EuroPHit

Final Report

Retrofitting for the energy revolution, one step at a time

Co-funded by the Intelligent Energy Europe Programme of the European Union

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Table of contents

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1. Foreword

Europe is on the leading edge of the energy transformation towards renewables and efficiency. It has been realized, that this is one of the most important tasks in order to create a sustainable energy future.

The single most energy consuming service within the EU is thermal comfort control in buildings; the highest part of which is heating, accounting for at least 30% of the European energy demand. At the same time, the heating demand is also concentrated during the winter months –the time period where renewable energy is not abundant at all.

But there is good news: in the past 25 years significant progress has been made in the development of new buildings with very low heating demand. The Passive House Standard, first demonstrated on a large-scale in the European “CEPHEUS” project proved that a reduction to less than 15 kWh/(m²a) is possible everywhere in Europe. Good experience with Passive House buildings was one reason for the European Commission to state the Nearly Zero Energy Building (NZEB) as the goal in the second decade of the 21st century. Heating demand in new buildings can be reduced by more than 80% compared to the existing average using the Passive House concept.

With this success for new buildings, there will be no problem with the additional energy demand of new construction – buildings with such an efficiency can easily be supplied with renewable energy.

The real challenge now is the existing building stock – mainly built during times where energy seemed to be abundant and cheap, efficient building components were not readily available on the market, these buildings consume between 150 and 250 kWh/(m²a), about a factor 10 more than well-designed NZEBs.

Now there is more good news: existing buildings can be improved during a thorough retrofit process. All the measures, which have been proven successful in the construction of new NZEB’s can also be applied for retrofits.

The only “problem” with that is that existing buildings have their own dynamics – these buildings are not static as many people think. Building components have to be retrofitted anyway from time to time. These events are the exact opportunities to not just replace an old component, but to improve their efficiency at the same time. If the improvement is not done at this time, it will be a lost opportunity. Therefore, it is really important to make the future-proof decisions at each of these refurbishment steps: “if you do it, do it right”.

Acknowledging the fact that building components are refurbished according to their own dynamics and often at different times, the EuroPHit project demonstrated how even in such a situation a deep energy retrofit can be achieved. The key for this is the EnerPHit Standard: using Passive House components in each single step of the retrofit chain will reduce the energy demand step-by-step. Using the Passive House Planning Package as the planning tool, the overall goal is kept in sight. Well-planned deep energy retrofits, ensure cost-effectiveness, longevity and comfort.

The pilot projects within EuroPHit, show that it is possible and desirable to undertake retrofit projects of all kinds. The concepts and examples developed within the framework of this project set a path for the European Union and its Member States to reduce energy consumption significantly in their existing building stock. This can only be achieved through smart policies, financing schemes that value and recognize the long-term potential, and forward-thinking product manufacturers. Examples at all levels are described here in this report with an eye towards the future, and sets the way forward for these institutions, individuals and relevant market players.

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2. Executive Summary

Recognizing the need for significant energy efficiency improvements to Europe's existing building stock in order to reach EU energy goals, the EuroPHit project aimed to significantly increase the quality and efficiency of building retrofits – leading towards deep energy retrofits. It focused specifically on the most common type of retrofit, step-by-step retrofits, those completed in stages over a longer-period of time. The project's main focus areas as such were in capacity building activities, developing a comprehensive certification and quality assurance process and implementing the theory into practice through a number of case study projects.

The project consortium of the EuroPHit project looked at identifying barriers for deep energy retrofits to the existing building stock in Europe and creating tools and examples of how they could be overcome.

The European Commission has estimated that 75% of Europe's buildings are inefficient and it has pushed for energy efficiency to be prioritised by policy makers. Recognizing that energy goals of the Commission can only be achieved through extensive involvement of the existing building stock, projects such as EuroPHit are crucial to the implementation of such buildings and a significant shift towards a sustainable energy future.

The initiative from the project consortium to define the activities of the EuroPHit project looked first at common barriers to deep energy retrofits and identified activities which could aid to overcome these barriers in pilot projects, but also to create tools which would

Central to this project was the creation of tools and resources as well as the dissemination of best practices and lessons learned which did and will further create opportunities for this to be replicated throughout the European Union and beyond. This project demonstrated what is possible – to building owners, investors and policy makers. The first important step to creating significant change and motivating market actors as well as politicians to engage in radical energy improvements, starts by showing examples of what can be achieved and how it can be achieved. For investors, this was especially important in the EuroPHit project, to demonstrate the long-term investment potential of deep energy retrofits, either step-by-step or all at once – and equally important that financial institutions and lenders learnt the basics behind these long-term energy savings gains in order to develop and implement appropriate and relevant financing programs.

The aim of the EuroPHit project was to significantly increase the quality and energy efficiency of step-by-step refurbishment of buildings throughout the EU by developing a comprehensive certification and quality assurance process, including an energy balance calculation tool allowing to evaluate and display several retrofit steps at once.

Partial refurbishments, carried out without an overall plan for the individual building, are supposed to keep up to the planned high energy efficiency standard and comfort improvement of the buildings retrofitted. Thereby case study projects for step-by-step retrofits all over Europe were carried out to showcase the possibility to develop refurbishment concepts with high efficiency as outcome, without lock-in effects and with high thermal comfort and satisfied owner satisfaction as to be expected for high efficiency measures.

The objective of these case study projects also was to learn more about the specific problems arising from step-by-step refurbishment processes and elaborate recommendations how to work around these barriers. Alongside with these projects, the intention was to train involved designers and craftsmen in high efficiency retrofit concepts. To deal with step-by-step retrofits completely, the consortium worked on detecting product demand for specific building components for step-by-step retrofits and support the industry in developing respective components, and to evaluate energy efficiency financing mechanisms and programmes for deep retrofits and get in touch with the funding or financing institutions discussing these concepts and to raise awareness of benefits for deep energy retrofits.

The methodology of the project looked at addressing the gaps to deep energy retrofits and specifically step-by-step retrofits in the categories of having adequate capacity, examining existing and required funding schemes, analysing required products and their energetic criterion and enabling market development and adoption of it. This was underscored by a certification scheme and relevant tools and the implementation of these practices in case study project in the partner countries.

Energy efficiency is the key factor for achieving the targets set by the EU for 2020. Due to long life-cycles of buildings, the EU's energy policy objectives can only be achieved by improving the energy performance of the existing building stock through both, complete and partial refurbishment. Significant reduction of energy costs by means of energy-optimised planning for complete refurbishment has been demonstrated in many successful examples.

The project centred around case study projects which would look at deep energy step-by-step retrofits on different buildings throughout different EU Member States. With the case study projects as the backbone, the following **main activities of the project** were undertaken:

- Internal training for tradespersons and designers on case study projects

Following the establishment of which pilot projects were to serve as case study projects in EuroPHit, the consortium embarked on internal training to share the latest knowledge on high efficiency step-by-step retrofits. This included training on a new beta version of the Passive House Planning Package (PHPP) which would enable the user to enter design variants or different retrofit steps, in order to further design and consult on these case study projects and their unique nature of achieving a high energy standard in increments.

- Project consultation and initial design for case study projects

With this new training and knowledge sharing completed, case study projects were entered into this beta version of PHPP and feedback was given, where the retrofit concept chosen was complicated to be entered and where additional features, improvements or adjustments might be needed.

- Creation of the energy balance tool and criteria for step-by-step retrofits, along with training materials and a handbook with recommendations for step-by-step retrofits

This saw the development of the latest version of PHPP9, which allows design variants to be entered as well as retrofit steps and economic comparisons of different variants can also be assessed.

The EnerPHit criteria was also extended with a new certification process for step-by step retrofits. A separate output file was created, containing an EnerPHit Retrofit Plan (ERP), which shows the overall process and plan for the entire retrofit.

An online manual on step-by-step deep energy retrofits to EnerPHit standard was produced with recommendations and descriptions of the quality assurance process provided by the certification concept. Training modules for designers, craftsmen and airtightness-specialists were also set up and implemented in the training schedule of many of the project partners to ensure adequate and growing capacity.

- Creation of overall refurbishment plans and execution of first retrofit steps for the pilot projects

For each pilot project an overall retrofit plan was created, in 8 countries, and implemented into the retrofit projects. This was in addition to consultancy regarding the efficiency design process, the PHPP data entry or detailing.

- Training for designers and tradespersons on step-by-step deep energy retrofits and documentation of findings from successful case studies

A total of 387 professionals, designers and tradespersons, were trained alongside the pilot projects in the partner countries. The designers and tradespeople learned about specifics of step-by-step refurbishments and deep energy retrofits. Additionally, the findings produced from the pilot projects, recommendations, product lists or short videos on the implementation of the retrofit steps will serve as further source of information for anyone interested to gain more knowledge on the pilot projects and step-by-step retrofits.

- Involvement of the financing institutions and development of attractive financial support programmes or one-stop-shop models

In the course of EuroPHit, more than 450 interested designers, municipalities or representatives of financial institutions participated in 12 financial workshops held in 10 partner countries. The workshops informed the participants of the concepts of step-by-step deep energy retrofits and the quality assurance process to be set up, the availability of financing concepts and programmes for energy retrofits to be found on the market, and further discussed the demand for future financing models to allow for better quality assurance or higher energy efficiency.

As preparation for these workshops appraisal guidelines for efficiency financing concepts were set up and provided to the participants, always adapted to new findings gathered throughout the project. At the end of the project, the evaluations of existing financing concepts and of barriers to efficiency financing were put together in a report and a market incentive concept was developed, just as well as a report on one-stop-shop models for deep energy retrofits.

- Product evaluation and support for the development of innovative concepts for new components for step-by-step retrofits

Based on the experience of the consortium and based on findings in the cases study projects, the product demand for step-by-step deep energy retrofits was evaluated and put together in a report on product demand, including the description of the international component requirements for highly efficient components in EnerPHit retrofits. The most promising product ideas were chosen to be further developed, first in form of design briefs, later in exchange in meetings or phone conferences with manufacturers interested to further develop products suited for the use in energy retrofits and stepwise energy retrofits. These design briefs were finally summarised in guidelines for future product development as well as in a presentation to be further used to engage further manufacturers in the future.

- Dissemination events: International Passive House Conferences and Component Awards

In addition to many national conferences organised by the partners, including sessions or at least presentations on step-by-step deep energy retrofits, two sessions dedicated on step-by-step retrofits only where organised in the course of the annual International Passive House conferences at Aachen in 2014 and Leipzig in 2015.

In addition, two Component Awards focusing on high-performance windows for step-by-step retrofits and ventilation concepts for refurbishments were carried out in early 2015 and 2016, to further involve the industry into the development process of new component concepts and raise the awareness of the demand for these products amongst the stakeholders.

Photo: PHI – dissemination activities such as the International Passive House Conference

3. Key takeaways and lessons learned

The lessons learned, the applied solutions and the resulting tools serve as the basis for implementation in future European-funded projects, throughout Europe and even worldwide. Some general takeaways from the project in regards to deep energy and step-by-step retrofits are as follows:

- There is a strong linkage between case studies/demo projects and project partners in order to highlight innovative projects in the region and/or country and show that it can actually be done
- A general consensus from all the project partners was the importance of communication and dissemination activities such as involvement of local media, the regional networks, having articles published, and housing tours (such as international Passive House Days)
- A general challenge expressed by many partners was overcoming working with multiple project partners in different countries and also dealing with change of staff members both internally and with other project partners which could often create unplanned for delays and hiccups in the moving the project and its milestones forward.
- While maintaining the EnerPHit Standard as the basis and prioritizing energy efficiency, the integration of renewables is also important in order to adequately address EU energy goals
- Better cooperation between the public and private sector is required in this area, specifically as it relates to financing opportunities and models

A summary of the specific key lessons learned from the project are presented here:

- Different approaches to replacement after the end of component lifecycles

It appeared that there is quite different approach to energetic refurbishing of buildings between European countries. Whereas it is assumed that the bigger part of all refurbishments is carried out as refurbishment steps, according to component life cycle and due to available budget. In other countries, the lack of budget funds seems to lead to building use that is exceeding the components life cycle and more or less allow only one-shot retrofits when the buildings have to be renovated completely. The necessity to elaborate special financial concepts for step-by-step refurbishments thereby is comprehended differently in the various partner countries.

- Innovative financing is required and still needs to be adequately developed in this area - financing bodies still need to see longer-term and the business case needs to be crystalised in order for them to do so.

More work is still needed on the financing aspect of long-term step-by-step retrofits. This comment was echoed in by project partners who were most heavily involved in the financial solutions work package, BRE and IzN who explained that more resources perhaps could have been devoted here to see greater impact in the financial sector. This was also a theme at the Final financial workshop, held at the close of the project, where results were presented and the way forward for financial institutions was discussed. Funding programmes are very fragmented and differ throughout Europe. As Georg

Kraft of IzN noted, "there was too much optimism regarding the interest of European financial institutions in this project. Further work will need to be continued to establish direct connections to European Investment Bank (EIB) and the Council of Europe Development Bank (CEB) in order to collaborate on central models and programmes to be integrated at the Member State level." Kraft also stated that, "There is still a huge need for investments and financing of the energetic retrofit of buildings throughout the EU member states."

- Implementation of mechanical ventilation is the most difficult task

Mechanical ventilation, with heat recovery for highly efficient buildings, is a very crucial measure to guarantee high quality indoor air conditions and mould free surfaces at critical joints. In case of window replacement and resulting airtight buildings, this becomes especially true. However, mechanical ventilation seems to be the most difficult component to convince the owners to implement. Promotional programmes to facilitate the implementation and raise awareness for the benefits of mechanically ventilated buildings are urgently required.

- Promotion for planning activities, quality assurance and certain components

Competent consultation and design and quality assurance are required to meet the ambitious efficiency goals of refurbishments to NZEBs. Promotion of such planning and quality assurance activities are thereby required, just as well as the promotion of specific components, which are both important but not jet financially viable, by soft loans and grants. Especially the design of step-by-step retrofit concepts should be promoted by a grant component

- Component development for step-by-step retrofits required

The availability of highly efficient components, has been increased lately, but there is room for improvement. The practical detailing of many component connections can be further developed to allow components suitable for the use in step-by-step retrofit processes. Manufacturers can and are willing to distinguish their product portfolio by offering respective concepts, evaluation and certification processes will be needed to approve such concepts.

Photo: PHI – Successful step-by-step retrofits are dependent upon high-quality building components

- Product solutions for supplementary installation of renewables

Currently there seems to be some reluctance to implement both, high efficiency and renewable energy sources, in one step. Even though it would make most sense to do so, to avoid additional costs for a future implementation of renewables, most of the case study project owners resigned from the additional investment. It seems advisable to take this into account and develop product concepts that facilitate a supplementary implementation of RES on highly insulated roofs or facades, thereby allowing another future step to further increase the efficiency of buildings that are currently renovated to a high efficiency standard.

- Housing associations must be better involved

Since many existing buildings which are in dire need of renovation throughout EU member states happen to be apartment buildings, it was also seen as valuable for a future iteration of such a project or in order to use the tools provided through EuroPHit through in the future, to involve housing associations – which were not implicitly involved as a part of the consortium or key target group within the project. Most of the case study and observer projects within EuroPHit were single-family homes and therefore not representative of where the largest gains could be had with deep energy and step-by-step retrofits. It was also seen that the input from housing associations into how financing programs could also be best organized would be extremely helpful for future goals.

- Improve awareness and availability of EU support for energy efficiency projects

There was little knowledge about the promotional activities of the EU in the field of energy efficient retrofits. The knowledge of these promotional programmes should thereby be improved among the stakeholders.

- No participant from abroad without travel budget

Even though a lot of representatives from municipalities or financial institutions from all partner countries were invited to the final financial workshop at Frankfurt, almost none of these wanted to participate, at least some admitting that without travel budget they couldn´t come. The benefits of international exchange in such a workshop are obvious, travel budget for important representatives of such institutions should thereby be foreseen in future projects.

Photo: PHI – component award being awarded at International Passive House Conference

4. Success stories

Other important takeaways from the EuroPHit project which will help bring the results of the project further, and in turn increase the knowledge and know-how on deep energy step-by-step retrofits.

20 retrofits in step-by-step approach started within EuroPHit period

Starting with considerable difficulties to convince building owners to commit to retrofitting their buildings to EnerPHit standard, even if only in a stepwise manner, the consortium struggled considerably to engage more pilot projects into EuroPHit, to increase the dissemination factor. At the end of the project period, a total of 20 retrofit projects, most of them carried out in a stepwise manner with an overall refurbishment plan. Of these projects, 11 have completed first retrofit steps of various kinds within the project period, 9 more projects are still ongoing and will be completed in the near future. For many of these pilot projects, the step-by-step retrofit approach, including the design of an overall retrofit plan and the pre-certification process, was the best way to cope with the situation for the owners, due to limited budgets, components still within their lifecycles or multi-ownership-problems, and still implement proper high efficiency planning and quality assurance guaranteed by a certification process.

Pre-certification process to EnerPHit released

Early summer 2016 saw the worldwide release of the pre-certification process for step-by-step retrofits to EnerPHit standard. Coming as a package, the EnerPHit criteria updated in EuroPHit and including requirements for stepwise retrofit processes were supplemented by an update of the Passive House Planning Package (PHPP), and the final version of the EnerPHit Retrofit Plan. The release could be announced in two magazine articles in Germany, as the interest in the stepwise retrofit topic and related quality assurance concepts has been increasing in the last years. The first pre-certification projects have already been requested, some of them to be presented at the next Passive House Conference at Vienna in April 2017.

Stepwise retrofit concepts competition

The Passive House Institute, representing the EuroPHit project, participated in a competition launched by German IFEU institute on behalf of the German Federal Ministry of Economics and Energy. The competition aimed at gathering good examples for step-by-step retrofit approaches. The contribution by EuroPHit consisted in a description of the pre-certification process to EnerPHit standard and the calculation tools included in the concept. EuroPHit´s contribution was awarded with the 1st prize in this competition, enabling the consortium to provide a detailed description of the concepts developed in EuroPHit in an article in the well-known German Energy Efficiency magazine “Gebäude Energieberater” (GEB).

Involvement in the BAFA Project

Based on the experiences gathered in EuroPHit, and surely also based on the reputation won by the above competition, the Passive House Institute was able to get involved in a project launched by the German Federal Office for Economic Affairs and Export Control, which is dedicated to develop the national solution for overall retrofit plans. PHI was able to bring in the experiences gathered in EuroPHit and to support the consortium to set Passive House Components as the target efficiency class for retrofit plans in Germany.

Engagement of manufacturers for product development

The EuroPHit consortium addressed manufacturers of building products in order to raise awareness for the need of high efficiency products or concepts for retrofits and step-by-step retrofits and to support the industry in improving existing or developing new products. This was successfully carried out with two different approaches: The creation of design briefs with descriptions of the general product concepts and requirements on the one side, serving as basis for meetings or phone calls with discussions on improvements of the components. The other approach was the execution of two component awards in 2015 and 2016, with the concept of directly involving the manufacturers and encouraging them to develop new concepts of products meeting the specifications tailored to step-by-step retrofits. First sceptical, the manufacturers dealt with the challenge and created several suitable concepts for windows for the use in step-by-step retrofits or ventilation units to be installed in retrofits with minimised installation effort.

With the competitions as starting point and detecting the potentials of the new concepts, many of the manufacturers currently are working on products suitable exactly to be used in step-by-step retrofits or retrofits with minimised installation effort and optimised connectivity to future retrofit steps. The component awards thereby can be counted as successfully providing the initial encouragement to further engage in the area of product development for step-by-step retrofits.

Training on retrofit and stepwise retrofit design with PHPP

In order to train efficiency experts and PHPP users in using the PHPP and the EnerPHit Retrofit Plan (ERP) for retrofits and stepwise retrofits, materials for half a day of training were put together with the title “PHPP for retrofits”, shortly after the completion of EuroPHit. In this training, the EnerPHit criteria, as well as the pre-certification process to EnerPHit standard are explained, just as well how to handle data entry into PHPP when planning a stepwise retrofit and how to use the EnerPHit Retrofit Plan ERP to document the stepwise improvement of a building.

The workshop was quite successful presented for the first time at the 20th International Passive House Conference at Darmstadt end of April 2016. The interest in the use of PHPP and the certification procedures to EnerPHit standard has grown ever since, so a workshop has been asked for and has been held in New York and is further more scheduled to be held for 3-4 more times until next spring. It will also be included in the regular PHPP training materials of the Passive House Institute and will likely be translated into German and Spanish in the next months, thereby reach even more experts and interested PHPP users all over Europe.

Passive House Component Certification processes could be developed or significantly enhanced with retrofit criteria in addition to the creation of design briefs

In the course of EuroPHit, many product ideas for retrofits just as well for step-by-step retrofits have been developed or have been taken over from already ongoing development processes and were put together in design briefs, which describe the general concepts and requirements of these components. Creating these design briefs was the task in EuroPHit, and with these design briefs as basis, EuroPHit was able to engage relevant manufacturers and discuss product improvement or development of new component concepts.

In addition these EuroPHit tasks, during the period of EuroPHit developed or still in development there are 7 component certification processes which deal more or less related with the products or product ideas detailed in these design briefs created for EuroPHit:

- Certification of single-room ventilation concepts
- Certification of attic staircases
- Certification of drain water heat recovery systems
- Certification of internal insulation systems (still in development)
- Certification of window installation concepts (still in development)
- Certification of windows for retrofits (still in development)
- Certification of building systems for retrofits (still in development)

In the first three certification processes, several products could already be certified as Certified Passive House Components, some more are currently in the process of being improved and will probably be certified in the next months. For the 4 other certification processes which are still to be completed and released, the development of the components is already happening, partly based on the initial so further certified products can be expected in the near future

5. Target groups

Municipalities

Municipalities could successfully be involved in several activities in EuroPHit. First of all, some of the pilot projects worked on in EuroPHit were owned by Municipalities, so these profited directly from the consultation by the project partners. This was given in Ireland, Britain, Bulgaria and Denmark.
Furthermore, municipality employees were invited to the financial workshops carried out carried out in each of the partner countries and were able to inform themselves about EuroPHit and the step-by-step certification and quality assurance process. Additionally the heard about the available financing concepts for energy efficiency measures and projects and furthermore discussed with the financial specialists from IzN Friedrichsdorf about the suitability of these concepts in their countries.
Finally, the many national or international Passive House Conferences counted municipalities as their visitors and communicated the latest learnings gained in EuroPHit on step-by-step retrofit processes and the quality assurance processes to be set up with the pre-certification scheme.

Financial Institutions

The involvement of financial institutions was successful, as in most of the 12 financial workshops carried out in the partner countries bankers and financers could be counted among the participants. In some cases the only participants in a small group, in other cases together with other participants like municipalities, energy agencies or designers and engineers, discussions on available financial schemes for deep energy retrofit financing and potential improvements were held. In total more than 450 participants in financial workshops could be counted.
However, the participation of EIB, CEB or EBRD representatives would have been appreciated for these workshops. Further workshops should be organized together with the European Development Financial Institutions, as in the workshops it seemed there was little knowledge about the promotional activities of the EU in the field of energy retrofit financing.

Designers / Engineers

Designers or engineers could successfully be involved. In the course of the consultations of the case study projects, many profited directly from the support by the project partners on the one side or many, a total 175 the partner countries, were trained in high efficiency and deep energy retrofit contents in the trainings carried out by the partners in the countries with pilot projects.
In addition, many national Passive House Conferences all over Europe and even beyond, and 3 International Passive House Conferences provided the opportunity to get informed about the importance and concepts of step-by-step deep retrofits and the pre-certification process to be developed. In total, 3 sessions related to retrofits and stepwise retrofits were offered for the participations of the International Passive House Conferences, and 2 component awards highlighted new concepts for products suited for retrofits and step-by-step retrofits.

Tradespeople and construction companies

Tradespeople were involved mainly in the execution of case study projects and in the trainings that were carried out alongside. By the end of the project, a total of 197 craftsmen were trained in high efficiency constructions and specific considerations of step-by-step retrofits. During the execution of the case study projects, the awareness and understanding of the construction teams for high efficiency retrofit principles and requirements was increased. Many of these craftsmen were additionally qualified in an airtightness-specialists course, were additional 138 participants could be trained in the theory of airtightness measurements and practical requirements for blower-door tests.

Manufacturers

The involvement of manufacturers, even the industry producing building components, was quite successful. With the creation of 18 design briefs as basis, several meetings with manufacturers were carried out to present the concepts and requirements described in the design briefs and to discuss potential improvements or developments for products meeting these specifications.
Not counting the phone conferences or email contacts, mainly PHI carried out during the component awards, 14 meetings with manufacturers were carried out, with presentations, discussions and elaborations of potential solutions. Due to new component certification processes, several of the products described in the design briefs are already being quality assured by the independent certification process offered by the Passive House Institute. On the other side several manufacturers work on the development of new products to be released and certified in the near future, as soon as the new certification categories have been officially released.

6. The EuroPHit project and concept

Background

Buildings within the European Union are responsible for 40% of total energy consumption and 36% of CO2 emissions. The European Commission has estimated that 75% of Europe's buildings are inefficient and it has pushed for energy efficiency to be prioritised by policy makers. With more than 200 million buildings in need of energy retrofits, many will require deep retrofitting if the EU's 2020 targets are to be fulfilled. The majority of the energy is used in heating and cooling. Deep renovation and improving the buildings envelope and applying Passive House technologies and concepts can save over 80 % of the energy requirement of those buildings.

The EU has introduced legislation to ensure that buildings consume less energy. A key part of this legislation is the Energy Performance of Buildings Directive first published in 2002, which required all EU countries to enhance their building regulations and to introduce energy certification schemes for buildings. At the same time, the refurbishment of the building stock provides an opportunity to create local jobs, stimulate the economy and generate savings.

While these figures show that the potential to reduce energy consumption through improving our building stock is huge, many barriers remain to turn these policy goals and recommended steps into action.

Some of the systemic barriers include, a lack demonstration projects to such levels of deep energy improvement (achieving Passive House Standard), lack of suitable products and professionals to meet the energy requirements, national and local policies which do not align with EU policy goals and lack of appropriate funding mechanisms, both through the private and public sectors. Other barriers at the builder and tenant level include disturbance of inhabitants, motivation and an inability to perform deep retrofits to an entire building all at once, typically due to financial constraints.

The EuroPHit project and the accompanying capacity building activities undertaken throughout looked to break down some of these barriers to provide a model to transform the existing building stock into one geared towards a sustainable energy future.

The project looked at implementing current know-how into pilot projects across the EU, including the development of a long-term retrofit planning tool and certification scheme, consulting and supporting industry to develop suitable products, and engaging with the financial industry to study the investment and funding existing best practices and potential future models.

The type of retrofitting required to achieve EU policy goals, is for a building, ideally to be performed all at once. However the reality for many building owners, is that it is financially and logistically not feasible to complete an entire deep energy retrofit in one step. More common, however, are partial retrofit steps, completed on a building over time, also known as step-by-step retrofits. Specifically for this type of retrofit, an overall and well-thought out plan right from the beginning is crucial to the final energy savings when all retrofit steps are complete. As the most viable strategy of a building retrofit is a step-by-step approach of applying, the best technologies should be implemented every time when refurbishment activities are undertaken. For each building this requires a lifecycle concept and a long-term strategy. These long-term plans must be tailored to individual buildings and their specific requirements, so as not to jeopardize future steps or to ensure that they are adequate for other steps to be carried out in the future and avoid not being able to further improve, also known as the lock-in effect.

The EuroPHit project

The EuroPHit project aimed to significantly increase the quality and energy efficiency of step-by-step retrofits throughout the EU by developing a comprehensive and integrated methodology, implementing uniform quality assurance of both design and construction, encouraging implementation by key actors and fostering knowledge dissemination through new and existing project networks.

The project worked with 15 partners in 11 EU-Member State countries over a period of 36 months. A minimum of 10 pilot projects (case studies) were also agreed upon to test the overall refurbishment. Within the EuroPHit project, a selection of residential and non-residential buildings across Europe are being retrofitted according to Passive House principles. There are currently a total of 20 pilot projects in 9 countries actively involved in the EuroPHit project. Of these, 11 have already completed the first retrofit steps. Through the EuroPHit project a total of 40,000m^2 of floor area are planned to be retrofitted with a budget of more than €26 Million.

The EuroPHit project made use of and promoted EnerPHit, one of the most stringent and integrated standards available internationally for energy retrofits. The EnerPhit Standard, in turn, is based on the Passive House methodology and concept, a tried and true approach to efficient building with over 20 years of positive examples to show.

Passive House

Through a focus detailed planning paired with quality building components, superior insulation, ventilation with heat recovery, thermal bridge free design and airtight construction, Passive House buildings reach levels of energy efficiency and comfort that are practically unheard of in conventional buildings. Adherence to the strict Passive House criteria result in buildings with superior air quality and comfortable indoor temperatures year round that use up to 90% less energy than typical building stock, or less than 1.5 litres of oil or 1.5 cubic meters of gas to heat one square meter of living space for an entire year. Vast energy savings have also been demonstrated in warm climates where conventional buildings typically require active cooling. Over the last two decades, the Passive House Standard has gained rapidly in popularity and has proven to be a reliable

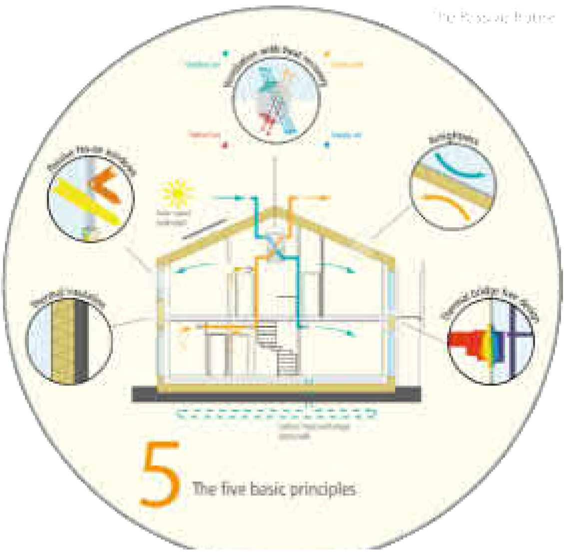


Figure 1 ©PHI, the five Passive House principles approach in an ever increasing range of climates. With an estimated 50,000 units built worldwide as of 2013.

The Passive House Standard is defined by five basic principles: an airtight building envelope, an adequate ventilation strategy, appropriate windows, a thermal-bridge free design and proper insulation.

Retrofitting with Passive House principles: EnerPHit

Achieving the Passive House Standard in refurbishments of existing buildings is not always a realistic goal, due in large part to unavoidable thermal bridges in the existing structure. Renovations according to Passive House principles are made possible by retrofitting to the EnerPHit Standard. Based on Passive House principles, the EnerPHit Standard calls for high quality, energy efficient building components. Setting the EnerPHit Standard as the target ensures that both the energy demand as well as the quality is future-proof.

Who are the partners?

Passive House Institute	**Passive House Institute, Germany** The Passive House Institute is the independent research institute responsible for defining the Passive House Standard. The Institute focuses its efforts on Passive House research, quality, assurance as well as international networking through iPHA, the International Passive House Association. Within the framework of EuroPHit, PHI has acted as the project coordinator and work package leader for quality assurance and capacity building as well as communication.
International PASSIVE HOUSE Association iPHA	**International Passive House Association, Germany** An initiative of the Passive House Institute, iPHA is a global network of Passive House stakeholders working to promote the Passive House Standard and foster a greater public understanding of its significance. Within the framework of EuroPHit, iPHA was the work package leader for dissemination and communication.
ZEPHIR Zero Energy and Passivhaus Institute for Research	**Zero Energy and Passivhaus Institute for Research, Italy** ZEPHIR is an Independent research institute in the field of energy efficient buildings promoting the Passive House concept in the Mediterranean region.
La Maison Passive France	**La Maison Passive, France** La Maison Passive is an association of building professionals active in development of Passive House construction.

	MosArt, Ireland MosArt is a multi-disciplinary environmental design consultancy firm that stands as a leading provider of Passive House training in the English speaking world. The firm is also heavily involved in certification of Passive House buildings.
	Inštitút pre energeticky pasívne Domy, Slovakia iEPD is a Passive House association standing for the promotion of Passive House technology. It provides information and works to stimulate the Slovakian market for energy efficient buildings and components.
	Interessegrupp Passivhus Sverige AB, Sweden IG Passivhus Sverige is the Swedish Passive House association. It works to promote Passive House technology, provide information as well as stimulate the Swedish market for energy efficient construction.
	Plataforma de Edificacion Passivhaus, Spain PEP is a non-profit association of Passive House stakeholders that aims to develop the Passive House concept and promote it in the Spanish-speaking world.
	Passivhus.dk ApS, Denmark Passivhus.dk is a specialised consultancy and knowledge centre for the implementation of energy-efficient buildings, providing engineering consulting services. The firm is also an accredited certifier of Passive House buildings.
	EnEffect Group, Bulgaria Eneffect Group, a subsidiary of the non-profit organisation EnEffect, performs energy audits and energy efficient certification of buildings.
	Atrea s.r.o., Czech Republic Atrea is a private company with many years of experience in the field of indoor air quality and heat recovery system development.
	Askeen S.r.l., Italy Askeen S.r.l. is an innovative window manufacturer focusing on energy efficient integrated window solutions for new and refurbished buildings.

	Onyx Solar Energy, S.L., Spain ONYX is an SME performing R&D in the field of photovoltaic strategy solutions and their manufacture for integration in buildings (BIPV) based on thin-film and crystalline silicon photovoltaic technologies through the replacement of conventional construction materials such as skylights, façades, curtain walls or roofs.
	IzN Friedrichsdorfer Institut zur Nachhaltigkeit e.V., Germany IzN is a non-profit association of professionals for research and advisory projects in the area of sustainable development.
	Building Research Establishment, United Kingdom BRE is a non-profit, independent research organisation, delivering consultancy, training and research programmes and as well as BREEAM and Passive House certification.

7. Practical implementation: case studies and observer projects

The use of the case study and observer projects in the EuroPHit project represented the importance of having exemplary projects, not only to test and create new tools and calculation methods but also to represent locally that such a project is in fact doable. These projects stand as beacons to product manufacturers, financing bodies, rental associations, municipalities, building owners and other such stakeholders that a case exists for deep energy retrofits, even when completed in a step-by-step manner. Case study projects were those which were formally agreed on by the project partners and officially involved as part of the project. Observer projects were those which were implanting step-by-step retrofits and following the concepts of the EuroPHit project but rather volunteered into the project from project partners of from the EuroPHit project network.

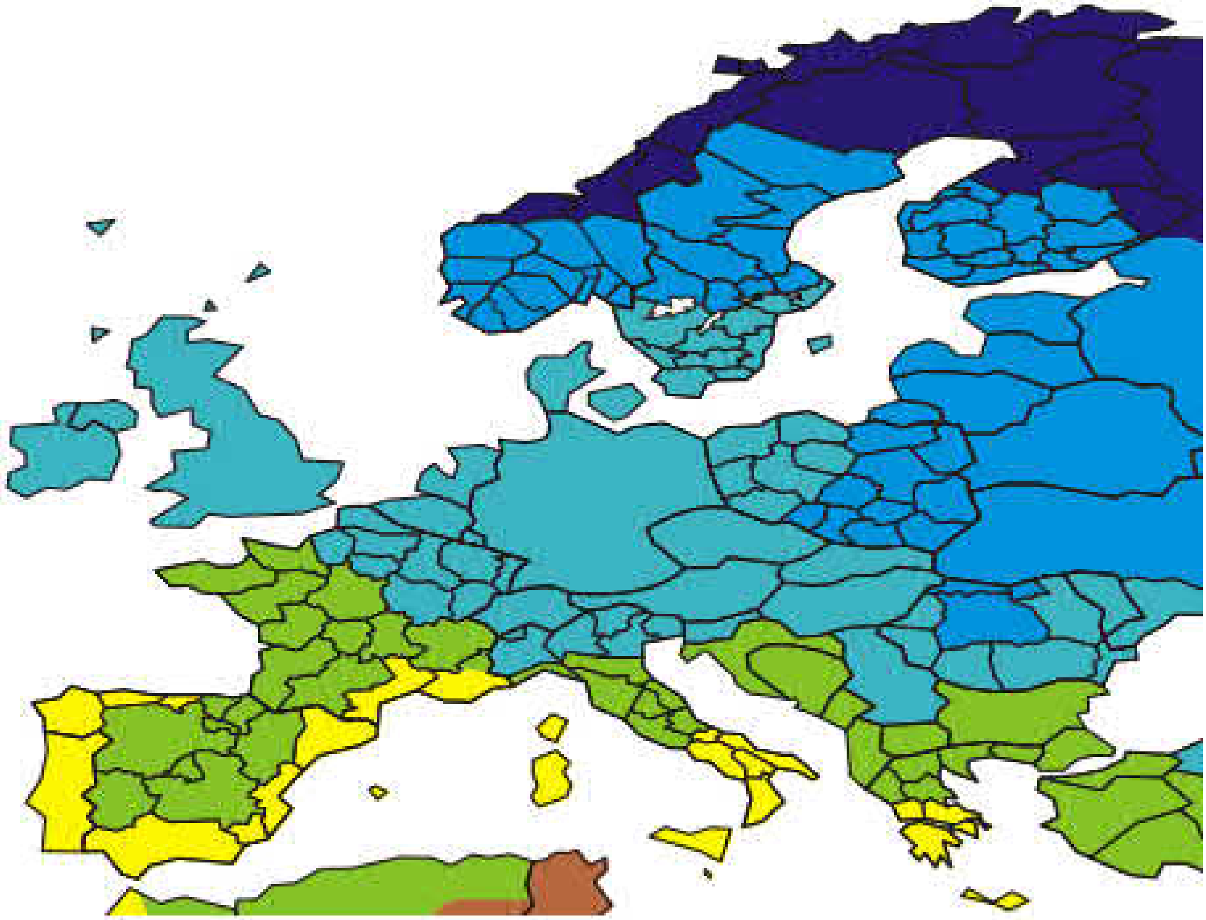


Figure 2: a map showing the different climate zones within Europe for project partners to ensure the identification of climate-appropriate building components for the step-by-step retrofits

The case study projects represent the successes of the EuroPHit project in implementing step-by-step retrofits across Europe. In addition they highlight that step-by-step retrofits to the EnerPHit standard are possible for various building types and in various climate zones.

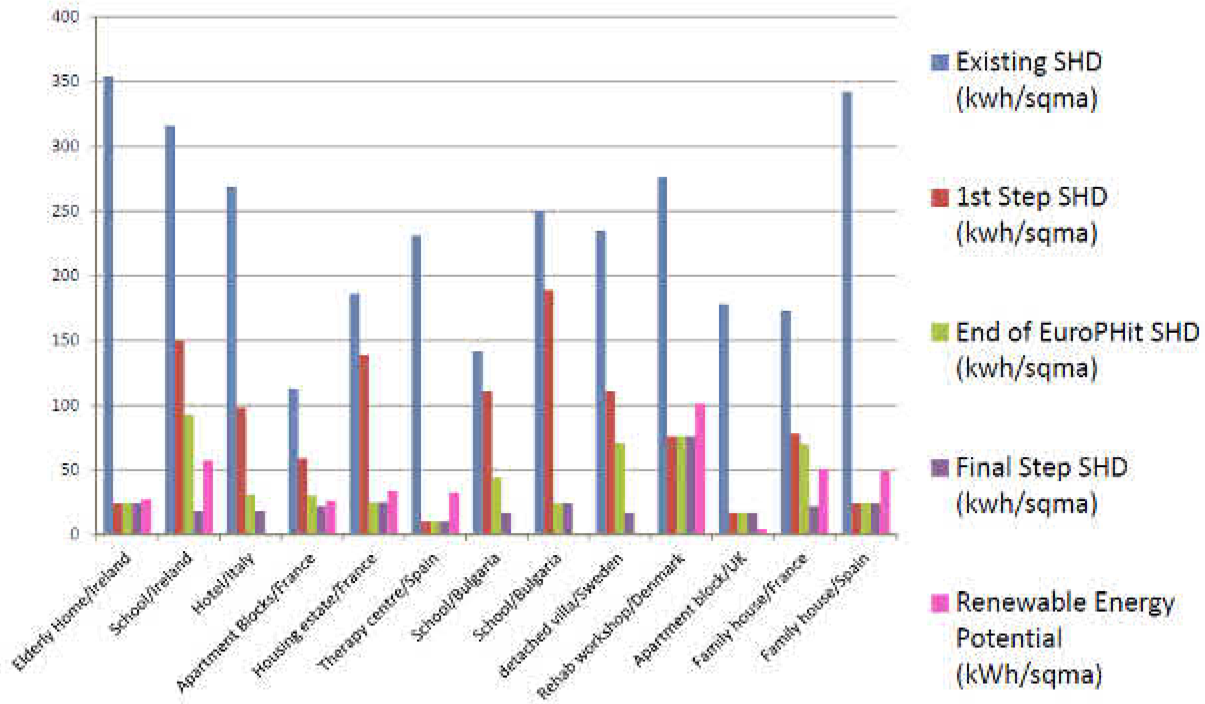


Figure 3: survey for the case study projects, showing energetic impact on project after each retrofit step and finally, the renewable energy potential

For all the 20 pilot projects active by the end of EuroPHit, a potential of PV electricity gains of 595.000 kWh/a was identified for all roof surfaces and 165.000 kWh/a on façades, a total of 760.000 kWh/a. This amount of RES gains translates to approximately 19 kWh/(m²a) of living area on average for all projects, of course not available all over the year due to the winter gap. The PV potential analysis for each project was also added to the reports on the case study projects to document the potential of the implementation of renewable energies, even if the most projects mainly choose to increase the efficiency of the building first.

Case study projects

CS01 Rochestown Home for Elderly in Dun Loaghaire (Ireland)

Figure 4: Northwest view of building before construction works

Figure 5 Northwest view showing site progress

Building Owner:

Dun Laoghaire Rathdown (DLR) County Council

Consulting EuroPHit Partner:

MosArt

Existing treated floor area (usable floor space):

1,613m²

Rochestown Home for Elderly was originally a two-storey block of 34 apartments built during the early 1970's. The floors, walls (external and internal) and roof are made from concrete with little or no insulation. Ventilation was mostly natural, using windows but there were also some room-based fans.

The proposed modernisation plan was to add an entire new floor on top of the existing building as well as minor extensions to accommodate vertical circulation. The number of apartments remained at 34, however the living space in each apartment was increased. The retrofitting of the existing structure involved external wall insulation and Passive House certified windows and doors. The new top level comprised of aerated concrete block walls, external insulation, Passive House certified windows and doors and a lightweight metal deck roof. Mechanical Ventilation with Heat Recovery units were installed in each apartment as well as in each communal area and circulation area.

The programme of works for the first retrofit step was completed in early 2016. Apartments are now being offered to elderly social housing residents wishing to downsize and benefit from the cost saving energy efficiency measures.

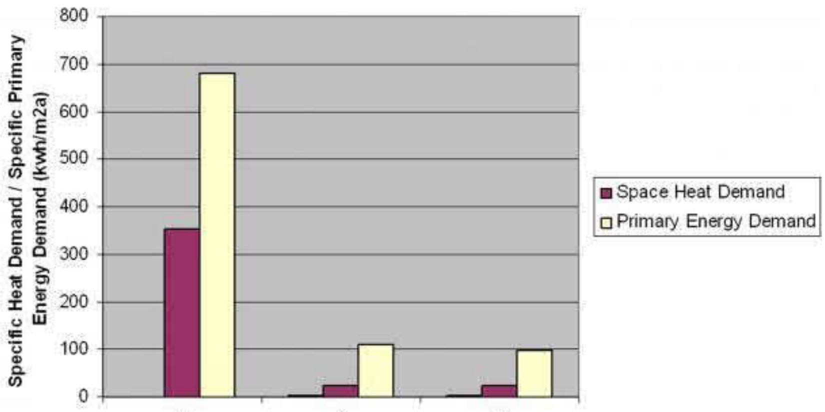


Figure 6 Predicted efficiency improvement for each retrofit step

CS12 Single family home, Svartbäcksvägen 11, Stockholm (Sweden)

Figure 7 View from the south before retrofit measures

Building Owner:

Ville & Andrea Mäkinen

Consulting EuroPHit Partner:

IGPH Sverige AB - Contact person Ingo Theoboldt

Existing treated floor area (usable floor space):

150m²

The building is a typical concrete-block detached villa from the 1950's. The lower floor (partially underground) used to have 3 rooms and a bathroom plus a sauna. It also has access to the attached garage. The floor had been excavated and access to the upper floors had been blocked, i.e. the house was only occupied on the upper floor level. There was no insulation whatsoever (apart from some woodchips in the ceiling).

The first stage of the proposal was to insulate the lower level (floor and walls). This also provided the opportunity to block the radon gas infiltration and make the lower level useable again. In addition, the ceiling (flat under the roof) was insulated with easy-to-apply cellulose insulation, also improving airtightness. The airtightness of the existing windows was temporarily improved by a preliminary application of stick-on sealing tapes. Ventilation will be done naturally and with the existing extract fans.

The next stage would see the replacement of windows and doors plus the installation of the Mechanical Ventilation with Heat Recovery system. At the same time, the Passive House airtightness level will be achieved. The final step will be the insulation of the building façade.

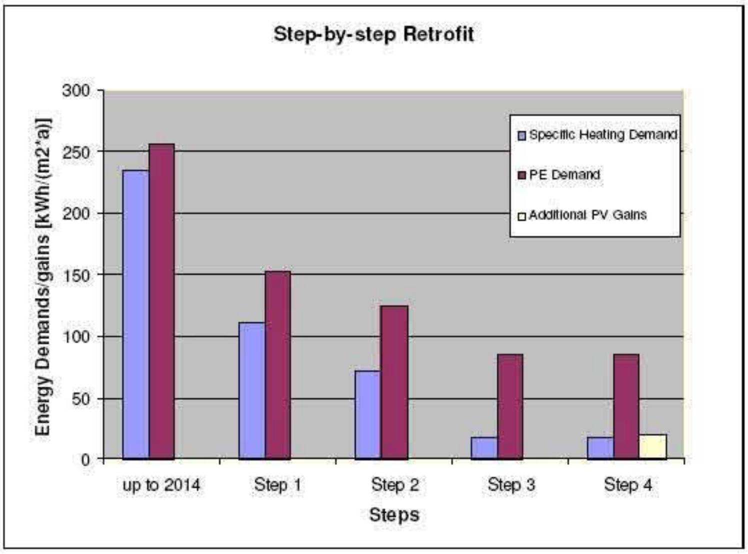


Figure 8 Predicted efficiency improvement for each retrofit step

CS13 Tommerupvej 8B. Rehabilitation Workshop in Næstved (Denmark)

Figure 9 Building before retrofit measures

Figure 10 Buildingafter façade insulation and window replacement

Building Owner:
Næstved Kommune
Consulting EuroPHit Partner:
Passivhus.dk
Existing treated floor area (usable floor space):
244m²

The building was built in the 1970's as a centre for people with mental disabilities. It currently houses rehabilitation workshops. The building was constructed from prefab concrete with 25mm polystyrene insulation in the outer walls, and 100mm insulation on the roof. The building has a heated basement, which is insulated on the outside with 50mm of hard mineral wool. The windows are double glazed with a wooden frame. A pressurization test and thermography showed that the concrete construction was very air tight, the only leaks were found at the windows and doors. Ventilation was solely exhaust with no dedicated replacement air openings.

The first step was to establish a balanced ventilation system with heat recovery. This was to be followed by replacing the original leaky windows with highly efficient low U-value windows and mending any remaining small air leakages. The next step was to insulate the basement to a depth of 1.86m followed by external insulation of the building façade. The final stage to be carried out in 2026 was to insulate the roof (The roofing felt is from 2006. It's expected to have a service life span of 20 years, thus the insulation of the roof has been postponed).

Steps 1-3 were necessary in order to deal with the immediate complaints about draught. Unfortunately the municipality ended up having to cut the budget for the project. This meant that the basement wall insulation was not carried out, only half the façade was insulated and only those windows corresponding with the façade insulation were replaced.

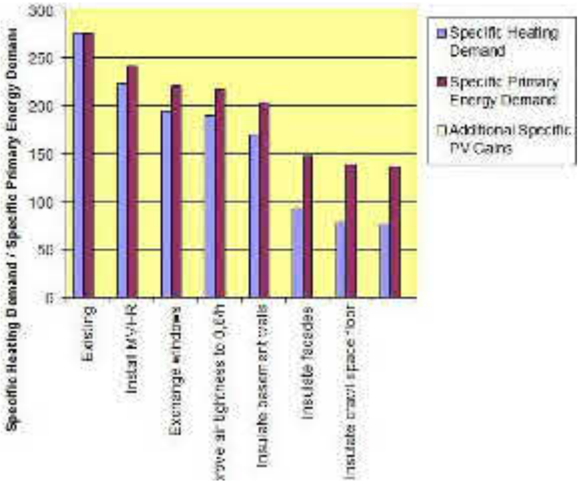


Figure 11 Predicted efficiency improvement for each retrofit step

CS14 Wilmcote Multifamily House in Portsmouth (United Kingdom)

Figure 12 Wilmcote House before works

Building Owner:

Portsmouth City Council

Consulting EuroPHit Partner:

BRE

Existing treated floor area (usable floor space):

10,233m²

Wilmcote House provides over 100 homes largely in the form of 3 bedroom maisonettes, which are arranged across 3 blocks linked via two main stair cores. The building is owned and managed by Portsmouth City Council. Wilmcote House was built in 1968 using prefabricated reinforced concrete; it is in need of significant repairs, including some structural work, without which the remaining life of the building is likely to be around 30 years. The concrete sandwich panels incorporate only around 25mm of insulation, which combined with all electric heating means staying warm in the building is expensive; many residents experience fuel poverty.

Wilmcote House will be the first large scale retrofit project reaching the EnerPHit standard. The building will be split into three thermal envelopes with the two stair cores remaining outside the thermal envelopes. External walk ways will be enclosed within the thermal envelopes of the blocks. The three blocks will be made airtight using an external membrane before an external insulation system is applied to each block. Each dwelling will be provided with individual MVHR systems. Heating could be addressed as and when the current systems reach the end of their lives, in accordance with the step-by-step approach taken by EuroPHit. Ground floors will also not be insulated at this stage but could be considered in a future 'step'. Work has now commenced on the first of the three towers, with a planned completion date of 2017.

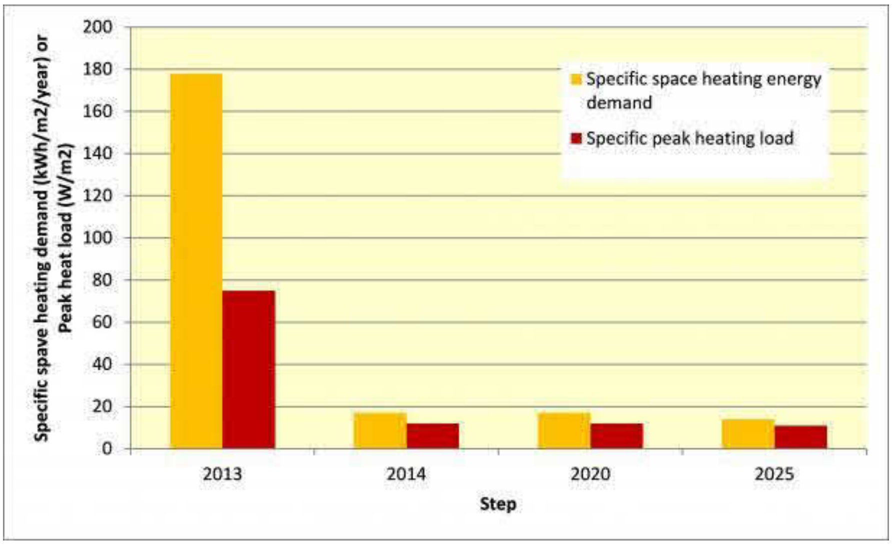


Figure 13 Predicted efficiency improvements

CS15 Single family home, Tournon sur Rhône (France)

Figure 14 Building before construction work

Building Owner:
Family André
Consulting EuroPHit Partner:
LaMP
Existing treated floor area (usable floor space):
155m²

The building was built in 1985 with floors following the slope of the terrain. The existing walls are made of hollow concrete bricks with a 6cm interior insulation of extruded polystyrene (XPS). The roofs comprise of a traditional wooden frame, partially insulated with mineral wool and XPS. Windows are double glazed with 48mm uninsulated wooden frames. The level of airtightness was relatively poor. A Mechanical Ventilation with Heat Recovery (MVHR) had been installed in the 80's, but is no longer functioning and will be replaced. Heating demand is covered by electric underfloor heating plus a wood stove.

The first step was to insulate and improve the airtightness of the basement staircase, walls and slab, with the installation of a Passive House quality door to access the unheated basement. The second step involves insulating the rooftop and installing a MVHR. Step 3 is to improve the airtightness layer on the existing wall render, install exterior insulation of walls and replace windows with Passive house quality (phA) windows. The final step is to replace the electric hot water storage tank and install solar photovoltaic panels on the south facing roof.

At the time of writing, the basement staircase had been refurbished and the owner was looking to begin insulating the roof.

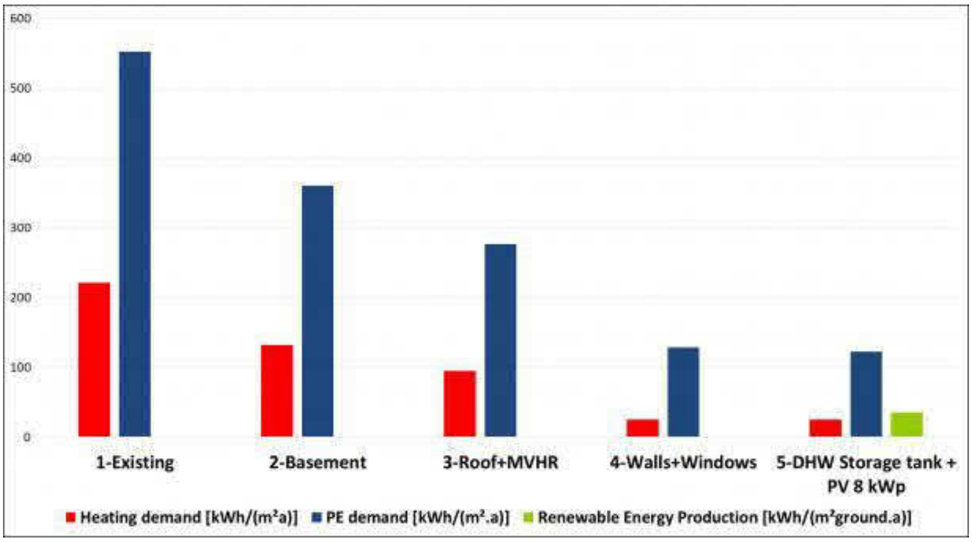


Figure 15 Predicted efficiency improvement

CS16 Single family home Centón, Santander (Spain)


Figure 16 Building before construction work

Building Owner:
Cesar Blanco Sancibrián
Consulting EuroPHit Partner:
Plataforma PEP
Existing treated floor area (usable floor space):
75.78m²

House Centón is a small single family home with brick walls and a light wooden structure for the floor and roof. The building is currently in a very bad condition as the building has been empty for 10 years. The thermal envelope has no insulation. Ventilation is done naturally by opening windows. Windows are single glazed with different types of frames. The heating and hot water system are coal based. The relatives who inherited the property have the intention of doing a refurbishment to prepare it for their present and future necessities: first as an office and later as a family home.

The retrofit steps started in 2014 with the first step being the reinforcement of the foundations and insulating the basement. The first step also involved improving the roof (structure, insulation and airtightness), installing Passive House windows and preparing the interior spaces to be used as an office. Step 2 involved adding exterior wall insulation. The third step was to improve airtightness within the building and install a MVHR system. If the building owners decide to use the building as a family home, step 4 would involve preparing and finishing the building for this use.

San Roque Social Housing, San Sebastián (Spain)

Figure 17 Building before retrofit measures

Building Owner:

Owners Community – San Roque, 32

Consulting EuroPHit Partner:

Plataforma PEP

Existing treated floor area (usable floor space):

559m²

San Roque Social Housing is a four storey building with 10 apartments and a common area. The building envelope has no insulation at all. Ventilation is done naturally through opening windows. The original windows and shutters are made from wood with single glazed window panes, but some owners have replaced them over the years. The poor façade condition, which comprises of load bearing bricks, forced the owners to take measures after a compulsory technical inspection. The roof is built from timber and was last improved in 1994.

The retrofit works that have been undertaken within EuroPHit include the first step of the refurbishment plan which was to install top floor ceiling insulation and improve the level of airtightness. Step 2 involves installing the External Thermal Insulation Composite System (ETICS), adding new Passive House certified windows, further improvements to the airtightness on the outside and the installation of a MVHR system. The final step was to install solar photovoltaic panels.

Observer projects

OP17 Sonnenstrasse 39, Zellingen am Main (Germany)

Figure 18 Building before measures

Building Owner:
Karl Theumer
Consulting EuroPHit Partner:
Passive House Institute
Existing treated floor area (usable floor space):
127m²

The house was built in 1959 with various improvements being made over time. Work on step 1 of the retrofit plan began in winter 2013/2014. The overall aim of this modernisation was to take a step towards achieving the EnerPHit-Standard.

The initial works were completed in early 2014. The building's thermal bridges were reduced by applying external insulation. Radio-controlled exterior blinds were installed to help control solar gain through the windows. Cross ventilation of the cold basement was introduced to optimise air flows and the airtightness of cable shafts was improved. The first step was completed in 2014 and energy bills prove the success of the measures with savings of over 70%.

Figure 19 Building after measures

OP20 - House in St Cyr au Mont d'Or (France)

Figure 20 Building before retrofit measures

Building Owner:

Single Family House

Consulting EuroPHit Partner:

LaMP

Existing treated floor area (usable floor space):

310m²

The house was built in 1978 from cast concrete with interior insulation. The exterior cement render was in good state with no cracks or leaks and was therefore effective as an airtight layer. The windows were double glazed in a wooden casement with poor energy efficiency. There was 300mm insulation in the unheated attic. A supply air mechanical unit with convective electric heaters at diffusion terminals was used for heating and providing fresh air.

The first step in the step-by-step retrofit plan has already been completed. This involved achieving an EnerPHit quality building envelope, installing a mechanical ventilation with heat recovery unit in the garage and the installation of a wood stove on the first floor. The second step will be to replace the existing electric domestic hot water supply with an efficient storage tank with solar thermal panels.

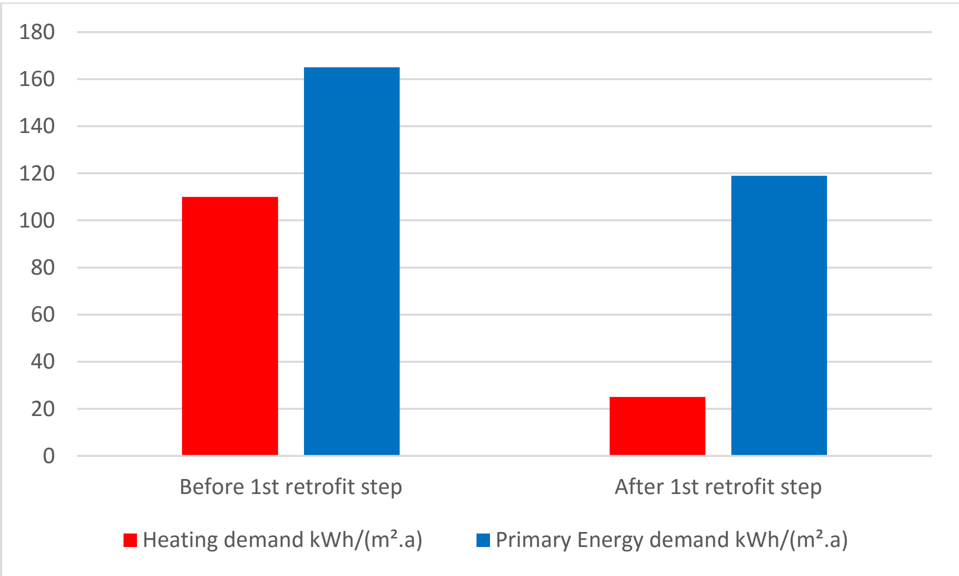


Figure 21 Predicted efficiency improvement

OP21 Stella Maris, Family Home in Wicklow Town (Ireland)


Figure 22 Building before retrofit measures

Building Owner:
Art McCormack
Consulting EuroPHit Partner:
MosArt
Existing treated floor area (usable floor space):
135m²

This house was originally a 1960s county council bungalow, built with concrete blocks without any insulation on the walls, roof and floor. In the 1990s the house was retrofitted and extended with a timber frame construction. At that time the existing floor was retrofitted with 50mm insulation and the walls were internally insulated with 50mm of fiberglass. It is naturally ventilated by the traditional vent/grids on the external walls. In 2009 a new gas boiler was installed along with a vacuum hot water solar system. There is a wood log stove in the living room.

The first retrofit step to improve the thermal performance of the existing roof through improved insulation and airtightness has been completed. In addition the existing block wall facing north has also been externally insulated. The chimney has been externally insulated and connected to a log stove. New certified Passive House roof lights, windows and doors have been installed and the heat recovery ventilation system has been installed in the attic along with the ducting network.

The second step will improve the side (east and west) elevations. The timber frame walls will be insulated between and over the studs. Again, new certified Passive House windows and doors will be installed. The third step involves a small extension to the south and the installation of south facing Passive House windows.


Figure 23 Building after retrofit step 1

OP22 Villa Nina, Bansko (Bulgaria)

Figure 24 Building before construction works

Building Owner:
Rila Solutions EAD
Consulting EuroPHit Partner:
EnEffect Design
Existing treated floor area (usable floor space):
400m²

Originally constructed in 2007, the house is located in the Bansko ski resort. The previous owner decided to sell the partially constructed building because of financial difficulties. It is a concrete slab construction with concrete columns, external brick walls and a wooden roof. It consists of four storeys and a basement. There is no insulation on the walls or on the ground floor and the insulation on the roof is not sufficient. There are no windows and a lot of thermal bridges need to be avoided.

The new owner has the ambition to achieve the highest possible energy standard. The house will be used as a holiday villa for 20 people. The proposed steps will include the installation of a high quality thermal envelope, airtightness measures, a ventilation system with heat recovery, and the installation of an air-to-water heat pump. Construction started in 2016 and is ongoing.

Figure 25 Building during construction works

OP23 Treviana Social Housing in Madrid (Spain)

Figure 26 Building before retrofit measures

Building Owner:
Marcos García Caravantes
Consulting EuroPHit Partner:
Plataforma PEP
Existing treated floor area (usable floor space):
5,580m²

Treviana Social Housing is a 14 storey building with 72 apartments and was built in 1968. External walls are made of a double layer of brick with a 50mm air chamber between them and no insulation. The building structure is made of reinforced concrete. Ventilation is done naturally by opening window sections.

The first retrofit step was undertaken by apartment owners who decided to improve their dwelling. This step included exterior and interior wall insulation, high-quality window installation, airtightness improvements and a new ventilation system with heat recovery. The next step of the refurbishment plan will affect the entire building. The step includes external insulation (ETICS), roof insulation and basement ceiling insulation. This project is particularly notable as it involves the collaboration of many individual apartment owners.

Figure 27 New airtightness seal by window

OP24 Church community centre "La Provvidenza" in Pergine Valsugana (Italy)

Figure 28 Building before retrofit works

Building Owner:

Church of Pergine Valsugana

Consulting EuroPHit Partner:

ZEPHIR

Existing treated floor area (usable floor space):

840m²

The building is located in Pergine Valsugana. It was built in 1922 to become an oratory for girls and a youth centre. In 1950 an additional floor was built on top of the existing floors. The wall assembly for the first two floors was made up of local stone and plaster, the third floor was constructed from hollow brick. The horizontal elements (ceilings and roof) were mainly made from timber. All construction elements had no thermal insulation. The windows were single glazed with uninsulated timber frames.

Figure 29 Existing building and extension

The retrofit plan includes the construction of an extension; the total existing building will be mirrored on the north-south axis. The retrofit aims to achieve the Passive House standard for the whole building (existing and extension). This will involve thermally insulating the building envelope, replacing all windows and doors with Passive House certified components. Building ventilation will be provided by 12 ventilation units with heat recovery. A large ventilation unit in the basement will serve the majority of the basement and the first floor, the 11 other ventilation units are much smaller and are located on the first, second and third floors. Heating and hot water will be provided by district heating. In terms of renewables, PV panels will be installed on the roof. A second step being considered is the implementation of façade integrated PV panels after the end of the project.

Figure 30 Building during retrofit works

8. EnerPHit Retrofit Plan (ERP) and PHPP

The challenge in step-by-step retrofits is to reach an optimal energy efficiency standard for the whole building after completion of all individual retrofit steps. In order to reach this aim all steps need to follow a common master plan. Such a plan should be worked out before the first step is tackled. It includes information about order and quality of all energy retrofit measure as well as general definitions of the position of the airtightness layer and the thermal insulation layer in each part of the building envelope. If of two adjacent parts one is modernized some years before the other a technical connection detail that works well during all phases should be developed. Other types of interdependencies between energy efficiency measures should also be considered carefully: e.g. when new airtight windows are installed a heat recovery ventilation system is advisable to be safe from overly humid air and mold growth.

A well-thought-out master plan is not only indispensable for a good final result, it also helps keeping the overall costs low. Costly alteration works because of short-sighted earlier measure can be avoided and energy costs are gradually reduced to a minimum.

In EuroPHit a feasible approach for such a master plan has been elaborated: the so-called Overall Retrofit Plan (ORP). The concept includes a template, a calculation tool, an online platform and an explanatory handbook amongst others. For energy consultants and architects the ORP is a great tool for efficient and well-structured planning of stepwise retrofits. The building owner receives a printout of the ORP to keep for future reference.

High-efficiency retrofit to EnerPHit Standard differs from standard retrofit in a higher quality of design, workmanship, and construction components. In order to ensure that the necessary quality is actually met, a third party check can be helpful. That’s what Passive House Institute and its accredited certifiers offer with the EnerPHit precertification for stepwise retrofit. Precertification includes a thorough check of the ORP as well as the detailed design documents for the first step. Once this first step is completed a preliminary EnerPHit certificate can be issued. An online platform facilitates and structures the data exchange between energy consultant and certifier. The precertification gives planners and building owners the certainty, that the desired energy standard will actually be achieved after the last step will have been completed.

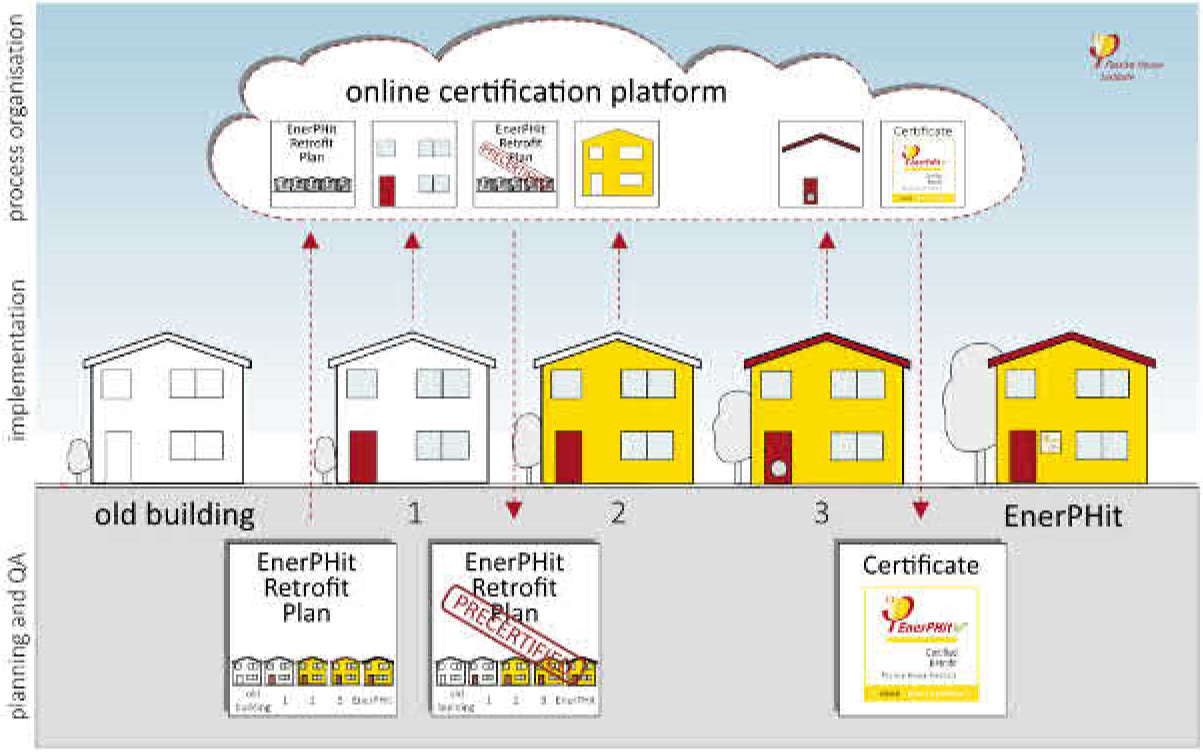


Figure 31: Schematic representation of the EnerPHit certification process for step-by-step retrofits.

If a building is meant to achieve a specific target energy standard an energy balance calculation software is an essential tool during the planning process. With such a software the easiest and most cost-effective way to reach this standard can be found. The Passive House Planning Package (PHPP) is an easy-to-use tool for energetic planning of new buildings and retrofits. It has been continuously developed since the 1990s and is validated for high efficiency buildings as well as for evaluation of existing buildings with high energy consumption.

In EuroPHit, additional useful features for step-by-step retrofits have been built into the PHPP. They include the parallel calculation of each retrofit step with the full range of results in one file. A comparison function shows the differences and savings from one step to another as well as the cost effectiveness of individual energy saving measures. From a completed PHPP file large parts of the EnerPHit Retrofit Plan can be created with only a few mouse clicks.

PHPP: Improved optimisation for step-by-step retrofits

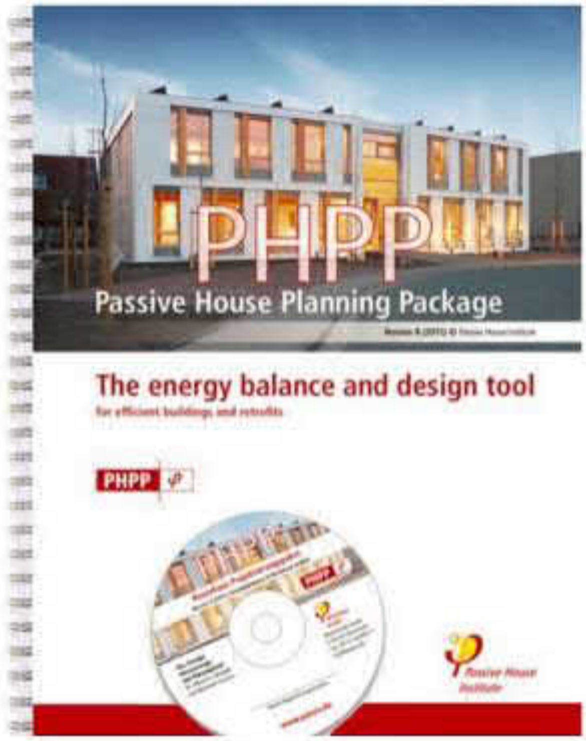


Figure 32: Version 9 of the Passive House Planning Package includes new useful features for step-by-step retrofits.

The English version of PHPP 9, the tried and tested tool for designing energy efficient buildings, was released in October 2016. This version included several new innovative features such as heat recovery from shower water and profitability calculations. The practical use of the tool is facilitated by means of automatic verification and plausibility checks. Different options for a particular measure can now be entered in one PHPP file and tested with reference to their respective effects. This allows energy balance to be calculated making it possible to depict improvements in efficiency due to individual refurbishment steps. In addition, the EnerPHit criteria for retrofits can now be applied internationally without restriction, with building component requirements suiting relevant climate zones.

For many years, the PHPP (Passive House Planning Package) has provided architects, designers and energy consultants with the possibility to optimise a building design on the basis of clear figures. The Excel-based calculation tool serves not only as a reliable planning aid but also as verification of compliance with the internationally applicable criteria of the Passive House Standard and the EnerPHit Standard for retrofits.

9. Product Demands

The EuroPHit project built into the need for appropriate building components which would be required to see out successful step-by-step retrofits on the way to the EnerPHit Standard. In order to achieve a cost effective and an energy efficient step-by-step retrofit, the use of prefabricated and already existing elements and products for newly built buildings or complete refurbishments was of great importance. Therefore, it was necessary to evaluate which components are already available on the market and how they can be used in a stepwise retrofit situation. EuroPHit identified areas that need development because certain products weren´t or still aren´t available on the market and concepts that could lead to successful product development.

Major activities and achievements

Major activities consisted of identifying products or concepts which would be suitable for step-by-step retrofits, but needed improvement to be used efficiently in the specific conditions of stepwise refurbishment processes. The partners then set up a list of components with potential to further evaluate the improvement strategies and develop concrete solutions. After the evaluation of this demand, technical and practical requirements had to be set up to serve as guideline for a further product development.

Based on these requirements, the product development started, first with sketch-like ideas and descriptions of possible solutions in preliminary design briefs. Theses sketches and descriptions were then discussed with manufacturers in several meetings, the products or concepts further developed and finally condensed in the final versions of the design briefs and the guidelines for product development.

Evaluation of product demand and definition of requirements

Brain-storming sessions occurred in every project meeting to identify existing or missing products based on the partners' experience or using feedback from the pilot projects. Based on these experiences a list of products was put together with the components, connections or whole concepts that would need to be evaluated. The final list helped to sort the identified components, connections or concepts into 4 main focus areas for which requirements needed to be assigned:

- Opaque components of the building envelope and windows

For all elements of the building envelope, the efficiency criteria was quite clearly set with the definition of the international EnerPHit criteria, which was available half-way through the project. The efficiency requirements for components meeting the criteria for these components all across Europe could thereby be derived from this criteria. In several cases though, like for the window connections, it was evident, that during a stepwise retrofit process, not all aspects of the criteria can be met with the first retrofit step, but only after the completion of the whole refurbishment.

- Heating, cooling and hot water

Criteria for heating or cooling devices only exists for so-called compact unit, providing ventilation, heating and domestic hot water all in one device. Elaborating criteria for such devices also suitable for also cooling buildings was discussed, as potentially useful for warm climates, but discarded, as the development of criteria for cooling devices was considered to be to excessive. However it became obvious, that in a big efficiency potential lies in the distribution of domestic hot water (DHW). Requirements were thereby described for Drain Water Heat Recovery (DWHR) systems, and potential new concepts for the technologies in the context of retrofits were set up.

- Ventilation

Criteria for ventilation unit existed for normal and for larger units (>600m³/h air change rate) before EuroPHit started. During EuroPHit, the practical possibilities of very small ventilation units like single room ventilation were assessed and the specific requirements of these evaluated. These requirements were then used to describe the products suitable for step-by-step retrofit processes, were the installation of ventilation requires concepts allowing a minimum intrusion of the living area

- Integration of renewable energy sources

In many cases the building owners chose to apply efficiency measures first of all, and in the most cases thereby didn´t chose to implement RES at the same time. It was thereby considered to be helpful to think about a supplementary implementation of RES, photovoltaics, mainly. In order to allow a future implementation of RES on components like exterior wall insulation or glazing, that have life cylces of 40-50 years, these components could be updated in a future step.

The evaluation of existing and missing products and the elaboration of the respective requirements lead to the creation of a summary of demands, containing explanations of the EnerPHit criteria setting the requirements and then listing the products identified as suitable for step by-step retrofit s and such products which are missing on the market.

Elaboration of product ideas and design briefs

The products on the above mentioned list was then started to be send out discussed with manufacturers working in these fields. Accordingly, the list was reduced to 20 products, including variations) to work on. Of these 20 products, guidelines were drafted to show how to meet the requirements. These guidelines were sorted and further elaborated, and preliminary design briefs could be set up, containing general descriptions how to evaluate and produce the products with the efficiency and practical specifications aimed for. These design briefs were set up partly based on existing knowledge based on the requirements, and partly based on discussions with manufacturers in meetings.

The final versions of 18 versions of design briefs were put together at the end of the project when the feedback by the manufacturers had been collected in meetings, phone call or email contact. The design briefs contain a short description of the purpose of the component, why it would be needed in the context of deep energy retrofits and stepwise refurbishments, followed by the definition of the requirements for the components in one or in several European climates and finally sketches, descriptions and calculation formulas if required for the products.
The following 18 design briefs were uploaded to the product section on the EuroPHit webpage and

offered for download by interested manufacturers.

Assessment and conceptual drafts for the integration of RES

The EuroPHit partners, ONYX mainly, evaluated the possibility of implementing PV systems in retrofits. The evaluation is documented in a report describing the current status regarding technical possibilities of BIPV in retrofits. In addition, the potential of PV implementation was evaluated for each of the case study projects. Even though the potential is considerable, the building owners seemed reluctant to combine both, high efficient components like suitable wall or roof insulation, with renewable energy sources. Thereby concepts for supplementary PV implementation were discussed and lead to a respective design brief.

Manufacturer meetings and, in parallel, component competitions

The meetings with manufacturers started off with short meetings to clarify their interest in further development of their products, which products and how they were to be improved and how this would match the requirements for step-by-step retrofits.

In addition to the manufacturer meetings, the two component awards carried played an important role it this process of direct support to the manufacturers. As the manufacturers participating in the competitions had to further developed their components to match the requirements of the competition specifications, this development was carried out in collaboration with experts of PHI to optimise the concepts set up by the manufacturers, in both, phone calls or email contacts. Especially for the component award focusing on windows for step-by-step retrofits, most of the windows participating in the competition had to be adapted

Elaboration of guidelines and product presentation

At the end of the EuroPHit project, the developed requirements and concepts were put together in final product guidelines describing the ideas and product concepts in detail. A product presentation which is used to further disseminate the potential to further develop products for the use in step-by-step retrofits

10. Training

EuroPHit Training for Designers and Contractors

Carrying out high performance retrofits is of course made easier with the expertise of trained professionals. Through EuroPHit, architects, engineers, and craftspeople were trained in what it takes to carry out a deep energy retrofit in a step by step fashion. Given the condition of our building stock and the current legal situation during the project, demand for trained professionals was certainly increasing.

Through the EuroPHit project, courses specific to Passive House and step by step retrofits were delivered in partner countries across Europe. The courses were based on material from the well-established Certified Passive House Designer and Certified Passive House Tradesperson courses with adjustments for a focus on step by step retrofits.


Practical trainings in dedicated PH labs, Photos © MosArt

These courses were rolled out starting in summer 2014 in all partner countries. The goal was to train the professionals working on the EuroPHit case studies - other interested professionals were welcome to attend as space permitted.

EuroPHit training course materials

The outlines of the EuroPHit training course materials are available on the EuroPHit website. These materials contain information on the Passive House Designer course, the Passive House Tradesperson course and the training module for Airtightness Installation and Measurement, as well as information on the details of step by step retrofits.

Financial workshops

Workshops were held throughout the EU to support interested financial institutions and local partners in offering financial products specifically for step by step refurbishments. In these workshops, draft financial guidelines for energy efficient refurbishment were presented, discussed, and refined with input from participants.

Individual regional workshops took place from 2014 through 2015. The final International Financial workshop took place in March 2016. These workshops aimed to inform and motivate a variety of decision makers, bringing together key representatives from:

-Financial institutions
-Home owner associations
-Tenant organisations
-Local authorities
-Energy advisors associations
-Property portfolio management groups

1st Financial workshop London, UK (16th September 2014)


This was the first workshop in a series that will be held in each of the EuroPHit partner countries. The workshops are being held to explore the barriers, opportunities and potential solutions to financing deep retrofits at scale.

The session was chaired by BRE, who are leading on the financial work package for EuroPHit. The morning session focused on the domestic retrofit market, with the afternoon session concentrating on the contrasting and overlapping issues surrounding commercial retrofit.
Adam Robinson of BRE began the session by explaining the context of deep retrofit in the UK and how the EuroPHit project is positioned to up-scale the number of such retrofits. Georg Kraft of IZN then presented on his experiences of mechanisms of financing retrofits in Germany and using EU funds.

Portsmouth City Council delivered a presentation on the EnerPHit retrofit of Wilmcote House, the UK EuroPHit case study project. This delivered a very informative insight as to why and how it was decided to go to the EnerPHit standard. Presentations were also delivered by representatives from RE:NEW and RE:FIT, projects in London which use ESCOs in order to guarantee energy savings in retrofit projects.

Many interesting discussions were had throughout the sessions, particularly around public perceptions, demonstrating cost effectiveness, and legislative drivers. The outcomes of the discussions will go on to inform the development of the EuroPHit project, with further workshops planned over the coming months.

Co-funded by the Intelligent Energy Europe
Programme of the European Union

2nd Financial workshop Bratislava, Slovakia (29th October 2014)


Bjørn Kierulf of Createrra began the session in Bratislava by explaining the context of the EuroPHit project and how it is positioned to scale the number of deep retrofit projects in Slovakia and other partner countries. After this brief introduction, Georg Kraft of IzN presented on his experiences of mechanisms for financing retrofits in Germany and using EU funds, which included sharing lessons from case study projects, discussing financial barriers to undertaking retrofits and exploring new/alternative financial models.

Peter Robl of Knauf Insulation focused his presentation on the domestic financing of renovations, showing some numbers of building stock in Slovakia, the costs of renovation and financing models.

Many interesting discussions were had throughout the sessions, particularly around public perceptions, demonstrating cost effectiveness and legislative drivers. The outcomes of the discussions will go on to inform the development of the EuroPHit project, with further workshops planned over the coming months. This concerns especially the following aspects:

- trying to attract more participants from the financial sector.
- arranging meetings with local banks which are possible intermediaries for the development banks (CEB, EIB, EBRD, KfW) to implement programs using EU funding

3rd Financial Workshop Copenhagen, Denmark (26th February 2015)

Claus Skytt of Merkur began the workshop by presenting the bank's financial products. Merkur issues bank loans with lower interest rates for "climate" projects. For refurbishments Merkur demands an overall plan for the actions. Sometimes they finance the most feasible steps first and implement the next steps after some years, when they are about to pay back, in order to keep the total loan down. In this way they finance not only the most feasible but all feasible actions, implementing the full energy saving potential.

Jette Moldrup, manager of the lending department at Kommunekredit presented their way of working. It's an association of all the Danish municipalities (kommuner). It issues bonds internationally and in this way offers loans to the municipalities, the regions, and to companies guaranteed by or owned by them. They don't take deposits and they have never had a loss on a loan. She finds that there are already a lot of energy efficiency projects going on, and Kommunekredit currently offers financing at around 0% interest rate. She hardly sees the need of further subsidies. In ESCO-projects Kommunekredit often cover the financing, as ESCO-companies can't raise financing at comparable interest rates and thus wouldn't realise the same amount of energy savings.

Georg Kraft and Klaus Stocker presented the EuroPHit-material on financing models. Some terminology was put in place:
-Recourse financing respectively project financing
-Forfaiting

4th Financial Workshop Dublin, Ireland (20th March 2015)

This workshop comprised an introduction to the EuroPHit project as well as relevant financial schemes and models nationally and internationally. This led to an exploration of barriers, opportunities and potential solutions to the financing of deep retrofits.

An overview of building performance in Ireland generally and the the EnerPHit Standard was given by Art McCormack, followed by an introduction to one of the Irish Case studies, Rochestown House, by Mariana Moreira, both of MosArt Architects. A retrofit financial model worked out for both academic and practical personal purposes was then presented by Fintan Smyth of Saint-Gobain. Involving previous public engagement, the presentation traced a shift in attitude towards greater willingness to invest in retrofitting once the case was presented cogently regarding significant savings in heating costs, comfort, longevity of structure, health and aspects of stress reduction. This was followed by an outline by Josephine Maguire of the Better Energy Finance Scheme developed by SEAI. Finally, Georg Kraft of IzN presented on his experiences of mechanisms for financing retrofits in Germany, including the use of EU funding. This presentation also introduced attendees to such concepts as Recourse Financing and Forfaiting / Forfaitee.

The workshop progressed on to discuss retrofit financing issues of concern and possibilities from the perspective of those who attended. It was generally recognised that the principle of spending money in order to save money should be recognised as a 'good risk' for lending bodies.

5th Financial Workshop Milan, Italy (21st March 2015)


The workshop was opened by Francesco Nesi who introduced the topics of Nearly Zero Energy Buildings, energy efficient retrofits and EuroPHit project. Fabio Ferrario presented the EnerPHit standard and the Passivhaus certification criteria for retrofits. He presented a study on the economic convenience of retrofitting a multifamily building to the EnerPHit standard by comparing it with two other solutions: 1. retrofitting the building to the minimum level required by law and 2. retrofitting it by replacing just the components that reached the end of their lifecycle.

Klaus Stocker presented the EuroPHit-material on financing models. He explained the promotion of energy efficient buildings, based on the experience in Germany and the promotional system of the EU. He discussed special financial tools to promote energy efficiency, like long term loans and redemption grants, recourse financing, project financing and forfaiting. With regard to the technical aspects of the EuroPhit project he explained what banks need to know about the whole house approach, target values for primary energy, reliable calculation tools and certification systems.

Valter Paoli discussed what an ESCO is and explained in which form ESCOs have been developing in Italy. He then introduced "Società Servizi Energetici Comunità Montana Vallesabbia" which is the ESCO he is administrating and the concept of a public ESCO. He showed a case study project of energy efficient retrofit that is going to be financed by this ESCO analysing cash flow and payback time.

Discussion and questions have been focused mainly on ESCO financing mechanisms and different types of ESCO existing in Italy. Moreover it has been discussed the Italian political situation and possible definitions of NZEB that could be introduced by policy makers.

6th Financial Workshop Leipzig, Germany (16th April 2015)


7th Financial Workshop Sofia, Bulgaria (28th May 2015)


8th Financial Workshop Sofia, Bulgaria (29th May 2015)


9th Financial Workshop Växjö, Sweden (22nd September 2015)


10th Financial Workshop Barcelona, Spain (25th November 2015)


On 25th November before the 7th Spanish Passivhaus Conference, PEP organized a workshop on the measurements for financing EnerPHit retrofits, the high efficiency Standard, carried out step-by-step.

A group of experts from different national and European organizations discussed the different alternatives they have available in Spain: credit lines, subsidies, loans, European programme funding, energy service companies, tax incentives, etc. The goal was to find a way how to make a building project attractive for a financial institution to invest in.

In the end of the session one of the EuroPHit case studies was discussed – a social housing building from the 50s in the city of San Sebastian. This was an example that perfectly represents the reality of Spain, where most residential buildings are multi-family rather than single-family, and the residents must approve every decision.

Co-funded by the Intelligent Energy Europe Programme of the European Union

11th Financial Workshop Barcelona, Spain (27th November 2015)

After the success of the first workshop carried out in Barcelona with financial institutions and other relevant organizations in Spain, PEP has organized a second edition of the workshop for the assistants of the Passivhaus Spanish national conference. Among the audience, there were architects, craftsmen, politicians, bankers and manufacturers. Nearly 300 participants, who work daily in energy retrofits all around the country.

This time Klaus Stocker has presented his experiences during the project and the main conclusions about how to deal with financial barriers in order to achieve the best results in energy retrofits: new strategies and options. A topic that is of great interest for the audience, due to the difficulties to undertake such projects since the beginning of the economic crisis.
The workshop was carried out in the beginning of a special session focus on retrofits. It was followed by the presentation of four relevant Enerphit projects: a congress center, a rural hostel, a pavilion of the University and a Civic Center.

The session concluded with a round table where experts and public have discussed about the roadmap of energy retrofits in Spain.

12th Financial Workshop Paris, France (23rd November 2015)

Final Financial Workshop Frankfurt, Germany (18th March 2016)

This workshop was the final culmination of a series of national financial workshops that were held throughout the EuroPHit Project. This workshop looked to bring the lessons learned throughout the project course and create a dialogue regarding the way forward to address barriers to financing deep energy retrofits and seize on potential opportunities.

Jan Steiger of the Passive House Institute started the workshop by introducing the EuroPHit project and its outcomes and results. After this brief introduction, Zeno Bastian of the Passive House Institute presented on built examples within the project and the new certification scheme for step-by-step retrofits, which assures owners and investors of the total energy savings following the completion of the final retrofit step.

To engage the group, a first group exercise was conducted where participants shared common financing implementation barriers and existing best practices.

Further presentations where then held, by Dr. Georg Kraft and Prof. Dr. Klaus Stocker of IzN, who examined different mechanisms and concepts of financing retrofits. Following this examples from Tirol (by Gerald Gaigg) and Germany (from Jan Steiger and Rolf Hennes) were presented to examine how this currently works in some areas. Dr. Witta Ebel then presented briefly on the design of step-by-step retrofit financing schemes before leading split-group work, where participants actually designed such a scheme in teams.

11. Communication to raise awareness and further project results

The true need for structures and models surrounding step-by-step and deep energy retrofits can be seen by the interest from key stakeholders also outside of the project, including those within Europe, but even beyond at the international level in areas such as North America and Asia. Several communication and dissemination activities and tools which were in part supported by the EuroPHit project, spread the project results and key learnings to a wide international audience. The momentum from these outside players is partially a key success of this project, in that its results will live on beyond the project's end and be implemented throughout Europe and the world, moving towards a sustainable energy future globally.

International Passive House Conference

The International Passive House Conference is organized by the Passive House Institute and held annually as the central event for highly energy efficient construction – both for new builds and retrofits.

EuroPHit brochure

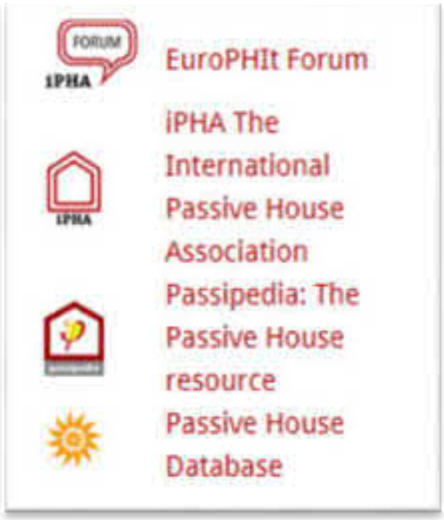
A final deliverable of the EuroPHit project was the creation of a brochure, oriented towards policy makers and municipalities, to highlight the case studies. The brochure, titled 'Implementing deep energy step-by-step retrofits', was published in English. The brochure was launched at the 20th International Passive House Conference in 2016 in Darmstadt and was so well-received by participants that many attendees from across the EU requested extra copies to distribute to local politicians in their home countries and cities.

Passive House Component Award

Two Component Awards were completed within the framework of the EuroPHit Project – one focusing on high-performance windows for step-by-step retrofits and the other on ventilation concepts for refurbishments. These were held in early 2015 and 2016 respectively, to further involve the industry into the development process of new component concepts and raise the awareness of the demand for these products amongst the stakeholders. The Component Awards were well received and future such awards to motivate manufacturers will be planned outside the framework of the EuroPHit project. A brochure was also created from the 2016 Component Award, highlighting ventilation concepts for energy retrofits.

EuroPHit Networks

As part of the communication and dissemination activities of the EuroPHit project, a network was created specifically for the project, with free registration for individuals to gain access to informative e-mails, project newsletters and publicity in our database of energy efficiency experts. Members joined from all over the world, especially from partner countries, highlighting the greatly diverse interest in the project, its findings and results. Members of the network also received access to benefits typically available exclusively to paying members of the International Passive House Association such as access to the iPHA Forum where one can ask questions and start discussions with Passive House experts as well as gain access to the members-only area of Passipedia. At the close of the project the network had close to 600 members.



12. Resources

Certification Platform

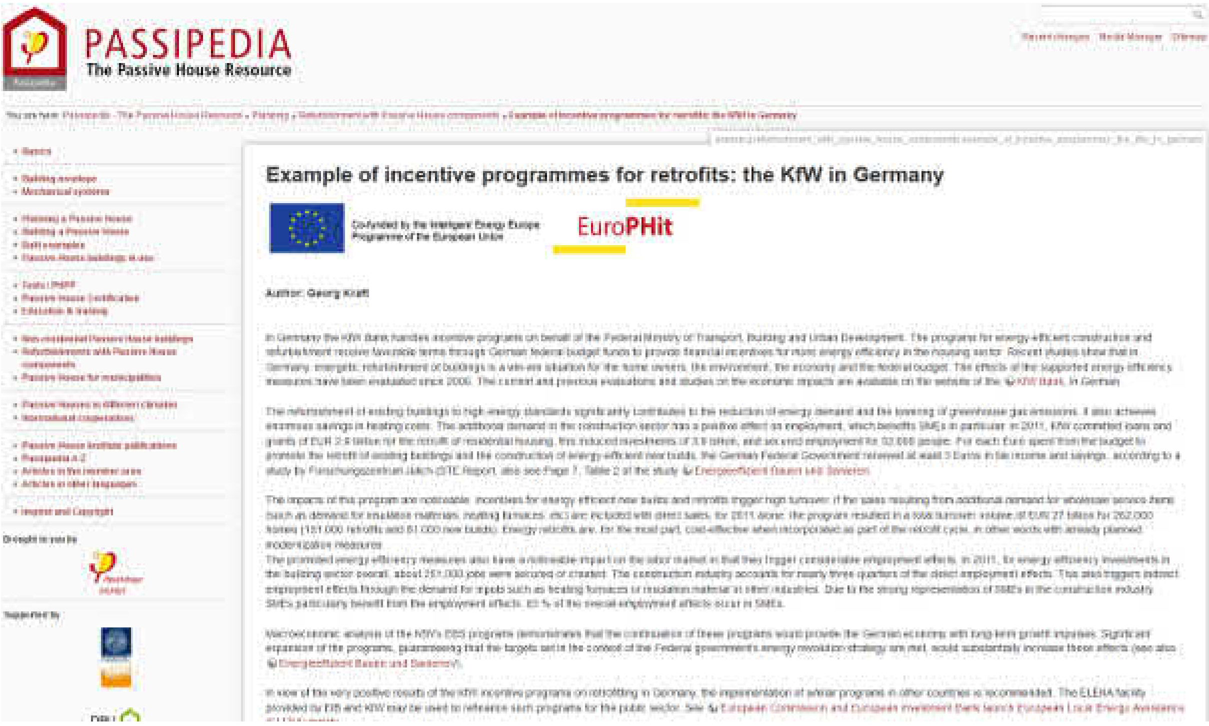
The EuroPHit team also developed and finally set up the certification platform for the certification of Passive House- and EnerPHit Certifications as well as pre-certifications for step by-step retrofits. This platform had been tested during the projects by the partners and was opened to all building certifiers accredited by the Passive House Institute at the end of the project. It offers a streamlined workflow for the certification process which is also explained in an easy-to-read guideline which explains the process to stakeholders involved in the certification, like designers or building owners. The by the end of EuroPHit, the first certification projects had already been completed via this platform.

Online handbook

Within the framework of the EuroPHit project, a digital handbook was created **"Step-by-Step retrofits with Passive House components"** which offers a practical guide to planning and undertaking such type of retrofit projects with the use of Passive House components. This handbook is available as a download and flipbook guide for reference from any interested parties and ensures the project results can be carried forward into real action across the EU and beyond.

Passipedia

Passipedia is the online wiki-based resource for all Passive House and energy efficient building information across a variety of subjects. There is a vast array of cutting edge, scientifically sound articles about the Passive House concept and related topics. On Passipedia, basic information and insights are available for all to see, whereas members of the International Passive House Association and the EuroPHit Network receive special access to more in-depth sections. This knowledge database is ever-expanding and comprises over two decades of research. There are also articles generated by the EuroPHit project, relevant to the implementation of step-by-step retrofits. These articles are freely available and serve as references to those interested in specific examples or cases of some of the theoretical aspects of deep energy and step-by-step retrofits. The EuroPHit-specific articles are also linked widely to the general themes of retrofitting, step-by-step retrofits, financing and high-quality building components.



Passive House Institute www.passivehouse.com

The Passive House Institute is an independent research institute that has played an especially decisive role in the development of the PH concept – the only internationally recognised, performance-based energy standard for construction. In addition to its research activities, the Passive House Institute is also involved in the certification of buildings, building components and construction professionals.

International Passive House Association (iPHA) www.passivehouse-international.org

The International Passive House Association (iPHA) is a global network for Passive House knowledge working to promote the Passive House Standard and connect international stakeholders. Based on a network of over 2700 individual members and organisations and 18 affiliate countries, including 12 from EU Member States, iPHA acts as the central international network and platform for international exchange relating to the Passive House concept and energy efficiency.

Passive House Planning Package (PHPP)

The Passive House Planning Package (PHPP) is the key design tool used when planning a Passive House or any other low-energy building, including retrofits and historical buildings, making it the perfect tool for the planning and verification of step-by-step retrofits. It is the PHPP's high level of precision and accuracy in calculating energy balances that sets it apart. Based for the large part on European norms, the PHPP makes use of numerous tested and approved calculations to yield the heating, cooling and primary energy demand of a building, as well as predicting its likelihood of overheating in warmer months.

13. The way forward

How to carry the results forward

Now having a consulting and or certification offer for many members of the project consortium means now that they can expand their businesses to serve these relevant potential clients looking for step-by-step retrofits and through the project an actual process and certification was created to guide the process and ensure that the results building owners and investors are looking for can and will actually be realised.

The time is ripe for product manufacturers to start developing new products, as the market is growing and the European potential is increasing. The need for affordable, high-quality components has never been clearer and with many of these tools in place to help there is the opportunity for manufacturers to start to innovate. Many of the EuroPHit results will assist in assessing the growth potential of the European market, the need for new components and most importantly, how they present these products into the market, as part of a retrofit plan and shift towards deep energy retrofits, which also have a business case thanks to the high energetic qualities of the components used.

The EuroPHit project has successfully shown that such projects are feasible and the frameworks required to see them implemented on a large scale are also possible and need to be further developed. Financing bodies and local authorities will be instrumental in the next steps to ensure that future energy goals and that the building stock is set on a path for deep energy savings through well-planned and well-executed retrofits. This vision is critical to achieve climate protection goals of the EU and its member states.