the individual both involved in the certification scheme.
Q.	Do you think that minimum qualifications & experience can be established as entry level for applicants and certification bodies?
A.	6 of the responses said 'yes' it is possible but expected this to be at a level of University education plus courses on energy efficiency, PHPP calculations, planning and construction.  1 respondent was unsure, however 6 respondents agreed with the assessment approach detailed for the applicants in the draft final report as the best was of determining capability and competence.
Q.	Which management systems certification is appropriate: ISO 9001: 2000 or a system of Factory Production Control or both?
A.	6 respondents stated that they the most appropriate system was either ISO 9001 or FPC or a combination of the two. 1 didn't want any system at all, 2 were not sure and 2 didn't provide an answer to the question.
Q.	Which type of evaluation is best suited to this scheme – examination or assessment or both?
A.	9 of the responses preferred a robust system containing both elements whilst 4 were in favour of just an assessment.
Q.	Should applicants be granted provisional certification subject to a satisfactory assessment?
A.	9 of the responses said that they would like to see a provisional scheme and two of those noted that it should be time limited to a year. 2 respondents said 'no' and 3 did not provide an answer.

## **4.2 Certification scheme for the construction process**

### ***Introduction***

Certification of the PassivHaus construction process is the second stage in the overall supply chain certification system.

### ***Objective***

To construct a dwelling to the certificated design.

### ***Scope***

This proposed third party certification scheme will evaluate the management systems of a Construction company to manage all aspects of the construction process from planning to commissioning, and to ensure that it meets the certificated design as well as National and European regulations.

For this scheme, the certification would not apply to each constructed dwelling but to the actual construction process that manages the construction of the dwellings themselves.

By Management systems we are referring to ISO 9001: 2000 or a system of Factory Production Control (FPC).

### ***Application and entry level***

The scheme should be open to any construction company wishing to engage in the construction of PassivHaus dwellings.

The company completes and submits an application form to their chosen certification body for review. The review establishes that the certification body has the capability themselves to deliver the service.

A proposal / quotation is developed by the certification body setting out the assessment requirements for management systems certification and the duration and costs for the assessment. The proposal should also provide details of how and when certification is granted and how it is maintained.

### ***Assessment***

Once an application is accepted the assessment activities are undertaken. Assessment of a Management System ensures that a company has the correct policies and procedures in place to manage the construction process. This type of certification places the reliance on the Construction Company to produce objective evidence to comply with the design and construction requirements.

Assessment should consist of an evaluation of the management System at the Company's offices as well as an assessment at a construction site to see how the policies, practices and procedures are being used as part of the construction process.

### ***Design changes / variations***

In order for the supply chain to work correctly, any proposed changes to the design, products or materials must be re-evaluated and authorised by the original designer through a design change system, which is an important element of the management system.

## **Certification**

Upon successful completion of all of the assessment requirements a certificate is issued to the Company stating that they have a management system which meets the requirements of the assessment standard (ISO 9001: 2000 or FPC). It is usual for certificates to be valid for three years. Certificates are issued and held in force through satisfactory completion of certification maintenance requirements.

## **Maintenance of certification**

Certification of Management Systems is maintained through surveillance visits to determine that the company continues to meet the certification scheme requirements. These visits are made to the Company's offices and to construction sites.

The frequency and duration of surveillance maintenance visits is a decision for the certification body. See section below for Duration.

## **Duration**

The recommended duration for assessments, surveillances and re-assessments for Management Systems certification is defined in document IAF-GD2-2005 available from [www.iaf.nu](http://www.iaf.nu).

## **Benefits of this scheme**

To ensure that Companies involved in the construction of PassivHaus dwellings operate management systems to construct PassivHaus dwellings according to the certified design.

## **Next steps**

To complete the supply chain it is necessary to find out if the constructed dwelling actually meets the certified design in order to be classified as a 'PassivHaus'. This is achieved through the last part of the certification chain by final inspection and testing.

<b>Summary table of construction process scheme issues discussed and agreed by the PassivHaus partners on 20 March 2006:</b>	
Q.	Which management systems certification is appropriate: ISO 9001: 2000 or a system of Factory Production Control or both.
A.	The majority of the responses (8) were in favour of either ISO 9001 or FPC. 2 respondees were not in favour of this particular certification scheme. The other responses received were: 1 not sure, 2 no answer, 1 ISO 9001, 1 FPC.
Q.	What additional requirements specific to PassivHaus construction should be included in the assessment activities?
A.	various: <ul style="list-style-type: none"> <li>- cost benefit analysis including energy costs and maintenance</li> <li>- thermal bridges and long term airtightness</li> <li>- ventilation and heat recovery system testing</li> <li>- proper fitting of insulation avoiding thermal bridges</li> <li>- inspection of prefabricated products</li> </ul>

- cost benefit analysis including energy costs and maintenance
- thermal bridges and long term airtightness
- ventilation and heat recovery system testing
- proper fitting of insulation avoiding thermal bridges
- inspection of prefabricated products

### **4.3 Certification scheme for post construction inspection and testing**

#### ***Introduction***

This is the final step in the PassivHaus process to determine whether the constructed dwelling actually meets the certificated design as well as the airtightness requirements.

Unlike the first two stages in this report, this final stage is a single piece of work and is not part of an ongoing system to ensure that the product meets and continues to meet the requirements. An independent inspection and testing body should conduct the inspection and testing activities.

The inspection and testing body may also wish to ensure good handover by additionally checking that the heating and ventilation system is set up to work as intended.

#### ***Objective***

This proposed third party certification scheme for 'Post construction inspection and testing' is necessary to determine whether the constructed dwelling meets the initial design. The output from this scheme (report) should form a vital part of the handover of the property from the Constructor to the purchaser along with a proposed building handbook (see recommendations and conclusions).

#### ***Scope***

This proposed third party certification scheme will evaluate the constructed dwelling to ensure that the correct products and materials have been used and that the dwelling meets the airtightness requirements. Additional airtightness tests may be required following changes to the design and in practice more than one test may be required to achieve a pass.

Airtightness testing – Air leakage test to EN 13829. The requirements for the air leakage test results are set out in the PHPP.

#### ***Certification criteria***

The certification criteria for this stage of the supply chain are as follows:

- airtightness testing to EN 13829
- review of the construction against the initial design
- review of the material and products used in the construction process

Other measures and tests such as infrared monitoring can be used for fault finding although they are not required as actual test under the certification scheme. The views of the Partners were sought on this issue.

#### ***Application and entry level***

It is suggested that the constructor or the designer completes an application and enters into a contract with a test and inspection body at the earliest stages of construction. This will allow sufficient time for the design to be evaluated and the testing regime and timetable for inspection and testing to be defined.

#### ***Assessment***

At the appropriate time, the designer / constructor invites the inspection and testing body to undertake the assessments and test as detailed in the criteria above.

The inspections and tests are conducted against a detailed test and inspection schedule.

Where the dwelling does not meet the requirements of the test schedule further inspection and testing may be required.

**Certification / test reports**

Upon satisfactory completion of all of the assessment requirements a test report / certificate is issued to the designer / constructor detailing the individual aspects of the inspections and their results.

The inspection and test is a statement of performance at the time that the inspecting and test is performed. It is not a guarantee of ongoing performance.

**Next steps**

Once the test report / certificates have been issued, the designer / constructor raises a final certificate for the dwelling.

**Summary table of construction process scheme issues discussed and agreed by the PassivHaus partners on 20 March 2006:**

Q.	Are additional tests such as infra red useful?
A.	All of the responses were in agreement that infra red testing was useful. Some of the respondents went on to note that this form of testing is useful if contractors do not have much experience in airtight constructions because it helps to identify and avoid thermal bridges. It was also noted that this testing can be expensive.
Q.	At what stage in the construction process should the airtightness tests be conducted?
A.	Most of the responses indicated that it was important to undertake this test as soon as the airtight layer is finished so that any leaks can be repaired. One response stated that the test should be repeated on an ongoing basis to achieve the maximum airtightness.
Q.	How should the contractual issues between the parties be organised?
A.	6 of the respondents thought that a single point contract was the best method and 5 thought that it was dependent upon how the contracts are let?



#### 4.4 Final certificate on completion

On completion of the supply chain certification process a final 'Quality Approved' certificate can be issued by either the designer or the constructor. The certificate guarantees that the dwelling built achieves the PassivHaus design criteria (as assessed using PHPP). The certificate is similar to the existing PassivHaus Quality Approval Certificate as detailed in the PHPP.

It is not a requirement for the certificate to state specific calculations and standards, as the certificate is consumer orientated – however individual countries may choose to provide this.

The designer or the constructor must keep record of the information entered into PHPP.

The figures used to complete PHPP must be in accordance with the following standards:

Element	Standard
Calculation of U-values for building components and elements (other than ground floors)	EN ISO 6946
Calculation of U-values for glass structures.	EN 673
Calculation of U-values for ground floors	EN ISO 13370
Calculation of thermal values for building materials and products	EN ISO 10456 (for interstitial condensation analysis manufacturers information or tabulated values in EN 12524 can be used)
Windows and Doors	U-value: <ul style="list-style-type: none"> <li>▪ Calculation EN ISO 10077 – 1 &amp; 2</li> <li>▪ Measurement EN ISO 12567 -1 &amp; 2</li> </ul> Radiation properties (glass): <ul style="list-style-type: none"> <li>▪ Solar factor EN 410</li> </ul> Air permeability: <ul style="list-style-type: none"> <li>▪ Test method EN 1026</li> <li>▪ Classification EN 12207</li> </ul>
Non-repeating/linear thermal bridges	EN ISO 10211-2
The technical specifications of building services, such as whole house mechanical ventilation systems, used to complete a PHPP assessment must be those calculated via the assessment criteria detailed in PEP report 3.4 'Building technologies certification' as some EU and national test procedures do not offer sufficient precision for PassivHaus design. The definition of treated floor area is dependant upon each nation, as there is no European norm, the preceding national statement to this report should provide information on this.'	

## 5 Relationship between certification and the EPBD

A supplementary question was asked of the Partners to understand possible relationship between the certification activities and the Energy Performance of Building Directive. A paper from the UK perspective accompanied the questions. In the second questionnaire this issue was also raised and received mixed responses with no consensus or sensible conclusions that could be drawn from the responses.

At the time of writing this final report, incorporation of EPBD into PassivHaus certification seems unviable – mainly due to the different national rating methodologies.

Some specific issues of individual countries are highlighted below:

Country	Names Organisation	Comment
Austria	Michael Prenner AEE INTEC	The implementation of the EPBD has not been agreed and unlikely to be finished until Autumn 2006. However, It is likely that energy performance certificates will be expressed as kWh/m <sup>2</sup> /yr. In addition, the calculation methodologies used in each of the 9 provinces will be different as they each operate under different laws.
Norway	Inger Andresen SINTEF	Full content and layout of the Norwegian energy labeling system has not been decided yet.  However, the proposed Norwegian energy labeling system is expressed in kWh/m <sup>2</sup> /yr so a PassivHaus will correspond to the A-class or better. Thus, in principle, it should not be a problem to eventually link the PassivHaus classification to the EPBD classification.
UK	Gavin Hodgson BRE	Linking EPBD energy labeling into the PassivHaus certification is not viable for the UK as the UK's EPBD certificate is based on the SAP methodology which is a completely different rating scale.
Ireland	Irena Kondratenko NUID	The Dwelling Energy Assessment Procedure (DEAP) has been developed on behalf of the Irish Government by Sustainable Energy Ireland (SEI), and introduced to the housing industry in Ireland in response to the EPBD.  DEAP is an adaptation of the UK's Standard Assessment Procedure (SAP 2005), but includes improved algorithms to assess heating energy use and to take account of the effect of the thermal capacity of a dwelling's fabric on its energy performance. The outputs of DEAP are expressed in kWh/m <sup>2</sup> /year.  Possibility where dwellings meeting the PassivHaus standard are to be represented on the Energy Performance Certificate, using DEAP rating could be further investigated.
Belgium	Erwin Mlecnik Passiefhuis- Platform vzw	Very similar situation as the UK.  Linking PassivHaus accreditation directly to EPBD certificates is unviable in Belgium (due to different rating methodology), we should, however, consider undertaking work to simplify the PHPP assessment procedure; this should ease the burden of having to carry out two calculations.

Germany	Anke Unverzagt Proklima	<p>In Germany EPBD hasn't been implemented completely. There is still no draft version of the new energy-savings-ordinance (EnEV2006) published which will regulate details for energy certificates. The main point of issue with associations of housing-companies is if the certificate should base on performance- or on asset-rating.</p> <p>The calculation method for Passive Houses according to Passive House Planning Package (PHPP) is validated and established in Germany. It was developed independently from German building legislation. The advantage is that calculation procedures and boundary conditions are not influenced by political considerations and special interests of stakeholders and fast integration of new research results is possible. Right these qualities are the reason that PHPP is a highly-estimated tool in Germany. Furthermore EnEV 2002 calculation procedure is included within PHPP to avoid extra work for planners.</p> <p>The future challenge will be to win more users for PHPP and to spread the planning and quality standards of Passive Houses. "Official" EnEV procedures are already integrated in German PHPP. PHPP will be updated after national implementation of EPBD.</p>
Holland	Isolda Strom DHV	<p>In August 2005: The Dutch Government decided not to adopt the EU directive on energy performance for buildings in the Netherlands in the near future. However plans leading up to that decision were for the EPBD to be implementation, in such a way that minimal adjustments to existing schemes have to be made. Therefore, the Netherlands mainly built upon the existing Energy Performance requirements for new buildings (EPN) and the EPA system for existing buildings.</p>

An 'Intelligent Energy Europe' project "Applying the EPBD to improve the **Energy Performance Requirements to Existing Buildings – ENPER-EXIST**, was recently completed. The work package 1 'Tools application' set out to identify the gaps between the EPBD CEN standards and practice for existing buildings. This was done by analysing the most important EPBD standards for aspects such as:

- missing influencing factors, especially important for existing buildings, and
- influencing factors, which are of less importance for existing buildings and are complicating the gathering of data too much.

As part of the public enquiry, **ENPER-EXIST** gave advice to the responsible CEN working groups about possible changes they can make to make the standards more applicable to existing buildings. Further details are available at [www.enper-exist.com](http://www.enper-exist.com)

## 6 Benefits of third party certification

The benefits of independent third party certification for PassivHaus dwellings are:

- Risk management for architects, contractors, designers, end users, insurers, clients & specifiers,
- Compliance with the PassivHaus Planning Package (2004), standards and legislation
- Assists market entry for PassiveHaus and for new suppliers
- Differentiation from dwellings which do not meet the PHPP requirements.
- Product and process improvement
- Customer satisfaction
- Consumer confidence
- Enhanced marketing and use of the PassivHaus mark

## 7 Accreditation and the role of the EA

This report recommends that certification bodies involved in offering these schemes are 'Accredited' by their national accreditation bodies to the some or all of the following accreditation standards:

- EN 45011 – Product certification
- EN ISO/IEC 17020 - Inspection
- EN ISO/IEC 17021 - Quality systems.
- EN ISO/IEC 17024 – Personnel certification
- EN ISO/IEC 17025 – Testing

Each of these standards also has an ISO/IEC Guide which is produced by the EA

EA stands for the [European co-operation for Accreditation](#) (EA) is the Association of the national accreditation bodies that provide accreditation of the following conformity assessment activities:

- Calibration
- Testing
- Inspection
- Certification of management systems
- Certification of products
- Certification of personnel

EA operates under Memoranda of Understanding with the Commission of the European Communities and EFTA.

The EA multilateral agreement (MLA) provides a means for goods and services to cross boundaries in Europe and throughout the world.

A test or inspection report or a certificate issued by an accredited body in one country is recognised as equivalent to a report or a certificate issued by an accredited body in any of the countries signatories to the EA MLA. Accreditation bodies recognise that they operate in an equivalent way and that they deliver equivalent accreditations, providing the same level of competence and confidence.

The MLA makes accreditation a "passport" which facilitates access to the EU and international markets through co-operation with ILAC (International Laboratory Accreditation Co-operation) and IAF (International Accreditation Forum).

### The scopes of the EA MLA

Accreditation of laboratories	Testing, Calibration	ISO/IEC 17025, ISO 15189
Accreditation of certification bodies	Certification of products	EN 45011 (ISO/IEC Guide 65)
	Certification of persons	ISO/IEC 17024
	Certification of quality management systems	ISO IEC 17021
Accreditation of inspection bodies	Inspection	ISO/IEC 17020

In the second questionnaire, the Partners were asked if they thought that all the certification Bodies operating certification schemes for PassivHaus should hold National Accreditation by an accreditation body recognised by the EA? - 7 of the respondees agreed and 6 disagreed.

## 8 Products and materials

To achieve the low energy requirements of a PassivHaus it is often necessary to use products and materials with certain aspects of their performance that far exceed normal regulatory requirements. To assist in the selection of suitable products it is recommended that there should also be a certification scheme for PassivHaus products (technologies). Although it is not intended to be a requirement that only certificated products can be used for a PassivHaus, the following are seen as the likely benefits:

- Benefits for designers and specifiers:
  - Provides a list of suitable products
  - All the parameters will be specified as required for the PHPP
  - These parameters will have been verified as correct
  - Ensures that quality is maintained
- Benefits for the manufacturers and suppliers:
  - Differentiates suitable products
  - Increased sales
  - Helps to target development
  - Maintains brand integrity
  - Eases market entry for new products

A paper on the certification of PassivHaus Technologies is being developed as part of the WP3 to address work items 3.5 – 3.8.

## 9 Conclusion and recommendations

This report sets out a supply chain approach to the certification of PassivHaus dwellings. This involves certification, and hence the control of quality, of the design process, the construction process and the post construction inspection and testing of PassivHaus dwellings.

Although the majority of the PEP partners agreed that this would be the most thorough procedure for ensuring the quality of PassivHaus dwellings, there was also a general recognition that it would be difficult to introduce such a scheme with the current state of the PassivHaus market.

The report therefore also sets out a simpler scheme, which should allow PEP partners to provide a degree of certification for individual PassivHaus dwellings while the market develops. This involves the verification of the 'as built' design in accordance with the Passive House Planning Package (PHPP) by a competent PEP partner and confirmation of the airtightness of the completed building by a fan pressurization test performed in accordance with EN 13829 by an accredited organisation or an organisation recognised as competent by the PEP partner.

It must be recognized that, although the airtightness of the building does give some indication of the quality of the construction, it does not give assurance that the construction has been completed in accordance with the design, especially with respect to the requirements for insulation and the avoidance of thermal bridges and hence does not cover all of the aspects that would be covered by the supply chain approach. It is therefore recommended that, if the simpler scheme is adopted, the situation should be reviewed as the market develops. It is also recommended that any certification bodies involved in certification to these schemes should be accredited to demonstrate their impartiality and independence.

The report also includes a brief review of the possible relationship between PassivHaus certification and the Energy Performance of Buildings Directive (EPBD). At the time of the review it appeared unviable to combine the processes required for these programmes due to the different methodologies used. However, a number of the comments suggested that there could be convergence in the future.

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