Public results-oriented report

Deliverable 1.4

of the FIT-TO-NZEB project, financed under grant agreement No 754059 of the HORIZON 2020 Programme of the EU

Led by:

Center for Energy Efficiency EnEffect

Contents

Foreword

Undoubtedly, it is a hard decision to invest your family's savings in renovating your home – instead of, let's say, buying a new car or going for your dream vacation. With all the hassle and uncertainties related to the retrofitting works, there's always a reason to leave the long-needed intervention for next spring… or later. And when the time finally comes, the problems are never far behind. Unfortunately, not all renovation works are of the quality we hope and pray for, and there's a good reason for that – in general, professionals rarely have the knowledge, skills and experience necessary to deliver a quality

The way we do it: Fit-to-NZEB implementation higlights from Ireland. Click to watch!

renovation project: one that not only saves energy, but increases your comfort, brings clean air inside, improves your health, and at the end - makes you happy and satisfied, with your money well spent.

As a matter of fact, we, as a society, will continue to invest heavily in building renovation. We all know that lower energy consumption in our buildings will help us fight energy poverty, create new employment opportunities, keep the money in our cities, change the urban landscape and increase the security of energy supplies. The most significant energy saving potential throughout Europe is in the renovation of existing buildings – so, then, why don't we try to get better value for the money we spend? Better value, in this case, comes with qualified professionals able to implement quality renovation projects using the most efficient materials, components and technologies available on the market. It also means better understanding of the benefits of deep energy retrofit by both investors and occupants: the process in which optimal energy savings lead to financial, health and comfort benefits for all of us.

This is precisely the goal of the new Fit-to-NZEB project: it aims to increase the competence and skills of the building professionals in the field of deep energy retrofit in the participating countries - Czech Republic, Romania, Bulgaria, Italy, Croatia, Ireland and Greece - through unique educational programmes, which contribute to both the quality and the scale of the deep energy building renovations. For its two years life, the project has produced all necessary requisites for the introduction of educational content on deep energy retrofit in the curricula at all levels of the vocational training and education system - universities, professional high schools and colleges, vocational training centers. It has suceessfully employed the training and communication infrastructure of its predecessor Train-to-NZEB (www.train-to- nzeb.com), which already operates 5 training centers in Eastern and Southern Europe, and has established strong connections to a significant number of other Horizon 2020 projects where shared partnerships already result in active exchange and collaboration.

Project concept

What is Fit-to-NZEB about

Reaching of the 2020 and 2030 energy and climate change objectives represents a major challenge to the construction sector, which needs to be ready to deliver high energy performing renovations and, in particular, nearly zero energy buildings. This goal requires a major effort to **increase the number of qualified construction specialists at all levels**, which is directly related to the **accessibility and quality of the educational programmes**and the inclusion of training on intelligent EE and RE solutions in building renovation. Responding to these needs, project is designed to increase competence and skills of the building professionals in the field of retrofitting to NZEB-levels in the target countries (Czech Republic, Romania, Bulgaria, Italy, Croatia, Ireland, Austria and Greece) through the unique educational programmes developed by the consortium, which will contribute to both the quality and the scale of the deep energy building renovations. This main challenged is addressed through streamlined action in the following major directions:

(i)   Elaborate a **set of required technological competences** related to the EE and RE solutions in building renovation;

(ii)   Develop **new training programmes** at all levels of the vocational education and training system employing the newly elaborated technical competences;

(iii) **Review the national educational plans for the relevant professions** and introduce the necessary changes;

(iv) Establish capacity for professional training of trainers and **train and certify (on behalf of the project) a sufficient number of trainers**.

(v)   **Support and monitor** the first courses on the new programmes at all levels.

Project objectives

In order to increase the interest in training on energy efficiency in buildings and particularly on building renovation, the number of qualified workers and specialists in the whole construction chain, and to accelerate the energy renovation of existing building stock and to raise the quality of renovated buildings, the project has set itself the following objectives.

1.   To develop a compendium (systematically organized collection of requirements) of the knowledge, skills and competences required for deep energy information, derived from all relevant professions from professional directions "Construction" and "Electrical engineering and energy sector".

Based on the compendium (above), to develop:

2.   A design-focused training programmes on deep energy building renovation for higher education establishments (EQF level 6-7) specializing in architecture and energy systems, consisting of 60 academic hours (30 hours theoretical lectures and 30 hours of practical training), with all necessary requisites, and to start its implementation.

3.   A training programme on deep energy building renovation, to be included in the training plans and programmes for the tradesperson professions in "Construction" professional direction *(see more in WP5 below)* in the professional high schools (EQF level 3-5), consisting of 24 hours of theoretical and 36 hours of practical training.

4.   Training content, to be included in the training plans and programmes for the professions in "Electrical engineering and energy sector" professional direction *(see more in WP5 below)* in the

professional high schools (EQF level 3-5), consisting of 24 hours of theoretical and 18 hours of practical training.

5. Two training programmes for acquiring qualification on part of profession (specialization, or similar qualification according to each national qualification framework), to be used in the training plans of the VTCs (EQF level 3-4), namely, "Deep energy renovation of the building envelop" and "Deep energy renovation of the building systems", targeting respectively professional directions "Construction" and "Electrical engineering and energy sector", consisting of 16 hours of theoretical and 24 hours of practical training.

6. A comprehensive scheme for validating of knowledge, skills and competences acquired at the workplace, consisting of entry level tests, training programme consisting of theoretical and practical trainings (8-12 hours) and evaluation scheme (EQF level 3-4).

7. To develop and disseminate through the official channels administered by the Ministries of Education and Science educational content on deep energy building renovation for the initial education level.

8. To develop the design of **demonstration and practical training models**, to actually build one such model for the use of the training centers providing the trainings, and to specify the equipment and building materials necessary for practical trainings and demonstrations on all programmes.

9. To conduct a **train-the-trainer course** for selected trainers from the supporting educational and training institutions and to organize, support and monitor the conduction at least one course on each programme within the duration of the project.

10. To conduct a systematic **large-scale communication campaign** promoting the new training courses.

Main Beneficiearies

Universities

Standing at the heart of the construction value chain, building designers are the key to the energy transformation of the building sector. The new requirements for nearly zero-energy buildings (nZEB) and cost effective deep energy retrofits already lead to significant changes in the design practice, as the approach to the energy saving measures is becoming more and more important – also driven by increasing clients' demand.

The objective of the Fit-to-NZEB programme is to extend the knowledge in the field of design, building and use of buildings. The development of the educational programme for levels 6-7 under the EQF was the cornerstone for implementation of this topical area of the project, covering the full range of learning outcomes relevant to deep energy retrofit. The model programme is divided into 60 hours (30 hours of theoretical lectures and 30 hours of practical seminars) in which 17 topics are taught.

Professional high schools and colleges

Crucial for correct exectition of design projects, avoidance of performance gaps and respectively, client satisfaction, and often standing at close distance to the end user, building professionals are an integral part of the process of market uptake of nZEB and deep energy retrofit concepts. Unfortunately, content related to energy efficiency and RES in building is still not well integrated in the educational curricula, and further efforts are needed to improve both theoretical and practical educational practices.

The proposed training programme Deep Energy Retrofit: Retrofitting to nZEB Levels is conceived as an additional module to be introduced in the curricula of the Construction and Architecture Professional High Schools and Colleges. Specific units of learning outcomes are also applicable in the

curricula of the corresponding educational institutuions in the area of energy and mechanical engineering. The model programme is divided into 60 hours (24 hours of theoretical lectures and 36 hours of practical lessons) in which 21 topics are taught.

Vocational Training Centers

The delivery of quality nZEBs represents a major challenge to the construction industry and requires systematic upskilling of the construction workers around Europe. The vocational training centers, exemplified in Fit-to-NZEB by the Building Knowledge Hubs in participating countries, are the perfect answer to this challenge.

The project has developed training programmes for EQF Levels 3 to 4 for the two streams of construction workers involved in the deep retrofitting of buildings: 1) Building envelope (including blocklayers, carpenters and plasters); and 2) Mechanical systems (including electricians, plumbers and those working in the HVAC sector). Different training programmes are envisaged depending on where the training might take place, as follows: 1) Delivered at a vocational training centre - this would be a training centre where models of deep retrofitting are available and where hands-on experience is provided; and 2) Delivered at the construction site ('on-site') – this would be where training is delivered at a construction site of a deep retrofit project, making it more convenient for the construction workers to attend and also helping to solve 'real-problems' which they might be experiencing on any given project. Lastly, different lengths of courses are envisaged depending on the knowledge and skills level of the construction workers involved, as specified below: 'Full-time training', amounting to 40 hours, 2. 'Upskilling', amounting to either 16 or 24 hours, and 'Validation', amounting to 12 hours (the focus of which is directed to validating skills and knowledge of already-experienced construction workers).

Project partners

Coordinator of the project:

Center for Energy Efficiency EnEffect – Bulgaria, www.eneffect.bg

Project partners:

University of Architecture, Civil Engineering and Geodesy – Sofia, Bulgaria, www.uacg.bg

SEVEn, the Energy Efficiency Center – Prague, Czech Republic, www.svn.cz

Czech Technical University in Prague, Czech Republic, www.cvut.cz/en

Association Cluster for Promoting Nearly Zero Energy Buildings (Pro-nZEB), Romania, www.pro-nzeb.ro

Technical College for Architecture and Public Works, Bucharest, Romania, www.colegiulionsocolescu.ro

Passive House Academy / MosArt Landscape Architecure Research, Ireland www.passivehouseacademy.com; www.mosart.ie

University of Zagreb, Faculty of Construction Engineering, Croatia www.grad.unizg.hr/en

Zero Energy and Passivhaus Institute for Research (ZEPHIR), Italy, www.zephir.ph

Hellenic Passive House Institute, Greece, www.eipak.org

Technical University – Vienna, Austria, www.tuwien.ac.at/en

Summary of Project's Implementation

Back in 2017, we promised that we will do our best to set up a full range of innovative qualification and training schemes for deep energy building retrofitting supported by RES. This target included both elaboration of new training programmes and materials for all professional groups and support for development of innovative training facilities - with the goal to provide world-class practical training on building renovations aiming at Nearly Zero-Energy Buildings (NZEB) levels.

Today, we are proud to share the following results:

- A full review of deep renovation training programmes and materials;

- A set of learning outcomes on 17 topics related to deep energy retrofit, distributed according to the relevant EQF levels;

- 7 model training programmes, ranging from Master programmes' classes to short-term upskilling courses;

- Training materials on each of the 17 topics, including annotated presentations, exercises, examination questions and references;

- Fully equipped training facilities in 7 European countries;

- More than 150 newly trained trainers, capable to deliver the new training content using the practical training facilities;

- 20 pilot courses conducted in universities, professional high schools and vocational training centers, subject to continuous monitoring for improvement of the training schemes;

- 8 Memoranda of Understanding with education and training providers willing to use the new training programmes and materials

- A large and constantly growing network of dedicated professionals, for whom deep energy retrofit has become a part of the daily routine and a source of professional pride and identity.

But the work is far from completed: as a result from the intensive stakeholder engagement campaign, in each involved country, Fit-to-NZEB partners are recognized as key partners for the development of national policies, support programmes, educational standards, curricula and materials in the area of nZEB and deep energy retrofit – an achievement that already bears tangible results, and will continue to do so in much bigger scope than anticipated!

Key Project Outcomes

Learning outcomes: new knowledge, skills and competences for deep energy retrofits

Based on a thorough review of the existing training programmes and materials on deep energy retrofit and an analysis of the training gaps in the involved countries, a compendium of the knowledge, skills and competences required for deep energy retrofit was developed. The learning outcomes, organized in 17 distinct topics of relevance to NZEB-level retrofit process, are defined for each targeted level along the EQF. The required technical competences are collected and analyzed according to the identified needs of the pre-defined target groups – the main beneficiaries of the project, in close cooperation within a broad network of local stakeholders.

The review of the accessible training materials, the analysis of the training gaps and needs and the set of learning outcomes are freely available at our website – www.fit-to-nzeb.com. Being one of the most important outcomes of the project, they are delivered in a flexible format allowing application of any selected topic in respect to the specifics of the training plan of the interested educational institution or vocational training provider.

Development of demonstration and practical training models

A key component of the Fit-to-NZEB project is the organization of practical training facilities following the example of the Building Knowledge Hubs (BKHs), developed under the preceding Train-to-NZEB project (www.train-to-nzeb.com). The design of retrofit models for the purpose of training serve two functions: a) Demo models for the purpose of demonstration of typical construction detailing and sequence of elements as well as for sketching exercise, discussion and oral examination. These models comprise one complete solution in respect of achieving the unbroken continuity of airtightness, insulation, minimal thermal bridging and, preferably, wind-tightness. The construction types selected are typical for each country but retrofitted in respect of the higher building performance required to achieve nZEB levels; b) Practice models that more or less correspond to the demo model construction types but for the purpose of hands-on practical training and examination. Unlike the complete demo model, these models are stripped to their basic structure, providing the basis for the practical retrofitting work.

Detailed guidelines for establishing of dedicated practical training facilities are freely available at www.fit-to-nzeb.com, ready for use by any interested training provider. With the support of the project, 4 entirely new such facilities are set up - in Croatia, Greece, Ireland and Italy, and 3 existing

ones expanded – in the Czech Republic, Romania and Bulgaria (with a new branch opening in the professional high school of architecture and construction in the city of Pazardzhik).

Trained trainers

After providing the necessary training facilities and equipment and developing the training programmes, specialized train-the-trainer courses were organized for dedicated groups of trainers in each country. Following a common design and programme, including technical and, where necessary, pedagogic training, a specialized training programme was developed.

After an international train-the-trainer course conducted in Ireland by MosArt in the spring of 2018, the programme was applied in all partner countries. Undoubtedly, this was one of the most successful and rewarding stages of the project: more than 200 professionals took part in the national courses and enjoyed the engaging discussions with our trainers. Registering extremely high levels of satisfaction from both trainees and lecturers, the courses will continue to be offered by project partners on regular basis in order to sustain the steady market uptake of the new programmes at all levels and thus, to support the sustainability of project results.

Model training programmes

Based on the set of learning outcomes and the feedback from the international train-the-trainer activities, model training programmes on deep energy building renovation for higher education establishments (EQF level 6-7) specializing in architecture and civil engineering, professional high schools for architecture, construction and mechanical engineering, and specialized vocational training centers with a focus on hands-on training were developed. The programmes are outlined according the project team evaluation of educational gaps and skills needed on the emerging NZEB market and integrate available and newly designed e-learning tools, facilities for practical demonstration and training, and examination programmes, available from the practice of the partner organizations and a set of selected EU projects.

Just as the set of learning outcomes, the model programmes are not a requirement for training and educational institutions but on the contrary – a reference and even an invitation for re-design by any interested VET provider, according to its own training plan and agenda. Thus, encouraging cooperation in the sector by providing a shared and open knowledge base, the project paves the way for future action, targeting mutual recognition of NZEB-related skills and competences among an increasing number of countries.

Country highlights

Bulgaria

The project in Bulgaria closely followed the footsteps of its predecessors BUILD UP Skills EnerPro Train-to-NZEB, using the broad network, experience and facilities developed during the years to enable application of deep energy retrofit training among all levels of the VET system. This time, with the University of Architecture, Civil Engineering and Geodesy attracted as project partner, a brand new discipline on "Management of Deep Energy Building Retrofit" was piloted for last-year students. The Professional High School for Architecture and Construction in Pazardzhik was attracted for integration of materials in the educational curricula, with the new discipline "Energy Efficiency and Ecological Construction" to be started in 2019. Pilot courses, including courses for validation of skills and knowledge acquired at the workplace, were conducted in the BKH in cooperation with the Bulgarian Association for Insulation in Construction and the (only) local producer of MVHR units Tangra. Full information about the local activities is available at www.eneffect.bg; a schedule of the training courses (in Bulgarian) is to be found at any time at www.busenerpro.com.

„As a certified passive house building designer, it has been extremely useful for me to see and apply on site the specific techniques for achieving airflow and the efficient operation of ventilation systems with heat recovery. I believe that this will be beneficial both for training in our new training centers and for our practical work in designing nearly zero-energy buildings."

Alexander Stankov, EnEffect Design

Croatia

The Faculty of Civil Engineering at the University of Zagreb was the first Fit-to-NZEB partner to implement a discipline on Deep Energy Retrofit in the academic curricula, facilitated by a newly equipped practical training and demonstration center and a number of study visits at actual construction sites, allowing the students to put the newly acquired skills and knowledge into practice. By all measures, the course was a definite success; and what is more important, the project brought to the public attention the important of quality deep energy retrofit not only for the construction industry, but for the health and well-being of the occupants. This was helped by the established media partnerships and the series of highly successful academic and public events ensuring application of the Fit-to-NZEB outcomes not only in the educational activities but also in the actual construction practice.

More information about the project in Croatia can be found at www.grad.unizg.hr/en.

Dear Professor and Respected Assistants,
I wanted to tell you that I'm not sorry to have enrolled building physics, in contrary...
I am thrilled with the course and effort you invest in providing us with a quality education:
- high quality live lectures with current examples and videos
- bring specimens and samples of the systems to lectures
- organize live experiments and tests for us
- organize guest lectures and technical visits
- you listen to the students' thoughts and criticisms
- you encourage the writing and presentation skills of us students through seminars and pitch presentations
- developed models with the full scale (1:1) details which are installed in the yard building
Keep doing it!
Krešimir Kolesarić, student Faculty of Civil Engineering, University of Zagr

Czech Republic

The Fit-to-NZEB project in the Czech Republic followed a well-paved path laid out by a number of initiatives in the VET sector by project partner SEVEn under the Horizon 2020 programme (such as Train-to-NZEB, PROF/TRAC and ingREeS) but instilled new power and energy through the delivery of the first academic course in the Czech Technical University in Prague. Attended by more nearly 40 students, it was an undoubted success and will continue to be offered in the next year. Based on the wealth of locally adapted training materials, Memoranda of Understanding were signed with two specialized professional high schools, providing sustainable application of the project outcomes. The fruitful cooperation with the Architecture and Building Foundation continued, as the Czech Building Knowledge Hub not only offered two new accredited courses on deep energy retrofit focused on building envelope and mechanical systems, but enriched its equipment with new dedicated demonstration models and specialized RES installations. The project outcomes will seamlessly flow into the new CraftEdu project, which will further work towards mutual recognition of acquired competences with selected professions vital for the quality of NZEB construction in the region.

„The unique models of building constructions in the Prague training center are great examples of nearly Zero Energy Buildings and deep energy retrofits. The students see the real details of modern construction solutions presented at attractive practical form.“
Jan Fibiger, ABF Foundation

Full information about the activities can be found at www.svn.cz and www.cvut.cz.

Greece

Building a strong professional community to spread the knowledge about NZEB construction – that is the key word for the activities in Greece, which were adeptly carried out by local partner Hellenic Passive House Institute. Based on a continuous partnership with local and international suppliers of NZEB-suitable products and materials, a new Building Knowledge Hub was founded in two location in Athens, displaying all that is needed to reach national and international sustainable building construction standards. A number of training activities were completed, from very intense train-the-trainer courses combined with the biggest events in the sector, to agreements with the professional associations of distributors of insulation materials and window installers for dedicated courses for their members. On top of the well-visited and appreciated training for construction workers, the market development is visible: with the help of Fit-to-NZEB support, the market demand for NZEB projects is steadily raising – and so is the need for vocational education and training in the field!

For more information, visit the website of the Hellenic Passive House Institute at www.eipak.org.

„It's is very important to see exactly how to install correctly a window or how to prevent mould and condensation in walls. It's also very useful to learn the commissioning of a residential ventilation system. For me as a building physicist this was all known in theory, but new in praxis. So it was very important to participate in a TTT course and get ready to share this knowledge with technicians and construction workers in our new facilities in the future."

Dimitris Pallantzas, Certified PH Designer, Education

Ireland

With long-standing practice in vocational training for NZEB design and construction and experience from actual passive house projects on 3 continents, the Irish partner MosArt has definitely established itself as knowledge leader - not only in the Fit-to-NZEB project, but in the European professional community. However, what was achieved in Ireland in the last 2 years is simply stunning: a dedication of public authorities to construct a large NZEB training center largely using the guidance available from Train-to-NZEB and Fit-to-NZEB projects was closely followed by a government decision to finance training courses for 50 000 building workers and specialists, again, putting into action materials and practices established in these two projects. This, combined with available incentives for energy efficient building retrofit for the end users and a well-developed system for recognition of the newly acquired competences, sets a firm base for fast adoption of the new building standards in the actual construction practice. What is more, the training practice followed the pattern and moved away from the classrooms – the first examples of on-site skills training using the Fit-to-NZEB programmes and materials already showed incredible results and undoubted added value!

For everything concerning the latest NZEB training experiences and practices from Ireland, consult www.mosart.ie and www.passivehouseacademy.com.

The Passive House EnerPHit plaque in deep retrofit is awarded to Dublin Lord Mayor Nial Ring and Dublin City Architect Ali Grehan for their projects for senior citizens in Dublin. Fit-to-NZEB partner Tomás O'Leary of MosArt presents the plaque at an official opening ceremony.

Italy

Slowly but surely, NZEB gains pace in Italy, and the activities of the national partner ZEPHIR supported by the Fit-to-NZEB project are a convincing proof of this statement. A new practical training center was established with the support of the local technical college ITS – Varese, where the pilot phase of the training was completed. Previously mentioned but never done in practice, the training models were constructed by the trainees themselves during the course of the training through an intensive learning-by-doing process, which is in the core of construction industry.

Additionally, a two pilot short-term courses for construction workers were conducted, adeptly blending the Fit-to-NZEB programmes in the well stablished training practice of ZEPHIR.

The final Fit-to-NZEB conference also took part in Italy within the frame of MADE Expo, the largest construction fair in the country. The BuildSmart (BSmart) event was visited by more than 100 participants, queueing up to register and listening carefully to the last minute, convinced that new practices in design and construction demand a new set of skills and knowledge – and that is what Fit-to-NZEB delivers.

Full information about Fit-to-NZEB activities in Italy is available at www.passivhausitalia.com.

Romania

Following a long-standing tradition inspired by previous projects as QualiShell and Train-to-NZEB, Romania witnessed the first Fit-to-NZEB course for professional high schools – and with what success! Engaging 50 students in 2 classes of the Technical College for Architecture and Public Works in Bucharest, the course had just one setback: time was not sufficient to encompass all new valuable content delivered by the project! It continues in the next academic year, already spread over two semesters, and Memoranda for Understanding for its implementation are agreed with two other high schools in the city.

Such training, however, needs facilities for hands-on work: here, the Building Knowledge Hub hosted by URBAN-INCERC has definitely proven its worth! Further equipped with new models and rooftop RES demo installations, it not only supported the high-school training and piloted the courses for construction workers, but served as the perfect spot for networking, attracting of new partners from Romania and abroad, and, yes, a visit from EASME. All of this was only possible through the efforts of local partner Cluster for Promoting Nearly Zero Energy Buildings (Pro-nZEB), demonstrating that stable demand for NZEB construction and training can only be achieved through collaboration of all engaged actors! Find out more on www.pro-nzeb.ro.

> *The module PASSIVE HOUSE - BASIC PRINCIPLES FOR TRANSITION TO NZEB is introduced in the curriculum of the Construction and Architecture High School. The students have been receptive to the new school subjects and have acquired knowledge, skills and competence in the field of their qualification. As a result, we have decided to continue the course in the next academic years.*
>
> *Eng. Liana Stanciu - Technical College I.N.Socolescu*

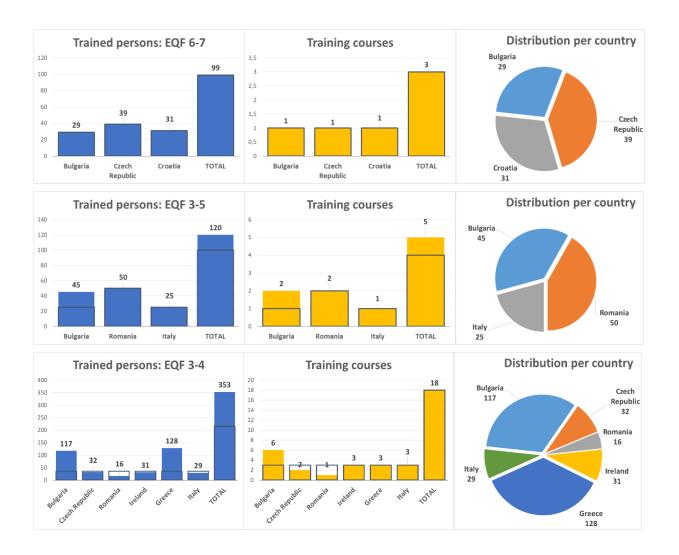## Large-scale implementation of the training schemes

Fit-to-NZEB educational course for EQF level 6 by UNIZAG - Croatia

The major impact area of the project remains the improved capacities and skills of building professionals. In the **second phase of the project**, as provisioned in the GA, a number of pilot courses were completed:

• 3 courses in universities specialized in Architecture, Construction and Engineering, targeting EQF levels 6-7, with a total of 99 students involved (Bulgaria, Croatia, Czech Republic).

• 5 courses in professional high schools and colleges, targeting EQF levels 3-5, with a total of 120 students involved (Romania – 2, Italy, Bulgaria - 2).

• 18 courses in vocational training centers, targeting upskilling/additional qualification of a total of 353 trainees with EQF levels 3-4 (Bulgaria, Romania, Italy, Greece, Czech Republic, Ireland).

Thus, a total of 572 specialists and workers (a minimum number) are trained only by participating training and educational institutions in the framework of the 2-year project.

Trained persons: EQF 6-7

Bulgaria	Czech Republic	Croatia	TOTAL
29	39	31	99

Training courses

Bulgaria	Czech Republic	Croatia	TOTAL
1	1	1	3

Distribution per country

Bulgaria 29 · Czech Republic 39 · Croatia 31

Trained persons: EQF 3-5

Bulgaria	Romania	Italy	TOTAL
45	50	25	120

Training courses

Bulgaria	Romania	Italy	TOTAL
2	2	1	5

Distribution per country

Bulgaria 45 · Romania 50 · Italy 25

Trained persons: EQF 3-4

Bulgaria	Czech Republic	Romania	Ireland	Greece	Italy	TOTAL
117	32	16	31	128	29	353

Training courses

Bulgaria	Czech Republic	Romania	Ireland	Greece	Italy	TOTAL
6	2	1	3	3	3	18

Distribution per country

Bulgaria 117 · Czech Republic 32 · Romania 16 · Ireland 31 · Greece 128 · Italy 29

Communciation and dissemination activities

Continuing the tradition of the National Platforms for Dialogue between the construction industry, energy sector and the VET providers stemming up from the BUILD UP Skills initiative, Fit-to-NZEB supported more than 30 national networking events:

- In Bulgaria, we started a national NZEB conference and exhibition, in cooperation with the Ministry of Energy and all relevant professional associations;
- In Croatia, a sequence of successful event culminated in a closing conference in the framework of the Zagreb Energy Days visited by more than 130 people, with lots of promises for the future;
- In the Czech Republic, the cooperation between SEVEn, the Czech Technical University in Prague and the Architecture and Building Foundation lead to Fit-to-NZEB courses officially recognized by the Chamber of Charter Engineers in their life-long learning programme;
- In Greece, the traditional national Passive House conference was brought to a new life, hosting events with more than 200 participants in Athens and Thessaloniki, coupled with Fit-to-NZEB training courses;
- In Ireland, Fit-to-NZEB motivated a broad partnership between national and regional authorities, training providers and the industry, resulting in a brand new training center and a large scale national upskilling campaign which plans to reach 50 000 building professionals

- In Italy, two national Passive House conferences brought Fit-to-NZEB to the attention of more than 500 participants from all over the world, combining motivational speeches with engaging study visits showcasing the best of the design and construction practice
- In Romania, local stakeholders took active part in the development of the Fit-to-NZEB learning outcomes, paving the way for large scale acceptance of the programmes and application of the training scheme among all levels of the educational system.

Ensuring EU-wide impact

From the EU Sustainable Energy Days to the International Passive House Conference, Fit-to-NZEB demonstrated its potential to be integrated within the education and training systems and research activities all around the continent. Here are some of the highlights:

- Fit-to-NZEB insights and experience were shared at the 22nd International Passive House Conference on 9-10 March 2018 in Munich, ranging from topics from life-cycle cost analysis to direct training experiences from the Building Knowledge Hubs;
- Together with Train-to-NZEB, the project team won the awards for best designed workshop and best workshop facilitation at the C4E forum in Serock, Poland on 13-16 June 2018;
- The coordinator of both projects was invited to share experiences and present the success factors at the EASME Horizon 2020 Energy Efficiency Info Day on 22nd January 2019 in Brussels;
- In May and June 2019, we are at CLIMA 2019 in Bucharest and the EU Sustainable Energy Days in Brussels, where avenues for further development and use of the results will be explored;
- A cooperation initiative with H2020 projects iBROAD, ALDREN, HAPPEN and Triple A-Reno will provide further integration of topics as building certification and renovation roadmaps into the training agenda.

Impact and Project Performance Indicators

Impact calculation (as defined in the project Grant Agreement)

The impact calculation is based on an extremely conservative approach, focused on the core activities of the project, using the same calculation method applied in the Train-to-nZEB project. It is assumed that the savings related to the conducted trainings for nZEB renovations will be achieved through delivery of deep energy retrofits instead of renovations completed according to the current norms and practice (as it would be without further training of workers and designers). After review of the norms and calculations of the expected savings in the different countries (details available in the DoA), it is accepted that the average savings in primary energy for the targeted countries are at minimum 120 kWh/m^{2}y.

Further on, taking into account the regular projects supported by Cohesion Policy instruments and the regular construction practice, it is assumed that for the execution of 1000 m^2 of nZEB 2 building fabric workers (EQF 3), 1 site manager (EQF 4-5), and 1 designer (EQF 6-7) with the additional qualification for NZEB renovations are needed. Such teams are expected to execute at least 2 renovation projects

per year that will have an improved performance of 5% in energetic terms due to the team's additional qualification.

Thus, the savings will be as follows:

	Teams trained*	m²/team/ year	Target savings / m² (kWh/m²)	Target savings per team (MWh/m²/y)	Total target savings (GWh/y)	**5% savings due to better trained teams (GWh/y)**
Impact indicator	99	2000	120	240	23.760 GWh/y	**1.188 GWh/y**

One team consists of 2 building fabric workers (EQF 3-4), 1 site manager (EQF 4-5), 1 designer (EQF 6-7). The project reports 99 designers (EQF 6-7), 120 site managers (EQF 4-5), and 353 building fabric workers (EQF 3-4), so a minimum of 99 teams as per the number of future designers.

The renewable production triggered by the project is calculated on the basis that 70% of the primary energy consumption is related to heating and cooling, out of which (according to the EPBD requirements) at least 50% will be due to RES installations (i.e. 8.4 GWh/year). Thus, at least 5% **(0.4158 GWh/year) energy from RES** will be due to higher quality renovations triggered by the core activities of the project.

Performance-gap approach to impact calculation

According to the guidance received by the EASME project adviser, another way of calculation of energy-related impact could be applied. With similar assumptions accepted as per the added value of the training courses regarding the achieved savings, it is more comprehensive as it covers the full number of trained persons. As per the guidance received, the <u>assumptions regarding retrofit projects are the following</u>:

- Predicted/ theoretical performance after renovation = 60 kWh/m2 (for heating & cooling)[1].

- Estimated performance gap = 100% of the predicted performance = 60 kWh/m² (i.e. actual energy consumption of 120 kWh/m² instead of 60 kWh/m² for passive house level H & C).

- Estimated reduction of the performance gap through improved skills = 4% * 60 kWh/m² = 2.4 kWh/m².

Applying the calculation method suggested, the following result is achieved:

353 trained experts * 50% applying new knowledge * 2 000 m² renovated floor area/expert per year * 2.4 kWh/m² reduced performance gap = **847.2 MWh/year**.

An impact-related case study: Modelled Energy Performance of a Fit-to-NZEB Case Study Project

One of the Irish case studies (St. Bricin's park by Dublin City Council) was fully modelled in the Passive House Planning Package, PHPP. The resulting space heating demand, airtightness and primary energy demand of the apartments is summarised below. With a space heating demand of just 21 kWh/m².year, this project exceeded the stringent Passive House EnerPHit standard of 25 kWh/m².year by almost 20%. Of note, the EnerPHit level of airtightness required is 1.0 h⁻¹, whereas the project below achieved an impressive result of 0.6 h⁻¹.

An adjacent apartment block, identical to that which was the subject of the Fit-to-NZEB training, was refurbished a year previously. Primarily due to lack of training, they did not achieve a good level of airtightness on that earlier project, with an average between upstairs and downstairs of 4 air changes per hour @ 50 Pa. The Irish team modelled the implications for the space heating demand of this lesser

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[1] CO referred to H2020 projects MORE-CONNECT and TripleA-reno to substantiate this figure.

level of airtightness in the PHPP energy model. The heating demand increased by a staggering 50% (from 21 kWh/m^2.year to 31 kWh/m^2.year). We can say quantitatively, therefore, that the training has had a significant impact on the energy savings and carbon emissions from these dwellings.

Impact Assessment from Deep Retrofit Building Owners:

The owners of the Dublin City Council project were clearly impressed with the benefits of the training as can be seen from the quotes below, taken directly from the video documentary which can be watched here: https://www.youtube.com/watch?time_continue=123&v=tE18Tp3THuE.

Dublin's Lord Mayor, Nial Ring:

"what they've achieved here in St. Bricin's is the gold standard in Passive Housing, but to do it in retrofit is even more extraordinary… it's an indication of what we should be doing"

Dublin City Council City Architect Ali Grehan:

"this project provides valuable lessons for retrofitting of all homes… we made it a condition of the tender that the contractors undertake Passive House training… because we didn't want to leave it to chance… "

Project Energy Consultant, James Walsh:

"From my point of view, the key benefit of training on-site was that people were taught why it's important to wrap the insulation tightly together, why was it important to do the airtightness and also to check it … and also for the following trades including plumbers and electricians so that they buy into the whole concept...the contractors bought into it, and that was a big plus… these residents are going enjoy a long life in these comfortable homes"

Dublin City Council Clerk of Works, Karl Payne:

The training "took a little bit of the mystery out of the idea of Passive House… each trade could see how it would be influencing another trade in terms of workmanship... the training was invaluable in meeting the quality goals of the project"

Dublin City Council Executive Architect, Cecilia Naughton:

The training centred on "trying to solve the problems together… it became a team effort… we know you can do it, maybe we can help… it was very useful…I'm pleased that everyone is back living in their home again…that's what the project is about really… "

EnerPHit Verification

Building:	Block 2
Street:	St. Bricin's Park, Block 2, Arbour Hill
Postcode/City:	Dublin 7
Province/Country:	Dublin — IE-Ireland
Building type:	Residential
Climate data set:	IE0001a-Dublin
Climate zone:	3: Cool-temperate — Altitude of location: 15.84 m
Home owner / Client:	Dublin City Council
Street:	Civic Offices, Wood Quay
Postcode/City:	Dublin 8
Province/Country:	Dublin — IE-Ireland

Architecture:	Low Energy Design	**Mechanical system:**	Morley Walsh Consulting Engineers
Street:	38 Bramley Walk	Street:	41 Lower Dominick Street
Postcode/City:	D15 W2WY Castleknock	Postcode/City:	Dublin 1
Province/Country:	Dublin IE-Ireland	Province/Country:	Dublin IE-Ireland
Energy consultancy:	Low Energy Design	**Certification:**	MosArt Ltd.
Street:	38 Bramley Walk	Street:	Wicklow County Campus
Postcode/City:	D15 W2WY Castleknock	Postcode/City:	A67 X566 Rathnew
Province/Country:	Dublin IE-Ireland		Wicklow IE-Ireland

Year of construction:	2018	Interior temperature winter [°C]:	20.0	Interior temp. summer [°C]:	25.0
No. of dwelling units:	11	Internal heat gains (IHG) heating case [W/m²]:	3.0	IHG cooling case [W/m²]:	
No. of occupants:	17.2	Specific capacity [Wh/K per m² TFA]:	132	Mechanical cooling:	

Specific building characteristics with reference to the treated floor area

				Criteria	Alternative criteria	Fullfilled?[2]
	Treated floor area m²	612.5				
Space heating	Heating demand kWh/(m²a)	21	≤	25	-	yes
	Heating load W/m²	11	≤	-	-	
Space cooling	Cooling & dehum. demand kWh/(m²a)	-	≤	-	-	
	Cooling load W/m²	-	≤	-	-	
	Frequency of overheating (> 25 °C) %	0	≤	10		yes
	Frequency excessively high humidity (> 12 g/kg) %	0	≤	20		yes
Airtightness	Pressurization test result n_{50} 1/h	0.6	≤	1.0		yes
Non-renewable Primary Energy (PE)	PE demand kWh/(m²a)	127	≤	127.40855		yes
Primary Energy Renewable (PER)	PER demand kWh/(m²a)	58	≤	-	-	-
	Generation of renewable energy kWh/(m²a)	0	≥	-	-	

[2] Empty field: Data missing; '-': No requirement

I confirm that the values given herein have been determined following the PHPP methodology and based on the characteristic values of the building. The PHPP calculations are attached to this verification.

EnerPHit Classic? yes

Task:	First name:	Surname:	Signature:
2-Certifier	Tomás	O'Leary	
	Certificate ID	Issued on:	City:
		30/04/19 Rathnew	

The project "St Bricin's Park Senior Citizens Development-Block 2" was recently selected as finalist in the annual SEAI Energy Awards and has also applied for the Irish Energy Efficiency Award (Property Industry Excellence Awards) and Irish building and Design Awards. It also hosts open days, as the next one is scheduled 12th of October 2019.

Progress beyond the State of the Art

With a network of Building Knowledge Hubs currently active in 9 European countries – Bulgaria, Croatia, Czech Republic, Greece, Ireland, Italy, Romania, Turkey and Ukraine – the project team is willing to position itself as one of the most recognized NZEB training establishments, offering world-class upskilling courses sourced customized to the local needs and in collaboration with the construction industry. To this end, a certain set of requirements is needed, including continuing cooperation with the leading research institutes, mutual recognition of training results and common certification, integration of innovative tools and methods (including on-site and web-facilitated training) in the training scheme. It however would not be enough: in order to stimulate the demand for NZEB training, we need a steady demand for NZEBs on the real estate market. This, in no doubt, is a complex task requiring common efforts by policy makers, industrial and market actors, and the civil society, but in all cases, the BKH network will be an active part of the process, as our mission remains intact: to constantly increase the competence and skills of the building professional to deliver high quality nearly zero-energy buildings.

Further information

For those interested to find out more about the activities and training opportunities available through the Fit-to-NZEB project, the final publication of the project delivers a complete set of information.

Available online at http://www.fit-to-nzeb.com/about.html and at all events organized by project partners – you're more than welcome to take a copy and meet us in person!

Find us on the web:

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