



Dedicated to stimulate demand for sustainable
energy skills in the construction sector

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Report:	D4.3 Guide for Methodologies and Pedagogical Training Tools
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SUMMARY

The current guide “Guide for Methodologies and Pedagogical Training Tools” intends to enlist the disposal of tools of the BUSLeague project partners and provide advice for their selection regarding the awareness raising and training interventions that will have taken place during the project. It is intended that it will provide useful information to interested third parties as well, with the target to support and enable the application of short practical training modules (including on-site training) corresponding to the current needs of the construction sector for time-efficient and cost-effective upskilling of the workforce.

To this aim, the BUSLeague consortium has prepared an inventory of tools that starts with the classification of demonstration models, training platforms and training centres, representing suitable tools for the spatial arrangements and practical upskilling of the trainees. A variety of such tools is discussed, ranging from demonstration mock-ups, mobile training platforms and training centres, product demonstrations, written content, awareness and training videos, to comprehensive learning management systems. In addition, various teaching methods are also considered in a thorough literature review, among which the direct and indirect instruction models, the self-directed and constructivist model, and the skill transfer training approach are elaborated.

The inventory of the tools available within the BUSLeague consortium consists of the instruments that support the conceptual and theoretical knowledge provision, demonstrating existing mobile and fixed training centres available in France, Ireland and Bulgaria, serving for both training and assessment purposes. Besides this, specific attention is given to various demonstration mock-ups, produced either through the support of international projects as Train-to-nZEB, Fit-to-nZEB and nZEB Roadshow, among others, or via direct market initiatives such as the Practee Formation tools described in detail in the report. These mock-ups, besides their value for short and on-site training activities, also display great potential for civil engagement and professional orientation campaigns, which make them suitable for multiple purposes and providing additional value for the operators of dedicated training centres.

Other training instruments, classified as audio-visual or written content, which can be used in learning management systems, are also presented in detail in the report. Specific examples for these tools are available from the practice in Ireland in Bulgaria, while the most comprehensive system emerges from the BAUHAUS experience in Spain, where significant investments have been attracted to provide a comprehensive learning platform for both employees of the company and professional clients.

In conclusion, the country teams participating in the BUSLeague project have developed national strategies for further development of these innovative training practices. Around them, the team has identified different sources that helped to characterise these tools and their suitability to specific contexts, including an analysis of the barriers and challenges for their practical application. A specific focus is placed on tools developed to organise training and demonstrations on energy efficiency and sustainable products at the DIY/Hardware stores. These methodologies and tools are collated as a guide for future trainings, used alongside the energy skills quality repository described under the *Report on training content and resources*¹, developed at an earlier

¹ Trnka, Georg (2022) AEA Report on training content and resources. Deliverable 4.1 under the BUSLeague project, financed under Horizon 2020 programme of the EU under Grant Agreement No 892894. Available at: https://busleague.eu/wp-content/uploads/D4_1_full_version.pdf

stage of the project. Further refining of the tools and channelling them to the specific professional occupations and qualification levels is expected to take place within the national discussion platforms and to materialise in the national qualification roadmaps to be developed under the ongoing BUILD UP Skills initiative, supported by the LIFE programme of the EU.

I TOOLS AND METHODS

This section briefly describes the main characteristics of the stock of tools and methods among the members of the BUSLeague consortium and especially of those involved in the task of organising and integrating upskilling activities to stimulate and meet demand for training of construction specialists. The details included in these definitions intend to address the classification of the identified tools particularly, to provide useful information for the intervention designers which would help them to choose certain kinds of tools among others. As so, the identification of space constraints, financial resources, stock disposal, and goals of the action plan for the designers, should serve to guide the decision process towards an optimisation of the resources used for the intervention strategy.

I.1 TOOLS

I.1.1 *Demonstration models*

The models are simplified replications of the constitutive elements of a building. These representations aim to capture only one of their dimensions to observe in detail a particular phenomenon affecting them. This abstract mock-up serves to feed the demonstration phase of the education process and provide a realistic approach to the examined fact. The models permit to gain detail in a three-dimensional observation and even the possibility to sense, to smell or feel changes in temperature or textures. Nevertheless, it is worth noting that the models require attention to the cost of reproduction along with the cost of transportation which represent limits to their utilisation.

The outcomes of the introduction of this tool are examined in Clevenger, Glick, & Lopez del Puerto (2012), where it is signalled the lack of spatial abilities among the engineer prospects as one of the recurrent defaults in current higher education, a principle that can be applied as well for craftspeople. In response to the necessity of visualising building system components, the article highlights the introduction of models to learn from the experience. The models offer the “touch and feel” possibility while supporting the conceptualisation of the structure.

In Europe, projects like Fit-to-NZEB invested efforts in the design of two kinds of models for capturing the characteristics of the building practices. For the first ones, the **Demo models**, the goal was to illustrate the elements of a typical construction presenting a defect with only one complete solution alternative. As such, they are often made of light materials in order to be easily transportable but not necessarily manipulated by the public. The second ones, the **practice models**, which stripped structure, permits the candidates to observe the details of the construction elements and work integrally on them to treat the pointed defect. In these cases, the materials are as similar as possible to the real ones, the dimensions are accurate, and the mock-up is expected to support repeated interventions on its structure. (Fit-NZEB project, 2018) (Train to NZEB project, 2015).

As a closing comment, it is worth mentioning that these models, tangible and physical, are not the only available tool for demonstrations. As described by Maing (2012), “practice **3D models**” of envelope sections have already been developed in a digital version. This version includes the whole amalgam of possible practices, designs and decisions that can be chosen in the construction process while reducing the production cost. While the implementation of these

tools started from the engineering side, its applications are relevant for other professions. One example of their educational performance was done by Schreyer (2014) on students of Architecture, Engineering, and Construction programmes as a way to complement the construction and material courses, showing positive results for the students' learning.

1.1.2 Training platforms and training centres

The principle of the training platform is similar to the concept of the demonstration model, notably to the one of the **practice models** seen in Fit-NZEB project (2018) and Train to NZEB project (2015). They seek to replicate constitutive elements of the building systems, capturing one, or a few, of their dimensions. Nevertheless, since the goal is not exclusively the demonstration, but the support of the training “do it” sections, the level of realism is considerably higher regarding the materials and the dimensions. As so, the platforms shall provide precise geographic notions to the candidate and offer him, or her, the possibility of executing the gestures instructed autonomously.

Given the increase in sizes and material requirements, the training platforms represent higher costs from a financial perspective and from a logistic one. This reason, perhaps, incentivises the training institutions to set an arrangement of training platforms – and sometimes of models as well, for economies of scale. This arrangement, driven by a logical criterion for choosing the platforms included, can be understood as a **training centre** that can be installed **fixed** in a building or that can be **mobile**, in order to deliver accessible training.

1.1.3 Product demos

The product demos are real working materials that are used for candidate testing and utilisation during simulation activities. From the candidate perspective, these permits to run the professional simulation with a high level of realism while executing the gestures learnt and accumulate a minimum level of “authentic” practice. From the staff side, the products can be bought by the training delivery in order to ensure the quality of the learning, or they can be donated by the manufactures, which recognise these kinds of events as an opportunity to showcase their products and to awaken the interest and trust in their brand among the professionals.

1.1.4 Written content

The written content includes the most traditional learning materials: the pamphlets, books, manuals, infographics, etc. They represent the classic method of knowledge provision by offering manuals of instructions, guides, awareness announcements, descriptive documents and reports, among others. While the replicability is high and the cost of reproduction is low, they imply a high level of autonomy from the candidate regarding the absence of direct feedback during the process.

1.1.5 Awareness and training videos

The awareness and training videos represent a way of replicating the experiences of a classroom or a conference through a digital medium. A video can enlist the theoretical contents to the candidates with practical demonstrations, allowing them to repeat it or to set breaks while watching it and follow the process of reflection suggested by the tool.

The execution of the information delivery, in this case, can be run in a **dialogue** or **monologue** way, following Chi, Kang and Yaghmourian (2017)². Analysing the data from two different studies on school students, these authors find evidence for thinking that the dialogue videos encourage the embodying of constructive and interactive behaviours while watching them. As well, they found a positive relation of the presence of training participants during the learning process, possibly derived from interactive possibilities and the presence of conflict in the classroom following the crash of the wrong statements of the participants and the correction of the tutors. Regarding the content, the video can host a **standard exposition** of concepts or, they can be used as **example** videos - which, from a practical approach, can be understood like demonstration videos. About this last, as Dart, Pickering and Dawes (2020) comment, they started in mathematics fields following an instructor analysing a problem and developing, step by step, a strategy to solve it while describing its reasoning. It derives risks to the learning process, like that, under lack of a basic knowledge, the candidates fill the unmentioned steps of the process. However, after testing this toll on mathematics courses of engineering undergraduate level, the students showed higher levels of satisfaction and performance.

1.1.6 Learning management systems

From the educational perspective, Watson & Watson (2007) point to the standard education system as an industrial arrangement of the knowledge provision in which the students have a passive role. Given this, education in what they call the “Information Age” should permit the customisation to the individual capacities and necessities of the students. The opportunity of adjustable sequences of instruction, real-time assessment and support collaboration provide useful information for maximising the learning effectiveness.

This individualisation possibility is explored in Partridge, Ponting & McCay (2011), where integrating face-to-face and online delivery methods in education, and even integrating other kinds of knowledge delivery, is currently called “Blended learning”. The literature defines this as a combination of modes of web-based technologies, a mixture of instructional technology with actual job tasks, or a fusion of different delivery formats.

The massification of digital technologies has enriched the process of learning by leading it completely or by supporting the blended learning proposals. There, the way in which the information is presented plays an important role, as is described in Chen and Yang (2020). Their research tested the learning effectiveness of 2 formats of instructions: the static ones, which present text manuals and graphic supports, and the dynamic, presenting animated demonstrations. A useful outline of their efforts is that, while for short presentations the dynamic format works better, for the long ones its counterparts do.

The introduction of the digital tools to the learning process has permits to articulate the written and video content in web-based platforms. The learning management systems, just one kind among the entire platform disposal, are reviewed in the literature in the following ways:

² Chi, Kang and Yaghmourian (2017) recognise 4 modes of engagement among the students and the instruction or instructional materials: the Passive(attending) one, less effective for learning than the active one (manipulate the information), as well less effective than constructive one (generate knowledge) and the interactive one (collaboration of two or more peers), the more effective one.

“An LMS is a multi-user software application, usually accessed through a web browser. It helps organizations manage training events, self-paced courses, and blended learning programs. It provides automation that replaces rigorous and expensive manual work, saves time, and enables you to organize your content, data, and learners. It tracks and reports on training activity and results.” (Foreman & Association for Talent Development, 2018)

“LMS is the framework that handles all aspects of the learning process. An LMS is the infrastructure that delivers and manages instructional content, identifies and assesses individual and organizational learning or training goals, tracks the progress towards meeting those goals, and collects and presents data for supervising the learning process of organization as a whole (Szabo & Flesher, 2002). An LMS delivers content but also handles registering for courses, course administration, skills gap analysis, tracking, and reporting (Gilhooly, 2001).” (Watson & Watson, 2007)

These definitions imply a wide variety of possible dispositions and objectives that can help to distinguish them. Foreman & Association for Talent Development (2018), for example, classify these platforms into three kinds: corporate, academic and integrated LCMS-LMS[nI]. While the corporate highlights their self-registration-management and one offers short training sessions seeking to improve the employees' productivity inside the company, the academic one works as an extension of the educational centre (normally on a web-based platform), complementing long courses, hosting evaluation spaces and encouraging the interaction among teachers and students. The integrated LCMS-LMS goes further, offering a collaborative developing environment that permits users to set searchable libraries of contents and create workflows linking templates on them.

As for other kinds of software, the LMS can be as well classified by their scheme: commercial or open source. In the first one, the manufacturers provide technical support, and improve the futures based on the recurrent customer suggestions. In the second one, a voluntary developer community works on features improvements and tests them. While the result of this process is a freely available code that can be modified by anyone, the actual integration of modifications to the standard product follows some sort of agreement of the community or a third-party vendor that can work on the available code for offering private features.

The pertinence of this kind of tools will depend on the requirements of the organisation, the interconnection possibilities with other management systems and the characteristics of the training. The process for selecting the right LMS is detailed by Foreman & Association for Talent Development (2018), which advises to “analyse your needs, define your requirements, vet products, evaluate suitable products, and select a product”. This implies concrete actions like inquiring the stakeholders' expectations, the company targets and the management characteristics and linking them to punctual technical and functional requirements.

1.2 METHODS

The intergenerational transmission of knowledge and techniques is as old as the notion of society among human beings. This not only exercises permit to conserve the knowledge across the time but to encourage the improvement of the techniques of the enrichment of the knowledge. Borich (2017) summarises the modern strategies for the teaching in 4 big groups: Direct Instruction, Indirect Instruction, Self-Directed and Constructivist Learning and Cooperative Learning.

1.2.1 Direct instruction model

The *direct instruction model* departs from the teacher or software as the main source of information (didactic) and demonstration (modelling) while it is transmitted through the recitation or presentation through a verbal channel, followed by the correction of the student and checking the acquisition of the information. This model, however, requires high levels of interest and attention from the learners. The motivation is a key factor for the success of the model application and reaching an active participation of the public is the aim. Even then perhaps the most common model is more opportune when the information disseminated is not readily available (Borich, 2017, 255-258).

As such, the exposition often takes the path starting by a focus activity that prepares the attention of the students by encouraging a review material, a game or a question. Following, a goals and rational setting which specifies the objectives of the activities and their importance to their daily or professional lives. Later, the content is provided often through the part-whole, sequential, combined or comparative relationships of concepts. Done this way, the content exposition can be enriched with specificity and examples that will permit to establish abstract generalisations in the mind of the students and to ease their application on real life contexts.

Finally, the check of the understanding is done through an assessment stage in which feedback is done under the performance of the students on a question test or on a practical exercise (Borich, 2017, 255-258) (Petrina, 2007, 113) (Dell'Olio, 2007).

1.2.2 Indirect instruction model

When the contest to express implies a higher complexity in a theoretical or in a practical way, the instructors often use strategies that they call the indirect instruction model. This uses stimulus material that shall be transformed or constructed by the learners. Along with this process, they are adapting a desired behaviour that results from the experiences with the material but that is as well enriched with previous experiences of its own. As such, there is not a "correct answer", and the meaning of the material is "constructed" by the learner. Under this logic, 4 objectives can be reached: A concept can be thought by the exposure of examples and non-examples, the encouragement of the inquiry can be a goal itself by pressing the logic of organisation, change, inter-correlation of a series of objects in a universe and inviting the learner to use their element for building of knowledge. This way of learning opens the door to exercises as the self-evaluation by creating a dialog between the students for feedback on the highlights of the lesson and discussion groups (Borich, 2017, 285-310).

1.2.3 Self-directed and constructivist model

The *self-directed and constructivist* learning model develops a session in which the teacher is a provider of strategies for analysis and knowledge construction that the learners will take aboard the selected topic. Under a constructivist frame, this group of strategies depart from an explicit illustration of how to use the strategies for learning, of how these strategies can be used in the real-world, to interpret this situation with their own precedent tools and shift gradually the responsibility of the learning process to them. For this, several strategies are prices such as meta-cognition (that implies the explanation of a punctual rational process, the awarding of the rationing process, and the encouragement or applying this process), the teacher-mediation learning (encouraging the students into a learning process while the teaching conduct the analysis and correct on-time the conclusions drawn) or the functional error strategy, in which the

misunderstanding of the students (induced or genuinely) are analysed and discussed in order to clarify ideas and the reciprocal learning (in which the student predict ideas about the topic that will be treated, the teacher questions this prediction, summarises the status of the discussion, as a clarifying stage for preceding the right or mistaken ideas mentioned. (Borich, 2017, 319-348).

1.2.4 The skill transfer

According to Petrina (2007), “Emotion, knowledge, judgement, and technical skills develop together and are inseparable in experience and practice”. As so, the technical skills are coordination of bodily-kinaesthetic, logical-mathematical, and spatial intelligences that once learned become habits that are called as response to specific situations. These can be learnt under three prerequisites: having a motivational climate, instruction of balance and coordination and the provision of articulated procedures as exercising activities for the students. The resultant quality of the performance of this habit is what measures the effective skill acquisition. (Petrina, 2007, 101-102).

The skill acquisition can be also taught from two models: The psychological models depart from a perception stage (analysing the task and the derived objectives), followed by a performance step and ending part of developing emotional, mental and motor responses; all this framed into a closing feedback and a teacher-driven re-analyse and reflection part. Another approach is the “communities of practices” of the cultural model. There the students are conditioned by cultural and social factors and their learning path starts with their immersion in the culture in which norms and practices are identified informally through demonstrations. Later, the candidates practise the skills observed with the formal and informal feedback of peers and instructors (Petrina, 2007, 102-103).

Petrina (2007) also distinguishes between work-site cultures and school cultures. In the school cultures, the ethical grounds provided aim to hold uniform and standardised values. In contrast, in a work-site community the values of speed and stability are less appreciated in comparison with the performance of the individuals aiming to gain the skills. As such, the quality of the final product depends on the specific situation (on the stage of the learning process). These stages are therefore a processing element of a situation, rules of behaviour and decision-making and exercising the judgement, which degrees of complexity can be seen in the following table:

Table 6. Stages of skill acquisition (Adapted from Dreyfus & Dreyfus, 1986, 1999, 2004)

	Novice	Advanced beginner	Competent	Proficient	Expert
Processing elements of a situation	Sees only those that are clearly and objectively defined	Perceives similarity with prior examples	Reflects upon various alternatives to goal	Intuitively organizes and understands task without decomposing it into component features	Intuitively organizes and understands task without decomposing it into component features
Rules of behavior & decision-making	Follows clear procedures and rules	Transfers from one situation to another	Analytically calculates choices that best achieve goal	Consciously focuses on choice that best achieves intuitive plan	Acts in an unconscious automatic, natural way
Exercising judgment	Minimal	Minimal	Consciously deliberates	Acts based on prior concrete examples in a manner that defies explanation	Unconsciously does what normally and ethically works

Regarding the learning process itself, Petrina (2007) enlists the factors that influence the process of skill acquisition. About the learning environment, it is mentioned the importance of considering the readiness and personal motivation and the performer’s estimates of failure or

success in a given task (this affects their performance). About the teaching exercise, the importance of setting attainable goals is marked for the candidate within the task, the supply of a context for the skill to be developed, to show models of quality performance (the imitation is a vital for students and therefore is key to demonstrate procedures with clear directions and steps) and to distribute the practice sessions. Finally, regarding the students, it is signalled as essential to encourage them to make mental practices for ensuring the retention and the acquisition of the skill.

The author also suggests that the transference of the skills is more efficient focusing enough on the underlying principles in order to ease the development of the broadly applicable generalisations, to use several techniques and examples and highlight similarities between an original model of the task and an application context (Petrina, 2007, 107).

2 EXAMPLES OF PEDAGOGICAL TOOLS

The pedagogical tools listed below are to serve as an example and inspiration for training courses, aiming at describing and illustrating at best the principles of planning and executing energy efficient buildings.

2.1 DEMONSTRATION MODELS

2.1.1 Bulgaria

01 Building Envelope Model: Wooden Construction

Mobile: Yes **Property rights:** Own **Reproducible:** Yes, conditioned
Market availability: Yes

Width: 1m **Height:** 2.4m **Length:** 1.2m

Description: The model represents a 'slice' of building envelope, incl. foundation, wall with window, floors and roof. The construction is wooden and represents the nZEB construction principles.

Contents: Certified Passivhaus Tradesperson.

02 Building Envelope Model: Concrete Construction

Mobile: Yes **Property rights:** Own **Reproducible:** Yes, conditioned
Market availability: Yes

Width: 1m **Height:** 2.4m **Length:** 1.2m

Description: The model represents a 'slice' of building envelope, incl. foundation, wall with window, floors and roof. The construction is made to represent the widely used concrete and brick structure and embodies the nZEB construction principles.

Contents: Certified Passivhaus Tradesperson.

03 Building Envelope Model: Mixed Construction

Mobile: Yes **Property rights:** Own **Reproducible:** Yes, conditioned
Market availability: Yes

Width: 1m **Height:** 2.4m **Length:** 1.2m

Description: The model represents a 'slice' of building envelope, incl. foundation, wall with window, floors and roof. The construction is made to represent the widely used reinforced concrete and aerated concrete structure and embodies the nZEB construction principles.

Contents: Certified Passivhaus Tradesperson.

04 Building Envelope Model Retrofit: Foundation, Floor and Walls

Mobile: Yes **Property rights:** Own **Reproducible:** Yes, conditioned
Market availability: Yes

Width: 1m **Height:** 1.8m **Length:** 1.2m

Description: The model represents a 'slice' of building envelope, incl. foundation, wall with window and. The construction is made of prefabricated panels, and it represents the retrofit of such construction acc. to the nZEB construction principles.

Contents: Certified Passivhaus Tradesperson.

05 Building Envelope Model Retrofit: Walls and Roof

Mobile: Yes

Property rights: Own

Reproducible: Yes, conditioned

Market availability: Yes

Width: 1m **Height:** 1.8 m **Length:** 1.2m

Description: The model represents a 'slice' of building envelope, incl. wall and flat roof. The construction is made of prefabricated panels, and it represents the retrofit of such construction acc. to the nZEB construction principles.

Contents: Certified Passivhaus Tradesperson.

06 Practice Model: Wooden Construction

Mobile: Yes

Property rights: Own

Reproducible: Yes, conditioned

Market availability: Yes

Width: 1.2m **Height:** 2.1m **Length:** 0.9m

Description: The model represents the skeleton of a wooden wall. It also has several pipes penetrating it. The idea is to make the wooden wall air-tight and thermally insulated (incl. around the pipes). The trainees work in groups and recreate the exact activities that must be done on-site when working with wooden construction.

Contents: Certified Passivhaus Tradesperson.

07 Practice Model: Concrete Construction

Mobile: Yes

Property rights: Own

Reproducible: Yes, conditioned

Market availability: Yes

Width: 1.2m **Height:** 2.1m **Length:** 0.9m

Description: The model represents the skeleton of a concrete sandwich wall. It also has several pipes penetrating it. The idea is to make the wall air-tight and thermally insulated (incl. around the pipes). The trainees work in groups and recreate the exact activities that must be done on-site when working with wooden construction.

Contents: Certified Passivhaus Tradesperson.

08 Insulation model boxes

Mobile: Yes

Property rights: Own

Reproducible:

Yes,

conditioned **Market availability:** Yes

Width: 0.4m **Height:** 0.2 **Length:** 0.5m

Description: This tool is useful to show the importance of thermal insulation in buildings. There are two identical boxes: one thoroughly insulated and the other not. In each of them is placed ice and the time for melting and the temperature inside are measured over time to give an idea of the importance of the thermal transmittance.

2.1.2 France

01 Airtightness box

Mobile: Yes **Property rights:** Own **Reproducible:** Yes, conditioned

Market availability: Yes

Description: This demonstrative module includes 3 construction methods (timber frame, breeze block or brick masonry) in which the weak points have been treated in a “right” and “wrong” ways. By adding gas inside the model and its eventual filtration, the participants can identify which solutions were effective and which were not. In this way, the candidates recognize the value of a performing envelope, methods for preventing air leaks and familiarise with the tightness systems for new and renovating buildings.

Link: [Maquettes Pédagogiques](#)



02 House model

Mobile: Yes **Property rights:** Own **Reproducible:** Yes, conditioned

Market availability: Yes

Description: The model represents an individual house, including wet rooms, that illustrates the effect of airtightness on the mechanical ventilation by running a smoke generator.

Methods: FIT

Link: [Maquettes Pédagogiques](#)

03 VMC Model

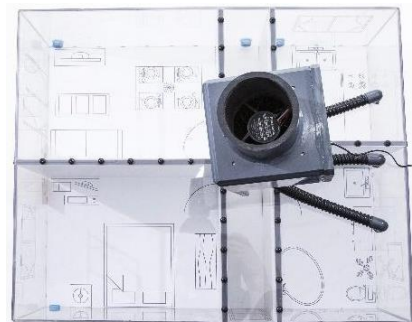
Mobile: Yes **Property rights:** Own **Reproducible:** Yes, conditioned

Market availability: Yes

Description: This model is a useful tool for demonstrating the relevance or the airtightness of buildings. By running an internal ventilator and a smoke generator, the public can appreciate the hot air spaces in non-appropriate thighed spaces.

Contents: Feebat heating, Feebat CMVent, Feebat Carpentry, Feebat Walls, Praxibat

Link: [Maquettes Pédagogiques](#)



04 Phase shift model

Mobile: Yes **Property rights:** Own **Reproducible:** Yes, conditioned

Market availability: Yes

Description: A part of summer’s comfort depends on the thermal phase shift capacity of the envelope and on the materials chosen for keeping the desired temperature inside the buildings. This model includes two light bulbs simulating sun lighting for demonstrating insulation and transference lag capacity of the material that can be measured through thermometers.

Methods: FIT

Link: [Maquettes Pédagogiques](#)



05 Vapor migration model

Mobile: Yes **Property rights:** Own
Market availability: Yes

Reproducible: Yes, conditioned

Description: The house is exposed to humidity from different sources like the rain, the humidity produced by the inhabitants and the rising damp. This model permits exploration of the tightness of diapositives (Vapour barrier, Vapour brake, Vapour barrier, HPV roof membrane) facing a vapour generator.

Link: [Maquettes Pédagogiques](#)

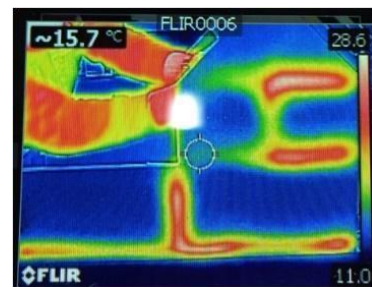


06 Thermal bridge model

Mobile: Yes **Property rights:** Own
Market availability: Yes

Reproducible: Yes, conditioned

Description: This model pretends to illustrate the in and outs of envelope surface through a house figure accompanied by an infrared camera permitting to identify the temperature flux through the structure. This model includes a version as well in which a training candidate can deploy actions for internal and external insulation.



Methods: FIT

Link: [Maquettes Pédagogiques](#)

07 Insulation model

Mobile: Yes **Property rights:** Own
Market availability: Yes

Reproducible: Yes, conditioned

Description: To demonstrate the relevance of a performing roof insulation, this model includes OBS and Plexiglas pads facing a smoke generator. The smoke dynamics through the membrane exemplify the attic insulation and the material effects.

Methods: FIT

Link: [Maquettes Pédagogiques](#)



08 Internal and external insulation models

Mobile: Yes **Property rights:** Own
Market availability: Yes

Reproducible: Yes,

Description: Through a transparent membrane, the model permits to watch the effect of the different insulation solutions picked for the internal and external insulation of the walls of the building.



Link: [Maquettes Pédagogiques](#)

09 Roof insulation model

Mobile: Yes **Property rights:** Own
Market availability: Yes

Reproducible: Yes, conditioned

Description: Through a transparent membrane, this model permits to watch the effects of the different insulations picked for roof insulation.



Link: [Maquettes Pédagogiques](#)

2.1.3 Austria

01 Gadgets wall penetration box

Mobile: Yes **Property rights:** Own
Market availability: Yes

Reproducible: Yes,

Width: 1 m **Height:** 1,5m **Length:** m **Weight:** 5 kg

Description: OSB wall with gadgets for wall penetrations to showcase how they are installed. A box of these devices was put together in crossCert project for the training on the construction site.



2.2 ASSESSMENT MODELS

2.2.1 France

01 BTP module (Roof and wall insulation)

Mobile: Yes **Stock:** **Users:** 2

Property rights: Own **Reproducible:** Yes, conditioned

Market availability: Yes

Description: Mobile wooden and metal sections hosting ventilation canals that emulate the structures of average roofs or of simple walls. These structures can host the installation of insulation materials and test the air tightness achieved after the intervention.



Methods: BTP

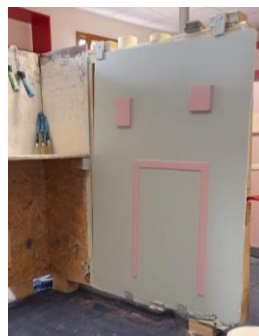
02 BTP module (Painting, Plastering)

Mobile: Yes **Stock:** **Users:** 3

Property rights: Own **Reproducible:** Yes, conditioned

Market availability: Yes

Description: Mobile Wooden sections that permit the candidates to enhance their skills in painting or plastering under wooden surfaces in order to evaluate the quality of their interventions.



Methods: BTP

03 BTP module (Electricity/ Plumbing)

Mobile: Yes **Stock:** **Users:** 2

Property rights: Own **Reproducible:** Yes, conditioned **Market availability:** Yes

Description: Mobile wooden panels with two faces: In the electric face, the panel hosts the plastic support of an electric installation, including the power source nodes, interruptions and the terminal nodes. In the plumbing face, the panel hosts the starting node and two terminals but points out obstacles as well that should be avoided. In both of the, the candidate must complete a functional installation under the most efficient conditions possible.



Methods: BTP

2.3 TRAINING CENTRES

2.3.1 Bulgaria

01 Fix Training Centre

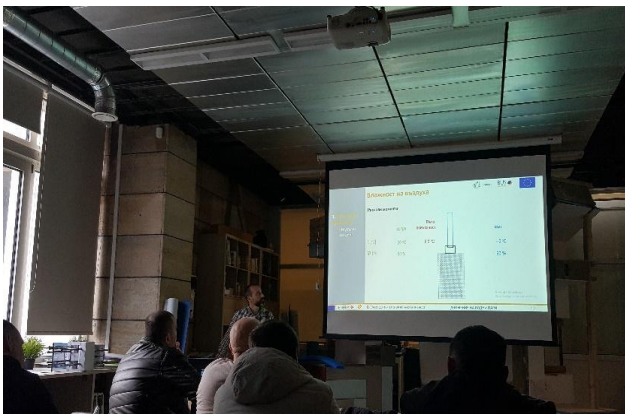
Mobile: No **Property rights:** Own
Market availability: No

Reproducible: Yes, conditioned

Description: Over a space of 65m² the training centre is located in the University of Architecture, Civil Engineering and Geodesy in Sofia, Bulgaria. On the premises there are several types of materials: from books, posters and technical details to training models for installation of thermal insulation and airtightness on a scale of 1:1. The training centre has conducted several Passive House Tradesperson and Passive House Designer courses and exams.

Contents: Certified Passivhaus Tradesperson, Certified Passivhaus Designer.

Link: Busenerpro



02 Mobile Training Centre

Mobile: Yes **Property rights:** Own **Reproducible:** Yes, conditioned
Market availability: No

Description: A nearly energy zero building, with usable space of almost 14m², this mobile training centre is meant to travel to various events, across Bulgaria- including conferences on Energy Sustainability to Training on Building sites. The nZEB Caravan, as it is called, is built following the Passive House Principles, aiming at energy- zero performance. It is a demonstration and training facility at the same time for anyone who wants to experience and learn more about nZEB buildings. It is equipped with heat pump, PV installation, and Heat recovery ventilation system. Triple-glazing windows and sliding doors, with selective surfaces ensure proper light and heat balance, while thickly insulated envelope, wrapped in wood provides comfort and additional warmth.

Contents: Certified Passivhaus Tradesperson, Certified Passivhaus Designer, nZEB

Link: [nZEB Roadshow](#)



2.3.2 France

01 Fix Training Centre

Mobile: No

Property rights: Own **Reproducible:** Yes, conditioned **Market availability:** Yes

Description: Over a space of 100m², it can be installed that includes the necessary tools for acquiring the skills for airtightness subjects.

There the candidates can practise and acquire the good practices for the airtightness installations departing from theoretical knowledge and profession models to apply them into a controlled environment.

This platform is designed for offering learning spaces to different work teams through all the different construction steps and kinds of materials (which can be adapted to regional specificities)

Following precise specifications, the installation of these blocks can be labelled as “Praxibat ADME”.



Contents: Feebat heating, Feebat Carpentry, Feebat Walls, Praxibat.

Methods: FIT

Link: [Centre de formation fixe](#)

02 Mobile training Centre

Mobile: Yes

Property rights: Own

Reproducible: Yes, conditione

Yes

Market availability:

Description: The Mobile platform “Practee Mobile” only need the space of four parking spaces for being installed. In these reduced spaces it is possible to impart training for 2 to 5 days for all the professionals concerned in all the steps of both renovation and building process.

This design permits all the work teams to skilling up close to the worksite profiting the different knots of Constructs systems and exploration of different construction materials.

Contents: Feebat Electricity, Feebat Carpentry, Feebat Walls

Link: [Centre de formation mobile](#)

03 Practee mobile training centre V2

Mobile: Yes

Property rights: Own

Reproducible: Yes, conditioned

Market availability: Yes

Description: This training platform has a size of twice the Practee mobile training centre permitting a more complete offer of tools leading to a wider variety of content that can be exposed and tested.

Contents: Feebat Carpentry, Feebat Walls, Praxibat

Methods: FIT

Link: [Centre de formation mobile](#)



2.3.3 Ireland

01 Fixed Training Centre

Mobile: No

Property rights: Third Party **Reproducible:** Yes, conditional

Market availability: No

Description: This course aims to provide participants with the knowledge in the general principles and practices of Nearly Zero Energy Building (NZEB) for their roles starting with the following NZEB Principles – Part L and Part F, Building Physics – thermal energy, heat and ventilation losses, U values, condensation and mould formation Building Fabric – Continuous Insulation, Thermal Bridging, Air Permeability, Windows and Doors.

Building Services – Space heating and Domestic Hot Water, Controlled Ventilation, Lighting, ICT and Smart Technology, Renewable Energy requirements – photovoltaics, smart metering

Communication and User Information – importance of communication during and after construction. Then concentrating on the specifics of the roles

Contents: NZEB Fundamentals, NZEB Retrofit, NZEB Ventilation, NZEB Site Supervisor, NZEB Electrical, NZEB Plumbing, NZEB Carpentry, NZEB Bricklayers, NZEB Plastering.

Link: [Mountlucas](#), [Waterford](#) [Wexford](#) [Limerick](#) [Clare ETB](#)



02 Grant Heat Pump Mobile Training Centre

Mobile: Yes

Property rights: Third Party **Reproducible:** Yes, conditional

Market availability: No

Description: The Mobile truck only takes up the space of one large lorry. It is deployed to Hardware stores where 2-3 staff are trained for about an hour at a time. This method of delivery is so as to not remove too many counter staff at one time, which may impact sales and add pressure to other counter staff. The training delivers the concepts behind the feasibility of installation, commissioning and maintenance of Heat Pumps.

Contents: Heat pumps.

Link: [Grantengineering](#)



03 Chadwicks Hardware Stores Eco-Centres

Mobile: Yes

Property rights: Third Party **Reproducible:** Yes, conditional

Market availability: Yes

Description: TUS carried out a specific piece of work with Chadwicks Group (one of Ireland's largest Hardware/DIY store groups) whereby we supported them in developing their Eco-Centres. This allows staff to be able to discuss energy efficiency measures with their customers and show them the particular measures directly. This gives the customers the ability to make different and better decisions. As a positive effect of our interventions, DIY hardware stores made alterations to the design of their Eco-Centres based on the BUSLeague project interactions and added to their displays wood based and sheep's wool insulation which is the first time natural and sustainable materials were displayed at a general Hardware store. There are also short informative videos played on the interactive screens on display at the ECO-Centres. The screens also have trainings displayed that can direct customers to NZEB training, particularly the:

- Fundamentals 1 day introductory
- Retrofitting
- Ventilation
- Commissioning & maintenance of Heat Pumps.

Courses

Contents: Heat pumps. NZEB

Link: [Chadwicks Eco-Centre](#)



2.4 WRITTEN CONTENT

2.4.1 Bulgaria

01 Online Learning Platform

Property rights: Own
availability: Yes

Reproducible: Yes, conditioned

Market

Description: It is an online learning platform that serves as a support for the training programs offered. It contains theoretical material, graphical material and technical details and drawings.

Link: [BuildingGreen](#)



02 Online Learning Platform

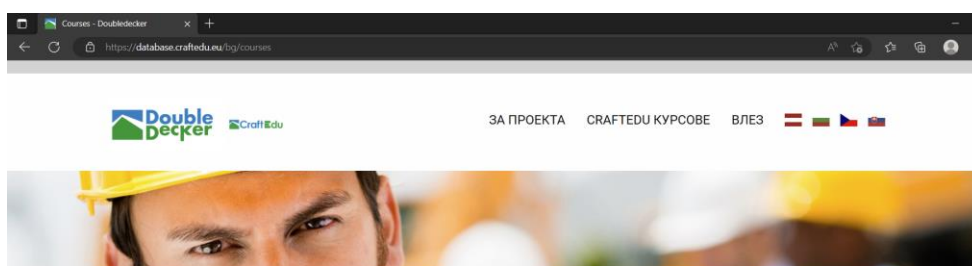
Property rights: Own

Reproducible: Yes, conditioned

Market availability: Yes

Description: It is an online learning platform that serves as a support for hybrid training programs offered. It contains theoretical material, graphical material and technical details and drawings.

Link: [CraftEdu](#)



Предлагани обучения CraftEdu

Държава

- ☐ AT
- ☒ BG
- ☐ CZ
- ☐ SK
- ☐ Всички

Курс	Дата	Град	Държава
Строителен специалист за почти нулево-енергийни сгради	15.08.2021	София	BG
Основни принципи на почти нулево-енергийната сграда (ПНЕС)	30.09.2021	София	BG

2.5 AWARENESS AND TRAINING VIDEOS

2.5.1 Bulgaria

01 TOKI videos

Property rights: Own

Reproducible: Yes, conditioned

Market availability: No (Free disposal)

Language: Bulgarian

Description: Video material presents different topics and is directed at citizens and users with interest but without deep knowledge in energy efficiency. It describes in general what is thermal comfort of buildings and about cost of energy. It goes on to explain the main principles to achieve nearly energy zero buildings and what other accessible building alternatives exist to expensive low- energy solutions. Main goal is to promote knowledge among public about the benefits of energy efficient homes and ways

to achieve it. It is sponsored and promoted by an electrical supplying company in Bulgaria.



2.5.2 Spain

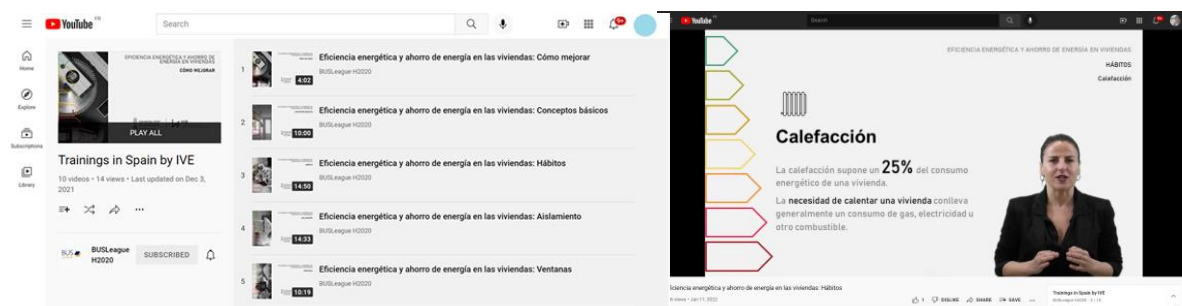
01 IVE videos

Property rights: Own **Reproducible:** Yes, conditioned

Market availability: No (Free disposal)

Language: Spanish

Description: The video series entitled “Energy efficiency and energy saving for lodgings” is composed of 10 videos developed by the Instituto Valenciano de la Edificación framed in the BUSLeague project. These series of videos are addressed to employees and installers of DIY stores, in particular those of BAUHAUS, another partner in the project. Nevertheless, they have been uploaded to YouTube, so they are now available for all the public. The videos define the main concerns related to general energy efficiency, and enlist solutions related to the isolation, the windows, and the



lighting, among others.

Contents: Energy efficiency literacy

Link: [BusLeague Youtube](https://www.youtube.com/channel/UC8vLqKqKqKqKqKqKqKqKqKq)

2.5.3 Ireland

01 TUS TALKS

Property rights: Own **Reproducible:** Yes, conditional

Market availability: Free to access on YouTube

Language: English

Description: A webinar series entailing a suite of short online expert talks, known as TUS talks, were delivered and recorded and published on the TUS RDI You Tube channel, covering homeowners and trades.

Comfort & Energy in Construction Topics covered were:

Series 1:

- NZEB (Nearly Zero Energy Building)
- Heat Pumps Overview
- Heat Pump & Refrigerant
- SEAI Heat Pump Grant inspection Points
- Heat Loss Calculations & DEAP Software
- Circular Economy and Waste
- Emission System (Radiators, Underfloor heating)
- Pipe sizing (delta Ts) with Heat Pumps
- Retrofit Management
- Insulation
- Airtightness
- Ventilation
- Refrigeration & Air Conditioning
- Customer handover of energy efficient houses

Series 2:

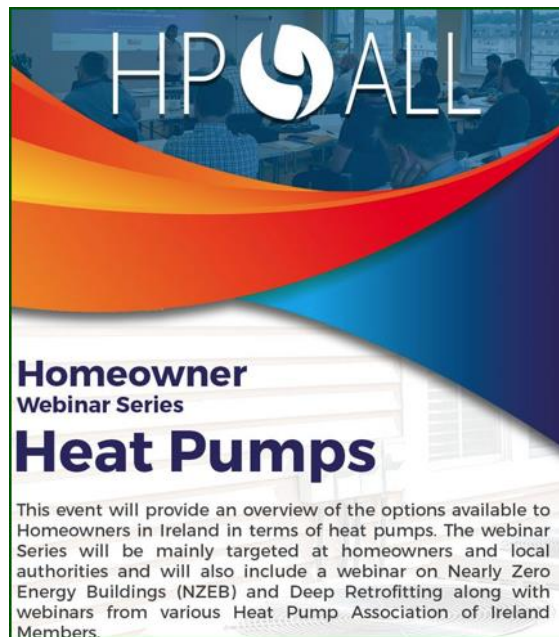
- District Heating with Heat Pumps
- Other technologies/solutions
- High Temperature Heat pumps and process heating
- Industrial Applications of Large-Scale Heat pumps
- Innovative solutions, pairing with other solutions
- Funding of Large-scale heat pumps
- Cascading Domestic Heat pumps
- Renewable Energy
- Biogas & AD

**The links are below and open source.

TUS are now assessing the potential to convert the series to Continuous Professional Development (CPD) points, where those who view the YouTube webinars can track and document the skills, knowledge and experience they have gained, beyond any initial training. In the future TUS intend:

1. be a documented process
2. be self-directed
3. focus on learning from experience, reflective learning and review
4. help add personal development goals and objectives
5. include both formal and informal learning.

Contents: Energy efficiency measures, Building Physics, introduction the heat pumps and heating systems



[HP4ALL Homeowner Webinar Series-TÚS Talks](#)



[Comfort & Energy in Construction- TÚS Talks](#)

Link: [BusLeague Youtube](#)

3 EXAMPLES OF PEDAGOGICAL METHODS FOR SKILL PROVISION ON BUILDING SECTOR

In order for the demonstration models and other described pedagogical tools to be successful, there is a need for an appropriate strategy set in place to create conditions and mindset relevant to their original purpose. It is necessary, when using those tools, for a training provider to captivate the trainees with interest, to activate their engagement and to provoke critical and constructive thinking, applying pedagogical methods which on the other hand are key to knowledge transfer and understanding as already outlined in Chapter 2.

Below are a few examples from consortium countries in BUSLeague in which various training models have been listed and presented here for information and inspiration to best practice pedagogical methods.

3.1 BULGARIA

01 Certified Passive House Designer

On site: Yes **Hands-on:** Yes, **Cross Training:** Yes

Instructor: Qualified Trainer

Property rights: Passive House Standard **Reproducible:** Yes, conditioned
Market availability: Yes

Description: A two-day training course for construction specialists in the principles of Passive house

Day 1: Introduction to Passive House

The cost and energy effective Passive House- presentation of benefits

Airtightness meaning and practical examples to construction and exercises

Thermal heat insulation and thermal bridges – theory and design

Day 2: Continuation of day 1

Windows, their role and importance in the context of existing buildings, combined with practical examples and exercises

Main principles and importance of ventilation in Passive Buildings

Ventilation and heating

Models: Certified Passivhaus Tradesperson

3.2 FRANCE

01 FIT

On site: Yes **Hands-on:** Yes, **Cross Training:** Yes

Instructor: Qualified Trainer

Property rights: Own **Reproducible:** Yes, conditioned **Market availability:**

Description: The FIT 2.0. method is composed by 4 modules of knowledge

Module 1: A technique approach to the airtightness

1. Thermal regulation and its modifications 2. What is airtightness? 3. The main issues of airtightness 4. How to achieve an airtight building 5. Verifying the building airtightness.

Module 2: Coordination, design and deployment of a low consumption work side

1. Thermal regulation and its modifications 2. What is airtightness? 3. The main issues of airtightness 4. How to achieve an airtight building 5. Verifying the building airtightness.

Module 3 (Part I): The airtightness: The good manners

1. Presentation of products exposed during sessions 2. managing wall penetrations within the structure 3. Installing a wood part 4. How to isolate a building 5. design airtightness and insulation of a sloping wall 6. design the airtightness and insulation of a vertical wall and manage wall penetrations 7. Receiving and assessing finished work 8. Self- controlling the quality of a building thermal envelope.

Module 3 (Part II): The airtightness: The good manners

1. Presentation of products exposed during session 2. managing wall penetrations within the structure 3. Installing a wood part 4. How to isolate a building 5. design airtightness and insulation of a sloping wall 6. design the airtightness and insulation of a vertical wall and manage wall penetrations 7. Receiving and assessing finished work 8. Self- controlling the quality of a building thermal envelope.

Module 4: Experience feedback

1. Feedback on procedures and applications for airtightness. 2. Recalling the verification process of airtightness in building 3. Analysis on test reports.

Models: Thermal bridge model, Phase shift model, VMC model, Fix training centre, Practee Mobile, Insulation model

02 BTP

On site: It would **Hands-on:** Yes, **Cross Training:** Yes

Instructor: Qualified Trainer

Property rights: Own **Reproducible:** Yes, conditioned **Market availability:**

Description: This method has Three Objectives:

- Awake the interest in construction careers in the jobseekers (Young people and adults from all genders) looking for professional orientation.
- Test the skills of the job seekers already enrolled in the construction sector and guarantee them.
- Orient and support the jobseekers in their process either through training programs or job allocation.

To achieve this, this method offers two tracks for two candidate types:

1. Discovering: For the job seekers without any “build-up skills”.
2. Evaluation: For the jobseekers with previous training or some experience in the construction sector.

In each one of these tracks, the candidates are invited to follow the following three steps:

- The jobseekers are invited to enrol in 12 to 16 people groups (while in the “Covid setting”) and take a theoretical test of general knowledge.
- Following, the candidates pass a half-day training simulation session after which they can show their skills (in the evaluation track) or explore a profession (in the discovering track).
- Finally, they will receive individual feedback, guidance and support from their employment adviser regarding whether to address them toward formal training or to recommend directly to employers interested.

Models: Insulation Model, House Model, VMC model, BTP modules

03 AFEST

On site: Yes **Hands-on:** Yes, **Cross Training:** Yes

Instructor: Trained Trainer **Candidates:** 2

Property rights: Own **Reproducible:** Yes, conditioned **Market availability:**

Description: The work situation-based Training (AFEST on its French acronym), departs from an analysis of the work activity for identifying their suitability for the teaching purposes which is followed by the selection of a trainer. Once identified, the deployment of the training implies the attendance of “normal” work activities with segments of personalised teaching work situations. Consequently, the implementation of teaching work situations is complemented by reflexive phases in which the first are examined and analysed towards the goals of the training program. The method is concluded by an evaluation of the goal achievement regarding the candidate's progress and the new skills acquired.

Models: Insulation Model, House Model, VMC model, BTP modules

3.3 IRELAND

01 Grant Engineering

On site: Yes **Hands-on:** Yes, **Cross Training:** Yes

Instructor: Qualified Trainer **Candidates:** 14

Property rights: Own **Reproducible:** Yes, conditional

Market availability: Yes

Description: The rig visits various sites which vary from installers, designers, specifiers and service engineers. All the attendees are trained in the basics of heating systems, how to assess the feasibility of a heat pumps suitability for a dwelling, heat load calculations for a building, install and commissioning of the pump and the heat dispersal system (such as radiators Underfloor heating or through a ventilation system

* Grants also have a training centre at their manufacturing facility where any workers can attend the training courses.

Models: Mobile Rig visiting sites, local authorities and Hardware stores, Heat Pump storage, control systems, PV.

02 Centres of Excellence (CoE)

On site: Yes **Hands-on:** Yes, **Cross Training:** Yes

Instructor: Qualified Trainer **Candidates:** 12

Property rights: Own **Reproducible:** Yes, conditioned

Market availability: Yes

Description: Near Zero Energy Building Training courses are delivered at ETB's Training Centres. These courses are the first trade specific NZEB Courses being delivered in Europe.

The Learning outcomes are:

- Understand the Principles relevant to NZEB, Building Regulations and Product Standards.
- Explain why it is important to reduce the energy demand and consumption in buildings.
- Briefly outline the EPBD and EED drivers relevant to building regulations and NZEB.
- Describe how the NZEB standard relates to existing buildings, extensions, change of use and major renovations.
- Explain the importance of minimising heat loss through the building envelope.
- Understand Building Physics – Key energy terms and units
- Describe how the air permeability of a building has an influence on heat loss.
- Describe the techniques and types of materials that are commonly used to create the airtight layer.

- Describe the risks associated with poor workmanship relating to airtightness.
- Explain the importance of providing adequate ventilation to a dwelling with increased levels of airtightness.
- Explain the importance of ensuring good communication between all trades on the site as part of an overall 'system-thinking' approach to achieve NZEB compliant dwellings. In particular, communication with those trades which regularly make penetrations through the airtight and insulation layers (including electricians and plumbers) is especially critical.

Models: Building envelope, Mechanical and Electrical Systems, Renewable energy systems.

4 COUNTRY STRATEGIES TO DEPLOY PRACTICAL INTERVENTION IN DIY STORES IN THE FRAME OF THE BUSLEAGUE PROJECT

4.1 AUSTRIA

Establishing a cooperation with a DIY store in Austria was very challenging. One of the biggest challenges was that the public appearance of DIY stores is clearly focused on the specific needs of their customers in line with their product offer. This leads to the fact that it is very challenging to identify specific contact persons for energy efficiency or sustainability topics (although even if a DIY store has a whole department working on energy efficiency or sustainability it is not possible to identify relevant contact persons by web research). Moreover, DIY stores sell their products in a highly competitive field. That means, they have only very small budgets for further education of their employees and the focus of every intervention they agree on needs to be profit oriented.

After many unsuccessful attempts to get in touch with national DIY stores, a contact to a company which offers further education packages for the employees of an Austrian DIY store chain (until now mainly in the field of safety at work) could be established.

After many bilateral meetings, it was agreed, that short online training modules were designed and implemented for the employees of the DIY store (focus: salespeople) according to the following topics:

- Module 1: Basic knowledge on energy efficiency in buildings
- Module 2: Specific knowledge on the correct selection and implementation of windows
- Module 3: Specific knowledge on shading systems (including the correct installation of external shading solutions).

The training modules were implemented by an already available learning platform and consisted of a learning and an evaluation part (testing of knowledge and evaluation of training). The duration of the training is ca. 15 minutes. The short trainings were well accepted by the trainees.

4.2 BULGARIA

The contact with DIY stores in Bulgaria was extremely complicated, especially in light of COVID limitations and the prevailing economic crisis leading to sharp increase in the prices of the construction materials. The companies which were contacted did not respond to the invitation and the only operational connections made were with personal assistance by key representatives of the Bulgarian Construction Chamber and the mayor of the city of Gabrovo in relation to a joint event.

The contacts did not however result in positive collaboration, as the only goal of one of the contacted DIY stores was to promote its own production and it was unwilling to include products of other suppliers. On a different scale, the DIY in the mid-sized city of Gabrovo was interested in cooperation but did not have suitable materials on offer, as its supply is mostly targeted to low- and medium-cost products. However, an agreement for actual cooperation in the next event in the city is reached, which would coincide with the opening of a larger facility of the DIY store.

The practical interventions were planned to cover the key principles of nZEBs - insulation, triple-glazed windows, airtightness, thermal bridge minimisation, and mechanical ventilation with heat

recovery, RES installations, demonstrating the various benefits of energy efficient buildings when applied in their integrity.

The plan included the opening of an open-air stand in front of the store with several positions dedicated to the different principles, which could be visited by all customers entering the store. The alternative option was by striking a collaboration with a specific supplier presented in the store and concentrating the demonstrations around its products near the salespoint.

The main pedagogical method for the events was demonstration, gamification and personal consultations by EnEffect and selected supplier(s) experts. Besides the available equipment, the demonstrations can be improvised using a variety of materials offered at DIY stores, and games with practical action of visitors - including children - are planned and already tested at different events. Additionally, VR demonstrations are available, courtesy of partner suppliers/distributors of nZEB-compatible products.

The demonstration equipment is planned to combine small-scale mock-ups available from Train-to-nZEB and nZEB Roadshow projects combined with materials offered by the store and/or by selected product suppliers(s). This could be combined with the exposition of the nZEB caravan constructed under the nZEB Roadshow project, where all principles can be demonstrated in their integrity.

4.3 IRELAND

The contact with hardware stores was not difficult in Ireland as it transpired in some of the BUSLeague partner countries as the TUS team had previously been involved in the construction sector on the ground, as trades and developers, meaning TUS had previously developed relationships and had contacts. Therefore, the discussions with one particular hardware group (Grafton) led to them agreeing to send at least one staff member from each store (80 stores in total), trading as Chadwicks, to do the NZEB training at the ETB centres. Discussions were held on site typically and TUS delivered product specific training with other Hardware Stores. Chadwicks frontline staff undertook training in:

- NZEB Fundamentals
- NZEB Retrofit
- NZEB Ventilation
- Retrofit Insulation Skills.

Additionally, Chadwicks were designing Eco-Centres, display areas that show the customers measures and equipment that can improve the energy efficiency of both existing and new builds. TUS collaborated with them in the design to optimise the displays so the public would understand, by being shown by staff, the best way to implement the use of the products. There are also interactive screens at the Eco-Centres with short informative videos that introduce customers to the measures.

Anecdotally, the feedback from the stores was very positive, both from management and counter staff. We do believe in Ireland that the NZEB training is inspirational as it is interactive and informative. The goal of the stores was to upskill their staff so they could share with customers the best options and methods to improve energy efficiency of buildings. This is achieved through presenting customers with the measures at the ECO-Centre displays and by informing them of how this merges with the basics of building physics and its relation to performance which is also very important to understand. The stores also are very positive that this will increase their sales and customer numbers due to the word of mouth that they are very knowledgeable and helpful to customers. One Director of a hardware group agreed that retrofitting, renovation and

repurposing of building use, across the EU will become focused on new builds, as the embodied carbon and circular economics of using buildings that are already built has a beneficial environmental impact and helps in addressing climate change. So, they see this as a business path to develop.

NZEB courses at the ETB centres were:

- NZEB Fundamentals-160 attendees
- NZEB Retrofit-70 attendees
- NZEB Ventilation-70 plus attendees
- Retrofit Insulation Skills-40 attendees

TUS also engaged with ETBs to guide the development of their training centres display and rigs to emphasise the usage, where feasible and cost optimal, of sustainable & circular materials with low embodied carbon, sequestration abilities etc. The usage of waste and excess materials from other sectors, such as wood waste insulation and fibre insulation made from waste plastic collected from the sea and plastic bottles. Additionally, the breathability and hygroscopic properties of materials were also recommended as an option where possible.

The main pedagogical methods for the training were demonstration, hands-on practice and theory exams. The demonstration and practice areas were in the training centres, which allowed the trainees to learn, collaborate with other trainees and improvise with various materials that the hardware stores sell and are already on display at the Eco-Centres. Demonstration rigs and walls are installed at training centres courtesy of partner suppliers/distributors of nZEB-compatible products. Additionally, Virtual Reality training for retrofitting was delivered.

The main tools utilised were live training mock up building elements for installation of the products such as:

- Walls for insulating installing windows and airtightness
- Attics for insulating
- Ventilation systems for the training which taught the trainees how to install balance and ensure the systems were operating to Irish Building Regulations for Ventilation (Part F)
- Blower door cabins for presenting the practicalities of airtightness and how to remediate infiltration issues the blower door test identifiers
- Additionally, a theory class to deliver the basics of building physics ventilation internal air quality and moisture movement in buildings was also part of the training VR headset and handsets were also utilised to deliver the retrofitting and defects training in the NZEB Retrofitting course

4.4 FRANCE

We first contacted ADEO within the framework of BUSleague working groups about DIY stores and upskilling. A few weeks later, we (AVE & PRACTEE) had an online meeting with ADEO to discuss further partnership. In March 2022, a manager of ADEO came to Lens to attend a BTP workshop. The match between BUSLeague/ BTP workshops goals and ADEO's interests is very strong.

The Campus de l'Habitat is the training organization of the ADEO group, which aims to provide expertise, advice, and innovation to the companies of the group in terms of training actions.

The campus has signed an agreement within the framework of the BUSLEAGUE project with the alliance ville emploi and Practee Formation.

A demonstration of the Practee Truck was organized on November 18, 2022, on the parking lot of the ADEO headquarters (135 Rue Sadi Carnot, 59790 Ronchin).

In the unanimous opinion of the 6 participants, the Practee Truck appeared to be a well-thought-out tool to demonstrate and raise awareness of the problems of installing often-complex products in a very small space.

The truck can be used for very different purposes close to its users: construction site, store parking, training school etc

The truck, despite its great modularity, requires preparation to adapt to the mission of its movement. However, this is a sign of its ability to respond to very varied missions (awareness, training, evaluation) for very different audiences (clients in charge of their renovation project, professional craftsmen learning new techniques or skills, young people in orientation or training).

The truck is inspiring for the didactics to be implemented in the advice areas in stores.

For Adeo the Practee truck could be used subject to further development:

- In the parking lots of LEROY MERLIN stores to raise awareness among our customers (DIY enthusiasts)
- On the parking lot of BRICOMAN stores to raise awareness among our customers (professional craftsmen)
- To accompany the recruitment sessions of future craftsmen trained in alternation.

4.5 NETHERLANDS



In the Netherlands an exploration was done with Intergamma. Due to own investments by Intergamma in training their personnel in sustainable topics and due to a change in the team the doors closed.

With Technische Unie a further elaborated pilot was prepared, although due to internal circumstances at Technische Unie this pilot was delayed at least till mid-2023.

In the exploration with Intergamma we tried to work with them to create a space in the store where all products related to a better functioning heating system were demonstrated. In the store there is a place with several products related to the optimisation of central heating systems. Although the products are presented without application examples and several products needed for a complete overview are missing.

Goal was to:

- Visualise which additional products are available
- Refer the customer to good flyers with explanation
- Refer the customer to trained professionals if they need support <https://vakmanschapinregelen.nl/>

- Train the DIY-employees so that they can advise the products and support by trained installers to the customers of the DIY store.
- Think together about example mock-ups where the products are applied.
- Maybe organize 1 or 2 workshops for local energy-conscious do-it-yourselfers



For Technische Unie the topic selected was heat pumps.

A storyline to create awareness and inviting installers to start with upskilling was created.

Including a mockup on how that could be realised in the store of Technische Unie.

Achtergrond	Idee
<p>Wetun - Kansen</p> <p>door op te bouwen aan de kennis van de werkveld</p> <p>Theorie - Glijbaan van Karin de Galan</p>	
<p>Zelfbeeld</p> <p>Het beeld wat iemand van zichzelf heeft, beïnvloed het gedrag. Iemand met een positief zelfbeeld ziet als een zorgarme vader.</p> <p>Gereedschap</p> <ul style="list-style-type: none"> • Eigen rol en rol • Betrokkenheid van de organisatie • Commitment en engagement • Identiteit 	<p>Waarom pompen, daar loop je warm van, pak hier je kaart!</p> <p>Loop je al warm van je pompen? Stuur het bericht!</p> <p>Werd die volkomen/vrouw van de toekomst?</p> <p>Ik weet die toekomst van de toekomst!</p>
<p>Sociale omgeving</p> <p>Als de omgeving invloed heeft op het gedrag, dan is het belangrijk om te weten wat de omgeving kan doen.</p> <p>Gereedschap</p> <ul style="list-style-type: none"> • Interactie met de omgeving • Betrokkenheid van de organisatie • Commitment en engagement • Identiteit 	<p>Makkelijk idee, maar met de juiste kennis...</p> <p>Maak een plan, maak een plan, maak een plan...</p> <p>Werd die volkomen/vrouw van de toekomst?</p>
<p>Kunnen</p> <p>De beschikking over kennis, vaardigheden en middelen. Niet en geldt heeft invloed op het gedrag, zoals voldoende geld om biologische producten te kopen.</p> <p>Gereedschap</p> <ul style="list-style-type: none"> • Kennis en vaardigheden • Betrokkenheid van de organisatie • Commitment en engagement • Identiteit 	<p>Het idee is dat de kennis van de toekomst...</p> <p>Stuur het bericht!</p> <p>Werd die volkomen/vrouw van de toekomst?</p>



4.6 SPAIN

When preparing the BUSLeague project proposal, the IVE contacted the DIY chains BAUHAUS and Leroy Merlin as they are well established in Spain with many shops open. The first contact was made through LinkedIn and as we had no contact person there, messages were sent to approximately 50 people.

There were few responses but one of them was Ana Royo from BAUHAUS with whom we interviewed to assess the opportunity of joining a H2020 project as she had no previous experience in participating in European R&D projects. Fortunately, Ana Royo accepted the invitation and brought BAUHAUS as a partner to the BUSLeague project.

BAUHAUS is a leading brand in DIY, renovation, decoration, and gardening, committed to climate goals, and has made it a priority to continue increasing the range of environmentally friendly products and to promote their sale through its stores.

It is therefore important that its employees are familiar with energy efficiency concepts in order to advise their customers on the technical performance of their products for sale but also on their environmental benefits.

The Valencia Institute of Building (IVE) developed a course consisting of 10 micro-trainings whose overall learning objective was "energy efficiency literacy" focused on:

- Introduction to EE-buildings: <https://youtu.be/S5EQ8axnSmM>
- How to improve the EE: <https://youtu.be/wqnX63J68PE>
- User behaviour: <https://youtu.be/k5HcVGRGYnc>
- Insulation: <https://youtu.be/T6QMRBCxrO0>
- Windows: https://youtu.be/o2-t_kPSHpM
- Thermal installations: <https://youtu.be/SLIuLIHSAr8>
- Existing thermal installations: <https://youtu.be/BKvS9M-R2fM>
- Lightning: <https://youtu.be/Wz3nLDYQUxM>
- Home appliances: <https://youtu.be/RkydyK5ar2k>
- Renewable energies: <https://youtu.be/HUiQtbewlds>

BAUHAUS has organised practical workshops in cooperation with product suppliers. In total there were 15 workshops on: solar panels, solar lighting, air conditioning, windows, thermal insulation, robotic lawnmower, water pumps, heat pumps, bathtubs, boilers, portable power station, underfloor heating, heating, paraffin cookers. The training had to be short, accessible, and flexible in order to make it as easy as possible for working professionals. That is why we decided to organise online micro-trainings, covering various topics in a very general way and with a simple and direct language.

Traditional class where a “virtual” teacher explains the lesson.

Demonstrations and hands-on workshops to learn how to apply a product or install a system. Some of the workshops were developed online.



BAUHAUS already had a MOODLE platform, and its employees were already familiar with it. The main content of the micro-trainings consists of videos of approximately 3 to 5 minutes. In addition, supplementary information (PDF) has been added, which the trainees can voluntarily consult if they are interested in a specific topic and want more detailed information.

5 LESSONS LEARNED ABOUT THE USAGE OF THE TOOLS AND METHODS

In this chapter are experiences presented from the respective countries with the tools and method, applied in BUSLeague.

5.1 Austria

Logistic problems

Due to the pandemic, all the trainings were carried out online. Although the trainings were well visited - easy to join, no travelling needed - the exchange between the participants could not be performed well compared to the physical trainings. The equipment needed at the training to demonstrate the correct choice and installation (e.g., sockets) was done online and the possibility to install on-site could not be done. Therefore, training on-(construction)site or at training facilities in combination with experience exchange between trainees is a better option.

If the trainings are done at a construction site, choosing the right time and willingness of the construction company (contractor) to carry out training for all the involved workers at the same time are the main issues.

Financial considerations

The economical consideration could be the invested time and travel costs of the participants who join the training.

If the training is not carried out in a training centre, the training on a construction site could cause a pause in installation work. This could affect the flow of work and cause delays.

Effectiveness

Despite the issues mentioned above, the demonstration tools and methods of quality assurance, especially in small-scale construction such as single-family homes, are key to ensuring energy efficiency and avoiding construction errors that can cause unhealthy indoor air quality and high maintenance costs.

The involvement of energy advisors especially for the renovation of a building to provide a roadmap for the implementation of the work, the right choice of measures and their validation and quality control during and after the work is done, has been identified in Austria to be an effective way for having an energy efficient building.

5.2 Bulgaria

Logistic problems

The transportation of the demonstration equipment and tools requires significant effort and time, both in terms of pure logistical details as finding a suitable vehicle and driver at acceptable cost, and in terms of initial planning of the space for setting up the demonstration facilities, where access for the vehicle could often be an issue. This is relevant for both purely demonstration activities at fairs or other events, and for on-site training activities. This is why training at specialised well-equipped training centres is still a valid choice, given the fact they exist in the vicinity, which is still not the case in most of the cities.

Financial considerations

Considering the argumentation above, and given the fact that renting of a suitable vehicle to transport small-scale mock-ups and demo equipment and labour of driver and other supporting

personnel may add to the regular cost of the training a significant amount, even doubling the typical costs, it is assumed that public support is still needed for that kind of pilot activities before they become recognized by the market (including by public procurers, who can include it in training-based procurement). The wearing out of the equipment and the related maintenance costs should also be considered.

Effectiveness

Despite the logistics and financial challenges outlined above, the use of small-scale mock-ups and demo equipment on the construction site is still considered as very efficient training approach, especially in light of the unwillingness of the construction companies to invest time and resources for typical training activities and the possibility to focus the separate sessions on a specific component just before its installation. As in the examples from Austria, it is considered that training during the execution of pressurisation tests would be very useful as well; however, due to lacking regulations, this practice cannot yet establish itself on the market. The use of demonstration equipment has proven to be very useful for awareness raising and basic training for non-specialists and has the potential to assist and enable the application of dedicated policies at national and local level; as such, it could be supported by various communication- and skills-related components of targeted financial support mechanisms.

5.3 Ireland

Logistic problems

In Ireland mobile training rigs have been built by some of the equipment suppliers to introduce and deliver training to those involved in the development and advising of energy efficient building, this applies to both retrofitting and new builds. Significant effort and financial costs and time are required for this, both in terms of converting suitable vehicles and the provision of a driver who will also be a trainer/teacher. Additionally, access for the vehicle could often be an issue as TUS observed when setting up training demos for local authorities. There is also the administration paperwork and insurance to cover public spaces as well as private ones, for example the car park of a local authority is a public space with the advantage of presenting the systems and materials to more people but with a higher insurance cost in comparison to the display vehicle in a private space behind a hardware store where only staff have access. This makes the innovative NZEB ETB training centres crucial (now being rolled out across the state due the expansion of NZEB training across the sector). We believe TUS & IGBC through BUSLeague have expanded the interest in NZEB training due to sign posting, recommending and connecting stakeholders added to our own training offering. Central to this is the relevance of purely demonstration activities at fairs or other events and for on-site training activities e.g., at County Councils. Training at specialised, well-equipped training centres is still a valid choice, given the fact they exist in the vicinity of all geographical areas in Ireland, and we have proposed to the Educational Training Board central committee that more are opened across the state, which is now happening but is still not the case in most of the cities. Unfortunately trades people and construction SMEs are time poor and so travel for training is not always a viable option.

Financial considerations

As outlined above the cost of the training rigs and their operations are onerous in Ireland, given the geographical area and ease of reaching NZEB training centres which are being expanded across the country. The advantage of the centres is that they have more material, equipment, displays, training rigs and courses to deliver and upskill workers than a mobile training rig would

have. There is an option for upskilling and refresher training in the future to bring training rigs to sites.

Effectiveness

All the training courses are validated and certified in Ireland through our National Framework of Qualifications and City & Guilds.

5.4 France

Logistic problems and financial considerations

Practee Formation has only one mobile training unit. The unit enables a hands-on training experience for up to 6 training participants at once, under direct supervision & mentorship of the person managing/displaying the unit. This means that for now, we have a limited capacity on displaying the tool, in fact, even with sufficient funding, (the Practee truck is quite expensive); getting a new mobile unit takes too much time due to worldwide material crisis/shortage.

Effectiveness

The training method is validated, visual and hands-on (practical), and training contents (modules) are adjustable depending on the needs.

5.5 Spain

IVE has technical and audio-visual staff but has had to subcontract the services of a professional actress with communication skills to become the "virtual" teacher.

The economic investment consisted of the time dedicated by our technical and audio-visual staff and the subcontracting of the actress.

Although time and money have been invested at the beginning, the result can be exploited very easily and is therefore effective in the long term. At the moment the course already has more than 2200 registrations and there will be more in the coming months.

6 CONCLUSION

Practical training continues to represent an enormous challenge for both the supply and demand of vocational training and educational services, still struggling to make their way in the mainstream educational systems and in the continuous professional development activities around Europe. However, the increasing demand from the construction sector looking for fast and quality upskilling of the workforce under pressure of time and cost limitations has prompted the development of various training instruments and methods, some of which have proven as extremely successful in the countries represented in the BUSLeague consortium.

In this respect, the examples from the BAUHAUS chain of stores in Spain, providing a comprehensive learning management system for both employees and clients, and the Practee Formation in France, serving construction-sector SMEs with mobile training and assessment units, are very important, given the fact that they are based on entirely market initiative and do not depend on public financing. In France again, a wide variety of demonstration equipment and small-scale mock-ups have been prepared, which not only helps its authors' training activities, but is also available on commercial basis for potential replicating partners and other training organisations.

Similar equipment is available in Ireland and Bulgaria, supported by public resources – mostly national, in the first case, and international, in the second. In Ireland, the network of fixed training centres under the education and training boards already well integrated in the national qualification framework, providing upskilling courses to tens of thousands construction sector workers annually. In Bulgaria the developments are still missing scale due to the lack of national-level public support and uptake, even though the collaboration with the professional chambers and the business sector are very promising. In both of these cases, small-scale mock-ups are also available, proving their worth within various teaching methodologies and awareness raising events. What is even more important arguably is the analytical work for connecting the different tools and methods to tasks and learning outcomes defined in the BUSLeague Qualification Framework³ which provides an excellent opportunity for smooth and unproblematic integration in the national educational systems and training practices of individual educational service providers.

On the other hand, besides the excellent BAUHAUS examples and good practices in Ireland, common activities of training and education providers with DIY stores are still not common and are mostly a one-off action rather than a streamlined campaign, which demonstrates the fact that the business models of these actors still do not coincide and further efforts to exploit synergies are needed. However, the first signs are very promising, as towards the end of the project the cooperation activities have been increased, resulting in even larger-scale partnerships as the joint event of the Bulgarian partner EnEffect with the biggest commercial centre in the Bulgarian capital Sofia scheduled to mark Earth Day 2023 (21-23 April). With these first big realisations already taking place, it is believed that the preparatory and analytical work done by the BUSLeague project will bring positive results in the years to come.

³ BUSLeague project (2021) Qualification for the recognition of energy efficiency skills. Available at: <https://busleague.eu/outcomes/>. Last checked: 28.03.2023

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