Report 10.6
Training material, courses and workshops deployment

Revision........................................1
Preparation date......................2014-06-19 (m10)
Due date.................................2017-03-31 (m42)
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1. EXECUTIVE SUMMARY

This report is a product of Task 10.4 “Education and Training”. The main goal is to define a training methodology, strategy, plan and courses, which address the needs of key staff members, researchers, industrial executives (in particular for SMEs) and any potential users of the D4E solutions, in order to provide them with more competencies, new knowledge and life-long learning systems.

Firstly, the training methodology and the training strategy are defined. The training methodology illustrates how we determine the various indispensable factors involved in training, including the training objects, the training contents, the training forms, the training place and timetable.

Subsequently, the process to devise the training strategy is developed. The first step is to conduct current training situation analysis, in order to find the common issues and challenges in training and reach an agreement in selecting e-learning as a major training strategy. Secondly, the target groups for training are identified. The training groups are primarily divided into two categories, namely the internal and external. Furthermore, according to the roles that the various groups play, the training groups can be classified into three types, the potential stakeholders of D4E solutions, the students and researchers and the industrial executives. Since each of the groups have different focus and interest points, the training needs and values are analysed and the training scope is defined. Afterwards, four training forms are devised to fit the different requirements of the target groups. Training forms categorize a set of advanced training measures for different collectives aiming at improving their professional development and the efficiency of the SMEs and other stakeholders. Two training strategies are developed, respectively, Moodle training strategy and Gamification training strategy.

The training action plan is created based on the training forms and strategies. The training action plan contains different activities that should be carried out during the project or after the project, such as the development and collection of training material, the development of Moodle and 3D online gaming platforms and the deployment of training courses and workshops. The schedule for each activity is tabulated in order to ensure that the activities can be implemented as planned.

The available material for training is organized in Chapter 6, including the material for the D4E methodology, D4E tools and 3D gaming environment. The material is presented in different forms, such as written documents, presentations and videos. Using the material and resources available on hand, four training courses are developed, including the theoretical courses oriented mainly to universities or researchers and the practical ones oriented primarily to industry. The four courses are, respectively, Design4Energy Kits course, Design4Energy integrated solutions course, smart performance integration course and business opportunities course.

Finally, the workshops’ deployment is formulated in Chapter 7. The workshops that have been carried out and the workshops in progress are introduced, including their participants, the places, the topics, the main achievement, etc.

To conclude, e-learning is a main training strategy of D4E, the relevant Moodle and 3D online gaming platforms enable different target groups to learn the knowledge and/or skills as they need. A wide range of training material is available for learners. The training activities have been carried out as planned and further activities are scheduled.
2. INTRODUCTION

2.1 Purpose and target group

The purpose of this document is to define a training plan to ensure that comprehensive training is carried out throughout the entire duration of the project and even in the post project period.

To achieve this objective, a training methodology is defined and a training strategy is developed. The Design4Energy material for training is identified and developed, including material for the D4E methodology and integrated process, and material for D4E tools and 3D gaming environment. Four courses are developed based on the developed training material. In addition, workshops deployment is formulated to bring together the various targeting groups.

The definition of the training plan includes determination of different training activities and their schedule. Activities such as the identification of target groups, the development and collection of training material, the development of training courses, and the deployment of training workshops are all included, in order to ensure the success and obtain the desired effect of the training.

The main training target groups include (1) the potential stakeholders of the D4E solutions, such as architects, engineers and facility managers; (2) the universities and related academic researchers, aiming to disseminate the knowledge generated by the project among universities and make future improvement; and (3) the industrial executives for the practice of the knowledge and bring the D4E solutions to business. At the meantime, this document could be used among the consortium and serve as a general guide for the potential trainers.

2.2 Contributions of partners

The development of the first training plan has been led by IZN with main contribution from the Solintel team, and also other partners. The partners have expressed the demands and formulated the requirements for specific training sessions and provided description of the overall implementation context. The contribution of partners to the training plan is listed as following:

- Leader: IZN
- Partners involved: SOL, TUD, VTT, LU, FHR, UNIVA, COR, SALD, SYM, GSM, MRI, ANC, CAD, TPF, ASG

Regarding this report, the contributors include:

- SOL set up the overall framework of the report;
- SOL developed Chapter 1, 2, 3, 4, 5, 6 and 8.
- IZN developed Chapter 7.

2.3 Baseline

The training target groups are important for devising training plans. D10.4 has conducted a detailed analysis of the exploitation plan for D4E [1], and D9.1 has analysed the potential customers of the D4E solutions [2]. Furthermore, D7.5 has developed an online gaming environment for learning “How to Design Green Building” [3]. The online learning has been increasingly used to disseminate knowledge and enhance skills, due to the development of
communication and information technologies [4]. Meanwhile, the D4E project provides a variety of values as described in D9.2 [5], which makes the training worthwhile.

There are various types of forms for training, among which e-learning has the benefits that many other traditional training forms cannot provide, such as flexibility and resource savings [6]. The technologies that can be used to support on-line learning are diverse, among which Moodle and gamification [7] have been specified as widespread tools, and they have been increasingly used in universities, organizations and training institutes. Currently, a range of European projects have confirmed the growing interest in online learning as an effective approach to raise awareness in the energy domain, such as E-GOMOTION [8], BEEM-UP project [9], BEAWARE [10]. These projects provided good examples in the building of such platforms.

A lot of relevant research has been conducted in the area of training and learning locally and internationally. Senge [11] popularized the concept of the learning organization theory through his book titled ‘The Fifth Discipline’. According to Senge, through learning people should continually expand their capacity to create the results they truly desire, to nurture new and expansive patterns of thinking, to set free collective aspiration, and to see the whole together. Senge identifies five disciplines for learning: systems thinking, personal mastery, mental models, building shared vision, team learning. The five disciplines can be approached at one of three levels: practices (what you do), principles (guiding ideas and insights), essences (the state of being those with high levels of mastery in the discipline).

Research also suggests that to develop adaptive expertise, trainees should be active participants in the learning process and learning should occur in a meaningful or relevant context [12][13].

### 2.4 Relations to other activities

This report takes inputs from the following previous reports:

- D2.1 - Indicators and success factors, D2.3 - Guidelines for optimal building design

The KPI framework developed aims at supporting the design process holistically, steering the process, as well as supporting better integration of the developments by the design team and supporting the assessments needed in project decision points. These indicators can be used at project level, during process management, on domain level, at design activity level and in continuous commissioning.

The guidelines suggest, how to improve the current design process in order to integrate buildings with the neighbourhood energy system, while considering both foreseeable and unknown future changes.

The knowledge provided by these reports and the further developed presentations (facilitator) greatly helps to build the training material related to Design4Energy integrated solutions course.

- D5.3 – Data analytics based on building energy performance modelling

This report provides guidance on the main information required to be captured when conducting building survey of an existing building, guidelines on good practice when designing in BIM (and in particular in REVIT) to assist the architect in exporting good quality data for an adequate building representation. Together with the report, facilitating tools are developed to enable transparent exchange of data at different stages of the BIM to BEM process, a novel method for converting gbXML files to idf files is proposed, and finally, the state of the art in protocols enabling the incorporation of monitoring and basic control in the BIM to BEM workflow is identified.
The knowledge contained in this document helps to build the training material and guideline of best practice in preparing CAD models for energy simulation via gbXML, and provides the basis to establish the Design4Energy Kits course.

- **The reports about Design4Energy interoperability, including D6.4 –Design4Energy Interoperability Specifications and D6.7 – Design4Energy Interoperability Solutions**
  Such reports present the use of an IDM methodology for the BIM-enabled CBP for the Design4Energy tools and technologies through an integrated platform that enables collaboration and seamless information exchange between the stakeholders, provide a complete suite to support model driven interoperability amongst the tools and systems taking part of the Design4Energy collaborative environment.
  The knowledge provided by these reports greatly helps to build the training material related to Design4Energy interoperability suite, and the launching of the Design4Energy integrated solutions course.

- **D7.4 – Final design and Implementation of the virtual workspace to explore various design options**
  This report develops an interactive virtual workspace that can allow various actors to collectively simulate and assess the impact of various energy solutions within a visual space, with a view to achieving optimum energy efficiency at building level and/or neighbourhood level. The overall interactive design environment supports actors to explore “what-if” design scenarios, using an easy-to-use visual interface, and see its impact in a broader design context.
  The virtual workplace is the main platform that integrate all the other tools developed in the project, related outcomes consist of the main parts of the kit course, like the operation in building design. The workflows, methodologies in preparing building performance calculation, and integration of tools are key parts of the Smart performance integration course.

- **D7.5 – Final 3D On-line gaming environment for learning how to build green buildings**
  This document encapsulates the knowledge derived within this project within a gaming environment to create an online training environment for learning how to design green buildings. The virtual workspace is used as the basis for building this training environment. Additional features such as community learning, collaboration, tutorial, design advice are incorporated within the training environment. This training environment is built to enable users to learn individually or collectively through a ‘team space’ to design energy efficient buildings.

- **D10.4 - First version exploitation plan and D10.5 - Final version of the Awareness & Dissemination plan**
  The exploitation strategy and mid-term target defined, together with the dissemination plan are key factors for developing the training material and courses. Training activities and workshops go hand in hand with the exploitation and dissemination, the design of the training plan will be based on the strategies defined, aiming to maximize the synergy between different activities.

- **Other documents, including the D9.1 – Scenarios and customers analysis, D9.2 – Business model and value proposition, D9.3 – Market oriented guidelines for business development, provide resources for business opportunities courses and business creation workshops.**
3. **Objective and Methodology of the Training**

### 3.1 Objectives of the training

As the economy and companies globalise themselves, the principal objective of the training is to address the emerging need for a flexible and dynamic workforce with multiple skills, and to increase the competitiveness and innovation of the potential stakeholders of the D4E solutions, the involved academics and industrial executives (in particular to the SMEs). Furthermore, the project also aims to create a versatile platform to fit the significant and increasing demand for re-skilled people to cope with the new ways of working together and collaborating across borders and cultures, as well as the pace of change in business environments.

Bearing the principal objective in mind, more specific objectives of the training are planned:

- Ensuring optimal use and maintenance of the D4E tools and platform for end-users;
- Supporting the D4E team, which is composed of the personnel of the partners, to perform the evaluation and validation of the platform;
- Increasing the target stakeholders in terms of competitiveness, innovation, and skills to fit the required changes in current social situation.
- Increasing the awareness of students and any other future potential users in energy efficient building design;
- Enabling professionals to become trainers of D4E platform and all the tools integrated in it;
- Sharing the project outcomes and facilitating further exploitation of the D4E platform;
- Obtaining feedback on the platform, tools and methodology developed.
- Enabling the industrial executives informed of the business value of the D4E kits, helping them to create new building centred business and optimize the profitability.

### 3.2 Methodology of the training

Training methodology refers to how subject matters are to be dealt with in a broad sense. Hence, the training methodology for D4E is developed by the determination of the “Why”, “Who”, “What”, “How”, “Where” and “When” to conduct the training, as shown in Figure 1. “Why” means the reason that we carried out the training, and “Who” represents the target groups for training. It is critical to find an approach to identify the target groups, since different groups have different interest points, and different training contents and activities should be customized for them. Hence, “What” is followed by “Who”, which defines the training contents and the materials to collect. Afterwards, it is a matter of “How” to carry out the training and through what means to attain an effective and efficient training. The last two essential factors to take into account are “Where” and “When” to execute the training activities.
The determination of each of the factors is elaborated as following:

- **Why**

There are plentiful reasons to conduct the training because of the benefits in using the D4E methodology and platform for different stakeholders. While, these reasons can be divided into three main types:

- For knowledge dissemination, sharing the new knowledge generated in the project so as to improve the work performance of the associated actors;
- For skills enhancement, learning the tools and platform of D4E to increase the skills of the potential end-users;
- For awareness generation, increasing the awareness of energy efficiency for students or future potential users.

- **Who**

Both the partners in the consortium and the other potential stakeholders and beneficiaries are considered to be our target groups for training, hence the two major categories of target groups are considered, namely,

- Internal groups, who participate in the D4E project, the partners in the consortium, or other contracted groups such as the staffs for the platform maintenance;
- External groups, who do not belong to the consortium, but are interested in the knowledge generated in the project, the potential stakeholders, beneficiaries or end-users of the platform.

Therefore, both internal training and external training are supposed to carry out.

- **How**

Traditionally, the training is usually carried out face to face. While, nowadays with the increasing use of ICTs, remote learning is also widely used and feasible to spread our training courses in order to get wider audiences. Therefore, the training will be conducted based on the new training strategy defined in the next section, mainly relied on the following three ways:

- Face-to-face training;
- Remote training among the involved partners;
• Web-based e-learning and upgrading learning, a Moodle tele-education platform and 3D online gaming are developed to give various training courses.

○ What

From the initial stage, it is expected that the different partners express the demands and formulate the requirements for specific training sessions, as well as provide description of the overall implementation context. Such activity is performed through regular meeting among the partners. The available contents for training include:

- Theoretical content, which means the theory that has been generated in the project, such as the D4E methodology, KPI framework, novel workflows, process map and guidelines;
- Practical content, which refers to the application of tools that have been developed in the project, such as the D4E collaborative virtual space, decision support tools and others.

○ Where

The place for training depends on the training approach.

Regarding face to face training, the event will take place under the form of university style courses and training workshops, carried out throughout different places.

As the current trend is to use ICTs in training, the remote training and e-learning based on Moodle platform and 3D online gaming are the focus, which could take place anywhere, and could maximize the influence and application areas.

○ When

The training activities will be carried out throughout the entire duration of the project and after completing of the project. Hence, the execution time for training includes:

- Project duration, in which fundamental training activities are taken place for the consortium partners, which is focused on the theory, methodology and project concepts, making use of different project meetings; in addition, systemic practices and operation of the tools are carried out after finishing the concerned technologies;
- Post project duration, in which training activities can be carried out with the web-based e-learning platform and 3D online gaming developed during the project.
4. DESIGN4ENERGY TRAINING STRATEGY

The development of a training strategy is vital to make the training efforts successful and attain the training objectives. The process to create the overall training strategy in order to steer the training plans in D4E is as shown in Figure 2.

Firstly, the current situation of training within the partnership is analysed, as well as the situation of training in some other organizations such as universities and training institutes, finding out the common problems and challenges. Secondly, the training needs are identified based on both the current training situation and the knowledge and/or skill gaps of the target groups. The analysis of training needs helps to optimize the training value, define the appropriate training scope and choose the right type of training measures that fit for the requirements. The training scope deals with the training contents, which will be defined according to three main learning sessions, i.e., the knowledge-based learning sessions, the skill-based learning sessions and the awareness generating sessions. Afterwards, different training forms are devised for various training contents and sessions. The web-based e-learning platform based on Moodle and 3D online gaming is developed as the main training strategy of D4E solution. Lastly, the training action plan for different training activities should be created along with the timeline, in order to ensure the successful implementation of the training.

Figure 2 - The process to create the training strategy in D4E

During the process of creating the training strategy, the following are considered as the key objectives and measures:

1. Combination of different training forms.
2. Reach as much learning targets as possible by different training forms.
3. Make use of available resources of different partners (research centre, university).
4. Provide intuitive training materials, based on defined training scope and learning targets.
5. Development of training courses.
6. Relied mainly on web based training, widely spread the research outcomes, so to train more students, potential stakeholders, etc.
7. Gaming as an innovative training form and strategy.

8. Consideration of human factors (time constrains, flexibility, personal demand and progress control) to maximise acceptance of the action plan delivered. Human factors encompass those factors that can influence people and their behaviour, including the environmental, organisational and job factors, and individual characteristics. The consideration of human factors means that the training strategy will take into account various factors that influence the trainees’ behaviours, in order to attain the desired effect of training.

4.1 Current situation analysis

The main objective of the current situation analysis is to get reliable information on today’s training issues and challenges both inside and outside the consortium, and to establish common understanding on the trend of the future training.

Within the partnership, the most common way used for training and learning in SMEs usually includes face-to-face meetings. For example, in Solintel, the training of employees is usually conducted through face to face meetings, given by one of the domain experts or by inviting external experts. However, the face-to-face training provides very little flexibility. If someone cannot arrive on site, the only way they can participate in the training is through Skype connection or similar tools; and if their agenda and the training time conflict, they just miss the training contents. At the meantime, in universities or research institutes the training activities always take place in classrooms. Training courses in classrooms are an effective way to attain the desired results, but they are quite resource consuming and costly. In addition, the large companies usually have their own training system for their employees, but challenges still exist in different aspects, such as update learning with rapid change of technologies, courses adapted to employees with different age, gender, knowledge level, etc.

The organizations outside the consortium face similar issues and challenges with training. The issues in current training relate to the following five categories:

- Management issues;
- Social issues;
- Environmental issues;
- Psychological issues;
- Financial issues.

Regarding the management issues, the flexibility in time schedule and the consistency in training services are the two main challenges.

- **Flexibility in time schedule**: with the increasing size of the flexible workforce, people work in shifts. Therefore, time constraints exist when taking the in-situ training courses. Sometimes, it is also impossible for employees to take much time away from their job duties for training. To resolve this problem, it is essential to leverage technology to deliver flexible training courses, which could be taken at the learners’ convenience.

- **Consistency in training services**: with the organization spread across different locations and with multiple trainers, there is no guarantee that the training delivered will be consistent, due to the differences of trainers’ knowledge levels, emphasis and teaching styles. Hence, there will be no consistency in the delivered training. Consistency ensures that the content is correctly translated and that concepts are appropriately captured by different learners. To solve this problem, standardized curriculums could be created with the inputs and approval of the trainers, in addition, localized web-based or web conference training is also a possible solution.
Regarding social issues, the language and cultural differences are the main challenges.

- **Language problems in training**: language comprises both spoken and unspoken means of communication. With global expansion, it needs to reach geographically dispersed target audiences. Courses in English are essential, but will not be very useful for non-English speakers. Translating the content into local languages, using figures, videos or games can be helpful.

- **Cultural differences in learning style**: the cultural difference influence the way of learning, so diverse training forms and an intuitive training may support to obtain better training effects.

The environment issue mainly refers to the current rapid changes in technology.

- **Rapid changes in technology**: rapid changes in technology and programs can make it difficult to adequately prepare training materials and deliver training before learners need information and new skills.

The psychological issue deals with the learning interests of different target audiences.

- **Different interests in learning**: the trainees show interest in learning only those topics that benefit, motivate and ease their work. Selecting or developing training that is closely aligned with their interest is crucial to achieve effective training. Current organizations seem to fail in identifying the specific needs of learners. Learners on the other hand have limited control over their own development. The training objectives are usually set by trainers, rather than the learners.

- **E-learning provides an opportunity to design different training modules or courses incorporated with different training forms such as simulation-based environments, scenarios, games and case studies to make learning relevant and effective.**

Finally, the financial issues are one of the most important concerns of the trainer.

- **Reducing training cost**: a cost-effective training program that works well for the target audience is important. Face-to-face training or classroom sessions are no doubt effective, but they incur huge resources and costs, including the travelling and accommodation charges. Therefore, e-learning is one of the ideal solutions for today’s scenario. An e-learning course once developed can be used at any time and to train any number of participants, which can help save training costs to a great extent in the long term.

To overcome the issues, innovative e-learning and upgrading learning using ICTs can be adopted. Through inquiries and meetings with various partners, a common understanding in the consortium has been established to use e-learning as one of the main measures for performing the training needs of the D4E methodology and platform.

E-learning, or say, e-training, is one of the latest innovative approaches for training. It needs the support from IT to deal with technical glitches during the implementation, which can include all the electronic learning and teaching methods. E-learning is web-based and computer-based; its greatest advantage is that all sessions are centralized with trainers having easy access to all the material.

Furthermore, e-learning also helps to achieve the objective of adaptive learning. Adaptive learning breaks traditional models and allows employees to learn at their own pace. It has gained popularity among educational institutions, referred to as “adaptive teaching”, where a teacher will gather information on different students to know what they need to do to improve their learning. In the workforce, adaptive learning is carried out similarly. Employees can be monitored in real time to determine what learning approach will best suit their needs. Such way of learning can be effective in improving efficiency.
4.2 Training target groups

It is critical to identify the target groups for training in order to identify training needs, value and scope. Since human factors are considered, the identification of the target groups should take into consideration job characteristics and the purpose and benefits of using the D4E solutions.

According to the different roles in different sectors, the target groups for training can be classified into several categories. The main sectors, that may be the beneficiaries from using the Design4Energy methodology and platform, include ICT, construction, energy, management, education and training, as well as public and private sector. Among such sectors, the potential stakeholders can be identified, which are then taken as the target groups for training. In addition, the universities and academic researchers are also important target groups, since the D4E platform and methodology provides courses for the students with innovative concepts. Moreover, as tools keep developing, more continuous research in the future will further benefit the energy efficient building sector by keeping the platform and methodology evolving. At the same time, it is critical to train industrial executives (in particular SMEs) to achieve a smoother integration of new Design4Energy kits technologies into building design, integrating them in the business value chain.

The target groups for training can be either internal or external, in order to form activities for internal training and external training, as described previously in Chapter 3.2.

4.2.1 Potential stakeholders of D4E solutions

The potential stakeholders of D4E solutions are identified from the related sectors. In D10.4 “First Version Exploitation Plan”, the main sectors that may benefit from using the Design4Energy methodology and platform are identified, among which the AEC sectors and professionals are the main beneficiaries.

The potential sectors and their associated stakeholders are presented below in Error! Reference source not found.: [1]

<table>
<thead>
<tr>
<th>Sector</th>
<th>Stakeholder</th>
<th>Benefit from using the D4E methodology and platform</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICT</td>
<td>Programmer</td>
<td>• Extend or customize the platform; • Develop applications connected to the platform; • Obtain parametric information from the platform; • Work with different CAD tool and customize the platform for different users</td>
</tr>
<tr>
<td></td>
<td>Surveyor</td>
<td>• Use the information stored in the D4E platform to complement or support their work</td>
</tr>
<tr>
<td></td>
<td>Data services</td>
<td>• Obtain input from D4E database</td>
</tr>
<tr>
<td>Architecture and engineering</td>
<td>Architect</td>
<td>• Use D4E in all phases of the project, especially during the early stages of design, to increase the project energy efficiency without the help of energy specialists</td>
</tr>
<tr>
<td></td>
<td>AEC technician</td>
<td>• Use D4E for communication between agents involved in the project as a tool for collaborative work</td>
</tr>
<tr>
<td></td>
<td>Contractor</td>
<td>• Manage documents related to payments and project phases through D4E • Monitor guarantees and insurances related to the project</td>
</tr>
<tr>
<td></td>
<td>Engineer</td>
<td>• Use D4E to achieve the optimal solution than usual</td>
</tr>
<tr>
<td>Sector</td>
<td>Stakeholder</td>
<td>Benefit from using the D4E methodology and platform</td>
</tr>
<tr>
<td>-----------------</td>
<td>--------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Consultant</td>
<td>Consultant</td>
<td>• Obtain traceability of the decisions taken during the first stages of the design process</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Use the tool to make quick calculations or to give estimations about the behaviour of a building</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Use D4E to propose retrofitting solutions</td>
</tr>
<tr>
<td>Geospatial</td>
<td>Geospatial Modeller</td>
<td>• Use D4E to upload their models and interact with other models that are already part of its database</td>
</tr>
<tr>
<td>Modeller</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy expert</td>
<td>Energy expert</td>
<td>• Use D4E to avoid early mistakes that may affect the energy performance dramatically</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Smoothen and control the transition from the Scheme Design to the Detail Design</td>
</tr>
<tr>
<td>Supplier</td>
<td>Manufacturing and suppliers</td>
<td>• Create an online database connected to D4E platform, thus to sell better their product and explain better their technical features and implementation costs</td>
</tr>
<tr>
<td>Management</td>
<td>Contract Manager</td>
<td>• Manage documents concerning contracts between the various stakeholders through the platform</td>
</tr>
<tr>
<td>Facility</td>
<td>Facility Manager</td>
<td>• Use D4E and BIM tool to manage the building devices and systems, to monitor their condition and operation, and to control the guarantees and insurance</td>
</tr>
<tr>
<td>Manager</td>
<td></td>
<td>• Use D4E for agile decision making related to retrofitting</td>
</tr>
<tr>
<td>Facility</td>
<td>Facility Operator</td>
<td>• A tool to control all the systems and optimize their operation</td>
</tr>
<tr>
<td>Operator</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Financial</td>
<td>Financial estimator</td>
<td>• Use D4E database as a complement for planning and financial control of the project</td>
</tr>
<tr>
<td>estimator</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Budget</td>
<td>Budget specialist</td>
<td>• Use D4E database as a complement for budgeting</td>
</tr>
<tr>
<td>specialist</td>
<td></td>
<td>• Use it for Measurements and Quotation</td>
</tr>
<tr>
<td>Legal assistant</td>
<td>Legal assistant</td>
<td>• Keep track of all the documents related to the project and communicate with the different stakeholders</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Use to warn of violations of energy regulations</td>
</tr>
<tr>
<td>Insurance</td>
<td>Insurance agent</td>
<td>• Use to manage the insurances of the project</td>
</tr>
<tr>
<td>agent</td>
<td></td>
<td>• Use to perform state control of insurance policies and offer forthcoming renewals</td>
</tr>
<tr>
<td>Education and</td>
<td>Certified Trainer</td>
<td>• Enable professionals to become trainers of D4E platform and all the tools integrated in it</td>
</tr>
<tr>
<td>Training</td>
<td>Training centre</td>
<td>• Provide courses to BIM training centres or energy efficiency training institution, enable them become trainers of D4E platform and methodology</td>
</tr>
<tr>
<td>Public sector</td>
<td>Community Administration</td>
<td>• Track and monitor official documents relating to energy issues, such as permits, regulations and documents delivery dates</td>
</tr>
<tr>
<td></td>
<td>Urban Planner</td>
<td>• Use the platform to communicate with other project agents and get and provide information on insolation, right to light regulation and district heating and cooling</td>
</tr>
<tr>
<td></td>
<td>Public Agent</td>
<td>• A communication channel between any public agent and any project’s stakeholder</td>
</tr>
<tr>
<td>Private Sector</td>
<td>Customer (organisation)</td>
<td>• Improve the project in an energetic and economic sense, at a lower price</td>
</tr>
</tbody>
</table>
Among all the stakeholders identified, the **architects** are expected to be the main end-users of Design4Energy platform, since Design4Energy project has been developed from the start thinking about them. Nevertheless, the platforms should also reach other roles involved in the architectural design and the retrofitting process.

A professional sector that would benefit from using D4E are **engineers** and **consultants**, specifically those specialized in systems and energy efficiency. In conclusion **MEP engineers**, **RES engineers** and **energy consultants** are important targets.

These two professional areas (Architecture and Engineering), designated as most important user niches, generate a number of synergies on other professions that will create a range of side D4E users. **AEC technician**, **urban planner**, **geospatial modeller** can use the tool during the design process, primarily as a source of information, communication and management of the energetic aspect of the project.

On the other hand, the platform is not only a tool for early decision, it can also be used as a tool for benchmarking, project management, material and technology database, feasibility study, collaboration and other decision-making support, with no need to perform complex simulations and analyses to configure basic operational schemes.

**Materials suppliers**, **systems suppliers** and **surveyors** are also expected to be important users of D4E. Great efforts will be needed to enrich the D4E database and libraries, which are the main features that these professionals will use.

Last but not least, a phase of the building lifecycle seen as another primary goal is the Use, Operation & Maintenance, and the retrofitting project speciality. The D4E platform will help to monitor building operations and to design retrofitting solutions, providing an aid for decision-making and pay-back analysis. In this aspect, in addition to professionals mentioned so far, **facility managers** and **facility operators** can be expected as D4E users.

### 4.2.2 Universities and Academic researchers

Collaborating with universities and academic research institutes for the dissemination of knowledge generated by the project is a very interesting way to exploit and diffuse the achievements of Design4Energy.

Various courses could be carried out for the students to learn how to use the D4E platform to realize energy efficient building design, to understand the integrated and collaborative design strategies and to obtain new skills by using the D4E platform. A 3D on-line gaming environment is developed to provide an education platform for community learning. In addition, deep courses and training material could be provided to academic researchers, in order to offer them new knowledge about the core technologies and methodology of D4E, to facilitate the conduct of more comprehensive studies in the future, and to improve and extend the current results of D4E.

An enquiry took place with academics in the School of the Built Environment (SOBE) of the University of Salford to explore the potential of using the 3D on-line gaming environment in teaching architectural or other related subjects. SOBE academics welcomed the possibility of using the 3D on-line gaming environment in teaching architectural courses since it is aligned with such programmes’ main aims and objectives. Examples of the architectural courses
taught at the University of Salford where such a gaming environment could be used as an effective learning tool could include ‘Performance Modelling’ and MDP2 (Multidisciplinary Project); both are delivered for second year students. The game can provide end-users with a knowledge and understanding of integrated and collaborative design strategies, thus demonstrating a systematic understanding of the profession of architecture and its role. Such an approach will assist in providing students with a number of key skills such as developing the ability to work collaboratively within teams and the better communication of information, ideas, problems and solutions to both specialist and non-specialist audiences [3].

4.2.3 Industrial executives
The training of industrial executives is a key to extract commercial value out of D4E. The target groups focus mainly on SMEs. Revenue can be generated within this segment by selling the D4E kits to the potential customers who pay for the value that D4E creates for them. Design4Energy SMEs should establish links between themselves and their different customer segments in order to maximize the business value of the D4E solutions.

A business model is elaborated in task 9.4 in order to deliver value to the potential market and stakeholders. For customers, they will benefit from the relationship among SMEs, because the solution addresses their needs in a better way.

The training of industrial executives should be focused on the value proposition as defined in D9.2 “Business Model and Value Proposition”, in order to convince the potential customers and users to adopt D4E thanks to the benefits that they could obtain from using the Design4Energy kits technologies.

4.3 Training needs and values
Evaluating whether training is needed is an important step. Once the gaps in the skills and the benefits from using D4E solutions are identified, it’s time to decide what type of training is needed and who needs the specific training.

At the initial stage, it is also expected from partners to express demands and formulate requirements for specific training sessions, and to provide description of the overall implementation context.

The training needs were identified and categorized into three main types: practice need; research need; business need.

1. Practice need
Energy efficient design is significant to save energy use, reduce CO₂ emissions and achieve sustainability in buildings. However, the current process for energy efficient design is time, resource and cost consuming, especially when some other life cycle stages are also included. In addition, the traditional tools for energy efficient design are also complicated and less interoperable. The D4E methodology and platform tackles these problems. In order to help the potential end-users and stakeholders obtain optimal use of the D4E solutions to address their own practice need, the training of D4E is essential.

2. Research need
The technologies and knowledge evolve rapidly, and there will always be needs for improvement. The research needs primarily come from the universities and research institutes. For example, the current BIM technologies and its integration with energy efficient design still need further development, and the D4E platform also has space for improvement. The training of D4E will support these research needs.
3. Business need

Business goals are one of the main objectives of implementing the D4E methodology and platform, especially for the SMEs. The training should help generate more revenues and obtain profit from the efforts in developing the D4E methodology and platform. A customer satisfaction course can ensure that the customers return and recommend the solutions and tools to others.

The unique capabilities of the D4E solutions are also one of the training needs. Since the D4E methodology and platform are new and innovative, it has the benefits and advantages that many other solutions cannot offer. The trainers who grasp the knowledge and tools of D4E can also obtain more competencies.

Another need for the training is to train the trainers, in order to attain the desired results and the consistency in training. Trainers should be competent and dependable, with both relevant industrial exposure and academic knowledge.

The training will bring the proposed value (as depicted in D9.2 [5]) into reality, including the following:

- **Organizational values;**
  Organization aspect is one of the general areas in which the D4E platform can significantly influence the building workflow. The training of D4E will help the trainers using the platform for 1) documents and information management, 2) document issuance, 3) document monitoring, 4) communication platform, 5) role management and 6) project management.

- **Information values;**
  D4E provides access to multiple information sources. The training value lies on the appropriate application of such information, including 1) benchmarking and neighbourhood data, 2) territorial data (city plan, terrain model, energy source, climate data, etc.), 3) referent prices database, 4) materials & systems database, 5) CAD & BIM library for eeBIM, 6) technology database, 7) guidelines and showcase materials.

- **Analytical values;**
  D4E is a fundamentally analytical tool. The training facilitates the optimal use of such tools, thus to aid the design process in several ways. For example, it supports the project’s needs and values definition, the early design stages performance analysis and comparison, the model checking, the integrated energy performance analysis, and so on.

- **Educational values;**
  The training concept will maximize the educational values of D4E, oriented to design professionals, users of buildings and citizens in general.

- **ICT Service values.**
  D4E is an important tool for building design which is always supported by ICT professional services. The training of D4E will help the further function customization, extension and integration of tools, adaptation to the relevant working environment, etc.

### 4.4 Training scope

The training scope of D4E includes three sessions, namely the knowledge-based learning sessions, the skills-based learning sessions and the awareness generating sessions, which are consistent with the main reasons to conduct the training as mentioned previously in Chapter 3.2.
1. Knowledge-based Learning Sessions

These sessions deal with the issue of required knowledge for the learners, such as the guiding ideas and insights of the D4E methodology and platform. The learners can use this knowledge to improve their mind-set and orientation towards novel work performance. The knowledge to be disseminated includes D4E methodology, D4E theories, process maps and D4E business model.

The knowledge can be addressed at two levels aiming for different learners. One is the principle level, which only transfers the guiding ideas and insights of D4E; the other one is the essence level, which transfers the D4E core and essence to those with high levels of mastery in the discipline.

2. Skills-based Learning Sessions

These sessions deal with the issue of what to do for the learners, which provide the training contents that are applicable to the work environments of the trainers. The learners can use the skills to understand better and enhance the knowledge. The skills to be trained include tool operation, maintenance and usage, interoperability solution, modelling and good gbXML export.

3. Awareness Generating Sessions

These sessions deal with the issue learner awareness. The awareness that should be generated includes various aspects, such as,

- The current problem existing in building energy efficiency;
- Current limits and barriers;
- The importance to design energy efficient building during its life cycle;
- The benefits when using the D4E methodology and platform compared to other solutions;
- The information that can be provided by the D4E platform;
- The difficulty that may be encountered when using the D4E platform and its solutions.

The awareness can be generated by different ways, including the customised training material, the e-learning courses, the face-to-face training, etc.

4.5 Training forms

The training forms are represented by grouping a set of advanced training activities for different collectives aiming at transferring the training contents. In general, the training forms cover the following four types:

4.5.1 Speech on Training topics

The speech on training topics is one of main training forms during the project period. It can be carried out in face-to-face workshops, conference, meetings, seminars, etc. The speech can cover different training topics, including different training materials, such as the written materials and videos. Questions can be put forward and the relevant discussions can be carried out during the speech.

4.5.2 Webinar/Online Courses

The webinar/online course is the most important training form of D4E, because of its flexibility, modularity, economy and wide reach of audience. The webinar/online courses can cover various topics through the customized modules, and suit the requirements of different trainers from different background. A range of training materials can be incorporated, making
them available for the trainers and facilitating their download for future study. Leaners can also ask questions through the webinar/online platform and engage with other learners.

4.5.3 Courses or lectures in Universities/academy

The courses or lectures in universities and academy mainly take place in classrooms. Its purpose is to disseminate the generated knowledge and tools of D4E among students and researchers. The students are future potential end-users of the tools, and the researchers can benefit from the D4E methodology and platform for their further investigation. With the organized materials, the training courses will help them systematically understand the principles and essences of D4E, and enhance their skills by using the tools.

4.5.4 Video courses

The video courses include the manual, recorded speeches, and so on. It is essential to use intuitive ways to show how to use the tools, rather than using overwhelmed written materials. Therefore, video is an effective mean. The manual mainly comprises tutorial videos of the use the D4E tools. Additionally, recorded speech is also a possible way. Through installing the camera, the video courses can be delivered, which is available for learners from different places.

4.6 Moodle training strategy

Moodle (Modular Object Oriented Dynamic Learning Environment) is one of the main training strategies of D4E. The Moodle training strategy is a web-based and computer-based e-learning system, which can enable continual learning with the wide variety of training resources and contents organized in modular. Currently, Moodle platform is used widely in schools and institutions. The training plans in Moodle can be developed at several levels (annual, weekly, ongoing, etc.). Different training resources and materials can be incorporated for utilization, and such Moodle-based materials are available online anytime and anywhere. The training courses can be delivered using the text, images, or other media such as audio and video through the Moodle.

One major benefit of Moodle is its economy in terms of time and resources. Instead of having classrooms filled with books, audio and video cassettes, all these can be supplied electronically, and the students can access these whenever they need.

Furthermore, Moodle is easy for use. It has a simple user interface and intuitive navigation. It can enable the trainers to learn more independently, having control over their learning. In addition, Moodle has a lot of optional modules, such as a chat module which supports work in groups and discussing questions.

Considering the benefits of Moodle, a Moodle training platform of D4E has been built by Solintel, using it to provide various courses to potential users and stakeholders.

The Moodle platform for D4E training is open. Online courses are available for any actors. The platform can be accessed through the following link:

http://design4energy.eu/moodle

The platform contains four training courses and the material in relation to each course. The four courses are the following:

- Design4Energy Kits course, which contains the videos of different tools, the manual, the online gaming, etc.
- Design4Energy integrated solutions course, which comprises the D4E Methodology and process map, KPI framework and guidelines.
• Smart performance integration course, which incorporates the videos of the interoperability suite, preparation of good Revit model, gbXML IDF Converter, novel workflows in integrating performance simulation in building design, and exploration of design options through simulations, etc.
• Business opportunities course oriented to SMEs, which involves the D4E business model and the value proposition.

4.7 Gamification training strategy

3D gaming is another main training strategy of D4E. With the rapid growing field of digital gaming, gaming technologies have been increasingly used for educational purpose. The term “gamification” means the process of applying gaming designs and concepts to training scenarios, in order to make the learning more engaging and entertaining for trainers. The current gaming technologies enable to elaborate 3D immersive environments. The simulation and virtual scenarios are available for game-based learning.

Gamification helps create an effective e-learning system that learners can rehearse in real-life scenarios. It can provide better learning experiences by making the learning more interesting and enjoyable. The high level of engagement will increase the recall and retention. In addition, the learners are able to get instant feedback, so they know what they have already learned and what they should learn. The friendly and interactive gaming environment will also enhance the learners’ productivity.

Therefore, a 3D online gaming environment has been developed to create an online training environment for learning “How to Design Green Buildings”. The environment is built based on the gaming technology, but also the modelling and simulation components, in order to help learners understand how to design energy efficient buildings. The overall platform provides a “team space” for various actors.

The developed 3D online gaming platform can be accessed through the following link:

http://thinklab-salford.org/d4e_game/new_built.html

A capture of the user interface is as shown in Figure 3.

![Figure 3 - A capture of the user interface of the 3D online gaming platform.](image-url)
high level activities, specific tasks and detailed tutorials in the form of storyboards designed to enable users to achieve a number of learning outcomes. As a result, the platform will assist users to learn how to design ‘Green Buildings’ in terms of energy, environmental and social aspects. Added features such as collaboration assist the end-users to explore individually, or collectively, various design/retrofit solutions regarding energy efficiency, cost and CO₂ emissions.
5. **Design4Energy training action plan**

A training action plan is developed to ensure that comprehensive training activities are carried out throughout the entire duration of the project and the online learning is available after the project.

The training action plan traces back to the early stage of the project, in which different training activities were previously arranged, including the collection of training material, the development of training courses, the deployment of workshops, etc. This section devises a detailed training action plan, which decides the specific activities to be carried out during the project and after the project. The plan addresses also who should implement the activities, where will the activities be held and when will the activities take place. Activity schedules are made to ensure that the activities are carried out as planned.

Figure 4 lists the training activities in project and post-project durations. Internal activities are those that are conducted only among the personnel of the partners, and external activities are those that are open to the public. The training activities in project duration focus on the pre-preparation work and the relevant meeting and workshops, while the training activities in post-project period pay more attention to the online e-learning. In the following subsections, the various training activities during the project and post-project durations and their training schedules will be illustrated, respectively.

**Figure 4 - Training activities in project and post-project durations.**

### 5.1 Training activities in project duration

In project duration, the internal activities involve the pre-preparation works, such as training material development, project website development, Moodle and 3D online gaming platform development, and also internal training workshops and meetings. The external activities include the courses in universities and academics and the relevant workshops.

The different internal activities can be described as follows:
1. Training material development

The first activity to be carried out is the development of training material along with the technical development of the D4E platform and methodology, since it provides the basis for training courses and workshops, and also any other training activities. The development and collection of training material is supposed to be conducted throughout the whole duration of the D4E project, from the early stage to the final stage, from the initial idea to the final evaluation. The material should be updated when there are technical updates. All the partners should get involved in the development of material. Each of them is assigned to develop the material that is relevant to their tasks. Subsequently, the material will be collected and organized by SOL and make it available in the website and e-learning platform for different learners. The following Chapter 6 lists the collected training material.

2. Project website development with training material module

The development of the project website with the training material module is a way to share the training material with various learners. The website should be developed at the initial stage of D4E. The module should also be updated when there is new material and replacements are required. Currently, the training material can be found by clicking the “Courses” tab in the website and auxiliary material, project reports, papers, presentations are also available in the “Download” tab for detail study of any specific study.

3. Development of training courses

The training courses related to D4E methodology and platform should be devised in parallel with the development of training material. All partners should participate in the discussion of possible training courses and their implementation context. The final decision of the training courses is supposed to be made before developing the e-learning platform. As a result, four courses were designed, which will be detailed in Chapter 6.

4. Development of a Moodle e-learning platform

A web-based e-learning platform (Moodle) is planned to be developed in order to realize the remote training. This activity is conducted at the final stage of the D4E project, when the training courses have been devised and the training material has been collected completely. SOL is the partner in charge of the development of the Moodle platform. Currently, a link in the project website provides the access to the platform by clicking the “Course” tab and, afterward, the “E-learning” icon.

5. Development of a 3D online gaming environment

A 3D online gaming environment is developed for the stakeholder to learn how to design green building. This activity is assigned to University of Salford due to their rich experience in designing educational games. The activities should be completed before the final stage of the D4E project, so as to carry out trial courses among the students, obtain their feedback and evaluate the platform. The 3D online gaming environment can also be accessed through the project webpage under the “Course” tab.

6. Remote training (via i.e. Gototraining, webex etc.)

Remote training is one of the training forms in the plan. The 9th February 2017, a remote training session was held through Gototraining among the consortium partners, which aims to introduce in a more structured way the Design4Energy methodology and new tools for designing energy efficient buildings in neighbourhoods.

Internal training courses that help the architects use the platform are essential in the training action plan. This activity involves the D4E team that will be in charge of implementing the evaluation of the D4E platform, thus to improve the platform. During March and May 2017,
the architects from different partners took the courses to learn how to use the D4E platform and specific tools under the guidance of scientific partners via remote training.

7. Internal training workshop

Internal training workshop is an important part of the training action plan, because it helps the partners understand the Design4Energy methodology and platform, and support them to use, evaluate and improve the platform. Different workshops have taken place amongst partners, and sometimes they are conducted by means of face-to-face meeting. The internal training workshops start from the middle stage of the project, when the D4E methodology and platform were in shape.

Except for the internal activities, there are also different external activities planned during the project, including:

1. Courses in Universities and research centres

Course in universities and academy is one of the main training forms as planned. These training courses take place in universities and academies and will help students learn how to design energy efficient buildings and generate awareness about energy efficiency. The University of Salford, Loughborough University and VTT have delivered courses about the core idea and the concept of D4E to their students, using the 3D online gaming platform to facilitate the related knowledge retention.

2. Demo workshop

The demo workshop is planned to show the project concept, D4E methodology and tools to the public to demonstrate the capacity and reach more potential users. Through the workshop, it is also expected to collect feedback and visions from external parties. The demo workshops are planned to start from the second period of the project. The first demonstration took place in M26 (Nov 2015) and positive feedback was collected, which in addition benefited the technical development. A final demo workshop is scheduled at the final stage of the project (M48) when the platform is optimized after collecting evaluation data from the three buildings design.

3. Business creation workshop

The business creation workshop is planned to present D4E solutions, business creation and feedback towards D4E, empowering SMEs and even academic personnel to seize business opportunities. Besides the industrial partners from the project, external SMEs and related stakeholders are invited.

4. External training workshop

External training workshops are planned to get closer to the end users, showing the functions and capacity of the platform, and the advantages of D4E methodology to the public. This training activity can also enable the consortium to get first feedback from the potential users. In March 2nd, 2017, a public training workshop was carried out in Warsaw, organized by Iznab, TPF and Solintel. The workshop focused on the demonstration and training of D4E approach, methodology and new tools for designing energy efficient buildings. All partners and external stakeholders have participated in the workshop.

To conclude, Table 2 - The schedule of training activities during the projectTable 2 shows the schedule of the different activities devised during the project.
Table 2 - The schedule of training activities during the project

<table>
<thead>
<tr>
<th>ACTIVITIES</th>
<th>DESCRIPTION</th>
<th>RESPONSIBLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development and update of training material</td>
<td>Training material for courses and workshops</td>
<td>All</td>
</tr>
<tr>
<td>Project website with training material module</td>
<td>Add modules to the website, upload the training material</td>
<td>SOL</td>
</tr>
<tr>
<td>Development of training courses</td>
<td>Training courses related to D4E methodology and platform</td>
<td>All</td>
</tr>
<tr>
<td>Development of a web-based e-learning platform</td>
<td>Development of Moodle e-learning platform</td>
<td>SOL</td>
</tr>
<tr>
<td>Development of 3D online gaming environment</td>
<td>A 3D online gaming environment for learning how to design green building</td>
<td>SALD</td>
</tr>
<tr>
<td>Remote training (i.e. gototraining)</td>
<td>Learning D4E methodology and new tools among partners</td>
<td>All</td>
</tr>
<tr>
<td>Internal training workshop</td>
<td>Learning D4E methodology and new tools among partners</td>
<td>All</td>
</tr>
<tr>
<td>Courses in Universities and research centres</td>
<td>Teaching student how to design energy efficient buildings</td>
<td>RES</td>
</tr>
<tr>
<td>External training workshop</td>
<td>Learning D4E methodology and new tools</td>
<td>All</td>
</tr>
<tr>
<td>Demo Workshop</td>
<td>Product demonstration to public</td>
<td>All</td>
</tr>
<tr>
<td>Business creation workshop</td>
<td>Business potential discussion with SEMs (Poland, Spain)</td>
<td>SOL, IZN</td>
</tr>
</tbody>
</table>

5.2 Training activities in post-project duration

The training activities planned in the post-project period mainly include the online courses and gamification training, which aim to all publics. The internal activities are only limited to internal exchange among partners; no specific training workshops or meetings are scheduled. While, the partners can organize activities by their own, such as further implementing courses in universities and academy.

The different training activities are described as following:

1. Internal exchange

Internal exchange is the activity for all partners to learn the specific knowledge and tools according to their own needs. The activities can be organized by the associated partners, and scheduled according to their own availability.

2. Implementation of four courses in universities and research institutes

The courses in universities and academies will be continue after finishing the project, in order to enable the continual learning for students. The target groups are students and researchers, the activities can be scheduled according to the available resources in the universities and academy and integrated into the existing courses, for example, Loughborough University will continue incorporate it in the course “Lecture on Management of Information Systems” for the School of Civil and Building Engineering, School of the Built Environment from the University of Salford will continue to incorporate the 3D on-line gaming environment as an e-learning tool within their taught programmes.

3. E-learning through Moodle

E-learning through Moodle is the major training activity in post-project period. The learners can get access to the platform for continual learning at anytime and anywhere. After the
development of the platform, Solintel and Iznab will continue with platform maintenance, material updates, technical issues that may occur. To provide a stable and continuous service, a backup server will be created using the internal server of Solintel.

4. E-learning through 3D online gaming platform

E-learning through the 3D online gaming platform is another major training activity. Similar to Moodle, the gaming environment can also enable the learners to learn at anytime and anywhere. This activity can also be continued in the post-project period. The update and maintenance of the platform is expected to be implemented by University of Salford.

To summarize, Table 3 lists the schedule of the different training activities in post-project period.

<table>
<thead>
<tr>
<th>ACTIVITIES</th>
<th>DESCRIPTION</th>
<th>RESPONSIBLE</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal exchange</td>
<td>Internal exchange of the generated knowledge and tools of D4E among partners</td>
<td>All</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Implementation of four courses in universities</td>
<td>Continue delivering the courses in universities and academy</td>
<td>RES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>and research institutes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E-learning through Moodle</td>
<td>Online courses for different learners</td>
<td>SOL, IZNAB/All</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E-learning through 3D online gaming platform</td>
<td>Online gaming training for different learners</td>
<td>SALD/All</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6. DESIGN4ENERGY TRAINING MATERIAL AND COURSES

The analysis of the training situation and training needs leads to the definition of the training scope, which can be broken down into (1) Knowledge-based, (2) Skills-based and (3) Awareness Generation. Together with the defined training strategy, technical innovation and value proposition done in D9.2, training materials are developed by the consortium, and further developed into four courses.

6.1 Training Material

6.1.1 Design4Energy methodology

As one of the main outcomes of the project, the methodology is highly integrated into the D4E platform. Knowing the methodology will help the end user in better understanding the tools and benefit the green building design.

As a requirement of the training material, the D4E methodology should cover the main steps for green building design; namely the three main scenarios developed during the project. For training purposes, a highly comprehensible format should be used for this methodology. The following requirements were specifically defined:

1. To better explain the methodology developed in the project, a design guideline could be the best format.
2. This guideline should include intuitive workflows, such as maps and charts.
3. It should include the main points developed in the project, covering the three main scenarios, such as the KPIs and processes.
4. Following the concept of the project, emphasis should be given for the early design phase.
5. Check list or recommendation should be included.

The reports from different work packages becomes valuable feedback for the development of the above guideline, especially the D2.3 Guidelines for optimal building design. But in order to create user-friendly and easily understood training material for extended use, the solo information from D2.3 on its own becomes insufficient. Intuitive diagrams transmitting the methodology and concept could be a helpful. For this purpose, strong efforts have been dedicated in developing a series of documents. Finally, data-flow processes with symbols as another vehicle for creating BIM guidelines is developed and these Data-flow Maps include links between symbols and To-Do’s, Check Lists and Design Advisories. In this guideline, 2 types of symbols are developed:

1. The BIM models (Figure 5) are pinpointed to the description of data flow.
   - Models may have extra definitions (such as preliminary as-designed BIM). Registers and catalogue symbols show the origin of the model objects and attributes. Symbols of analyses are added to analytical models, which are configures from domain models.
   - the data content of each model and the owner of the model needs to be defined. One way to do this is to link each symbol to a respective content definition of a BIM guideline
2. BIM uses (analyses/simulations/assessment/class detection/viewing) to produce results shown in the D4E portal linking the data flow to a decision point or to a collaborative session.

This map will serve as a reference process for chief designers and support model based design management.

Taking into account the requirements and concepts developed for the training material, a Facilitator composed of three presentations were developed under the following topics:

- Guide for BIM models and model uses in Needs Identification and Requirements & Feasibility study
- Guide for BIM models and model uses in Concept design, Detailed design and Final design (including integrated design review)
- Guide for BIM models and model uses in Maintenance/ Retrofit processes

As core documents for the methodology and guideline, these three presentations could serve as key training material for better understanding the workflows of different scenarios. Meanwhile, D2.3 could be also used as a full document for those who wish to know more details about the methodology.

### 6.1.2 Design4Energy tools

The tool sets developed together with the methodology form the solution as a whole. The development of the tools was the key part in the co-innovation phase, it does not only follow the methodology, but also drives the evaluation and development of the methodology itself.
The D4E collaborative virtual workspace, as the main platform integrating all the other sub tools, reflects all the scenarios and workflows developed during the project. On the other hand, the sub tools developed in the project also have the potential to be used as a standalone software depending on the needs of the end user. From the training point of view, it is important to know not only the theory and operation of the main platform – collaborative virtual workspace, but also the details of the sub tools integrated into the platform, the management of the operational skills and logic behind the tools which could enhance the use of the main platform and better building design.

This section will summarise the training material developed for these tool sets.

### 6.1.2.1 D4E collaborative virtual space

In short, the workspace allows various actors to collectively simulate and assess the impact of various design scenarios in order to improve energy efficiency, at building or neighbourhood scale, as well as for retrofitting.

The training material for the platform should cover two aspects:

1. Operation for the new building design and general setting of the platform
2. Operation for the retrofitting design.

The best way to show the operation of the tool is to have intuitive tutorial videos, explaining the usage of the platform step by step with a case study.

For this, two tutorial videos were created:

1. Demonstrates the usage of the Collaborative Virtual Workspace for New building design.
2. Demonstrates the usage of the Collaborative Virtual Workspace for Retrofit design.

Additionally, a user manual “Instruction for Design4Energy Simulation Process” was also elaborated; it enables the end user to follow the operation steps by step with screenshot of the platform.

### 6.1.2.2 Other tools

The Collaborative Virtual Workspace is an integrated platform that needs the support and input from its sub tools, which are:

- Target setting tool
- Energy Matching tool
- Technology Database
- Interoperability suite
- Decision support tool for retrofitting and O&M
- gbXML – IDF converter

As key components of the platform, each tool can be operated or exploited as standalone tools as well, while at the same time, each tool is connected to the platform using the specific APIs. This mechanism makes the whole system more modular and flexible for future development and extension.

To be able to use the entire platform, it is essential to understand the usage of each sub tool. For this objective, it is needed as well to develop training materials for the above mentioned sub tools.

Similar to the Collaborative Virtual Workspace, the training material for these sub tools should be simple and easy to understand, tutorial videos or presentations or documents are more demanding.
Thanks to the efforts of the consortium, the following materials have been created:

1. A dedicated presentation for Target setting tool, explaining the key methodology behind and the use of the excel tool
2. A dedicated presentation for the Energy Matching tool, explaining the key methodology behind and the use of the excel tool
3. A tutorial video for the Technology Database
4. A tutorial video for the Interoperability Suite
5. A tutorial video explaining the workflow for retrofitting design and decision support tool, and the automatic gbXML – IDF converter

As another approach linking a building model to energy simulation, the energy-extended BIM data structure (eeBIM) archives enrich the building model and transform it to EnergyPlus. A set of tools (model validator, model combiner, model filtering, eeBIM2SIM converter) were integrated making the tool more complex. For the purpose of training and future demonstration of the technological innovation, a dedicated tutorial video explaining the operational steps with a case study was created.

### 6.1.3 3D online gaming

The 3D on-line gaming is a “snapshot” of the D4E platform and methodology. More importantly, as a D4E training tool, it will enable project architects and other SMEs to extend their knowledge about designing more energy efficient buildings taking energy and cost into consideration at an early design phase. This tool will also be used as an educational tool to teach architecture and engineering students and other technicians about energy design issues.

The development of the 3D on-line gaming environment follows the methodology and scenarios defined in the project, it is comprised of three learning modules [1]:

1. **New building**
   - The aim is to develop an understanding of the impact of using various solutions on reducing energy demand and cost.
2. **Neighbourhood**
   - This module creates an online training environment for users to learn about energy efficient buildings design in the district context.
3. **Retrofitting and O&M**
   - The main target of this module is to investigate the use of maintenance and operational data to explore retrofitting solutions and develop an understanding of energy demand and cost saving during operation.

Each learning module is structured around a set of activities, specific tasks and tutorials; conceived to enable users to achieve a number of learning outcomes. The tool is designed to support individual user training as well as community learning collaboration, where a minimum of two players can use it, taking the roles of an architect and a client respectively. The D4E 3D on-line gaming environment is integrated within the web environment, the interface is designed in a flexible way to enable end-users to select any module to start their training. The tool, as one of the most important training materials, is self-explanatory and easy to use, nevertheless, a user manual for this D4E Gaming Environment is also elaborated aiming to provide an overview to the end user before operation.

### 6.1.4 Knowledge oriented training material

The project outcome from D4E is not only the platform and tools, but more importantly, the knowledge and theories generated during the innovation and development stage. It is critical to transmit this know-how and logic behind the tools to the stakeholders, to inspire future innovation and establish a solid foundation for the usage of the tools. The techniques and
skillset of the end user can be increased by learning the operation of the tool, but will be further enhanced with the knowledge behind the tools. With this know-how, end users may discover or create more solutions with the tool provided the mechanism is clearly viewed.

Without any doubts, all the reports developed and papers published in the project are main parts of the knowledge oriented training material, but aiming to facilitate the end user in understanding the theory in a shorter time, the extraction of key information and explanation of the knowledge in an intuitive way should improve the learning process. For this purpose, the consortium decided to create a series of presentations and tutorial videos, on the other hand, these training materials can be easily managed and delivered to more potential users beyond the project duration and even inspire more researchers in a better way.

Besides the D4E methodology, other dedicated knowledge oriented training materials were created by the consortium:

1. D4E project concept
   This is an introduction to the Design4Energy Concept, showing the key ideas, architecture and workflows of the project. A video recording of the presentation is also available.

2. Neighbourhood data toward low-carbon district and building
   This is a presentation summarizing current challenges in getting neighbourhood data, data sets identified and the solution provided by D4E.

3. Novel workflow for considering energy issues in collaboration setting
   This is presentation explaining the novel workflow for considering energy issues in collaboration setting, including the process, tools, data sets needed and process maps in a high level.

4. Best practice in preparing CAD models for energy simulation via gbXML
   The main document is a guideline with photos and text explaining the steps needed to prepare a good BIM model which can be exported as a gbXML model for further process. For better understanding, a tutorial video using a case study and explain each step with detail and operation.

5. Exploration of design options through simulations
   As a key methodology implemented in the Collaborative Virtual Workspace, the exploration of design options via ‘what-if scenarios’ could help the end user in evaluating the impact of their decisions and choices on cost and energy performance. A presentation extracting the ideas and workflows is created as a training material.

6. Design4Energy workflow for new designs
   As a complementary training material, the presentation of the workflow for new design is elaborated aiming to help the end user in understanding the process of the platform.

7. Design4Energy workflow for retrofitting design
   Similar to the workflow for new design, a tutorial video is prepared showing the key information and steps.

8. IFC based eeBIM approach
   Similar to the “Novel workflow for considering energy issues in collaboration setting”, the IFC based approach introduces the workflow and key elements used in the solution.

9. Current market & needs
   This is a presentation summarizing the analysis result of the current markets, needs of the potential users and business opportunities.

10. Value Proposition
This is a presentation summarizing the key values identified during the development of the platform and methodology, extracted from D9.2, and more importantly, the methodology and tool for developing a value proposition.

11. Business Model
It is a presentation showing the methodology for creating business model for a certain product or service.

6.2 Design4Energy integrated solutions course

As part of knowledge-based training courses, the Design4Energy integrated solutions course aims at providing the theoretical framework developed in the project. During the development of the project, 3 main usage scenarios were developed:

- Scenario 1: Consideration of neighbourhood energy trading context in building design
- Scenario 2: Holistic energy design optimisation during early design phase
- Scenario 3: Retrofit & Maintenance

Aligned with these scenarios, methodology, workflow, process maps, KPI framework and specific technical requirements were developed after intensive co-innovation processes.

To benefit the further exploitation in the scientific realm and to support the end user in having a solid knowledge baseline in tool operation and to create different strategies in green building design, the Design4Energy integrated solution is separated in a series of sub courses, covering different key outcomes, including:

1. Design4Energy methodology and process maps
2. Guide for BIM models and model uses in Needs Identification and Requirements & Feasibility study
3. Guide for BIM models and model uses in concept design detailed design and final design
4. Guide for BIM models and model uses for retrofitting
5. KPI framework for designing energy efficient buildings in neighbourhoods - Target Setting Tool
6. KPI framework for designing energy efficient buildings in neighbourhoods - Energy Matching tool
7. Neighbourhood data toward low-carbon district and building

The training material used in these courses mainly rely on the Design4Energy methodology and the three guidelines described in section 6.1.1, KPI framework and neighbourhood data specified in 6.1.4.

The more the above theoretical courses are understood, the easier it becomes to learn the operation of the D4E tool sets and understand the “Smart performance integration course” described in the next section.

From the further scientific development point of view, the training courses will also help the scientific community getting the D4E outcomes in a more structured way. The interested researchers can even combine the technical reports published in the project with more technical details to carry out extended research.

The Design4Energy consortium expects not only that the project outcome could benefit wider users in creating more innovation in green building design, but also to contribute in increasing the social awareness in energy efficiency by encouraging the conversation in energy issues during the building design phase. A building is no longer an isolated system, but a sub system
at the neighbourhood level. The building design in such environments should start taking into account related data models, the introduction of the KPI framework and target setting tools with considerations of neighbourhood models. This is one of the measures implemented to foster reflection on energy issues in early design phases and it is expected to further increase awareness of energy efficiency and its economic potential.

6.3 Smart performance integration course

Under the Design4Energy methodology and workflows established, detailed processes are specified for the aforementioned usage scenarios. It is understood that building performance assessment is an elementary process in the workflow and is a key part of the D4E integrated solution. How to integrate the building performance assessment had become a technical challenge in the framework development and technical implementation. During the technical development, many questions and challenges were identified, such as:

- How the building performance assessment can be smart and simple enough for the end users who usually lack energy efficiency knowledge and simulation skills?
- How the performance assessment can be integrated in the early design phase and reduce the overall cost?
- How to address the interoperability issues when transforming building models to energy models, and at the same time, reduce the effort in modelling?
- How can the transformation of different models be smart enough without requiring too much involvement of the end users?
- How to integrate the building performance assessment into new building design and retrofitting design?

Design4Energy tackled these challenges and developed different approaches to integrate the performance in a smart and efficient way in order to help the end users, specifically, the architects who do not possess extensive knowledge in energy simulation and energy modelling. This facilitates collaboration when working on energy issues in building design.

The Smart Performance Integration Course is developed under the thinking of how the know-how obtained from the project can be transferred to a wider stakeholder, specifically, researchers and engineering entities who are eager for the integrated solution. How to make use of the building models produced by the authoring tool in the energy modelling tools is always a challenge in industrial and scientific research. It is expected, by delivering the following course, that D4E can contribute to industry needs and establish a solid baseline for a mature solution:

1. Novel workflow for considering energy issues in collaboration setting
2. Best practice in preparing CAD models for energy simulation via gbXML
3. Exploration of design options through simulations
4. Design4Energy workflow for new designs
5. Design4Energy workflow for retrofitting design
6. IFC based eeBIM approach

The training materials used in these sub courses mainly rely on the gbXML – IDF converter described in section 6.1.2.2. Other knowledge, like the guidelines for preparing good CAD models and workflows for different building designs are specified in 6.1.4.

It is true that for the tool operators or architects, there is no need to follow this course before learning the operation of different tools and following the “Design4Energy Kits course”.

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However, the understanding of this knowledge will surely enhance skills and facilitate the learning process.

On the other hand, for other users from the ICT sector or EeB researchers, this course will provide a shortcut in getting the key technical approaches of the D4E methodology and understanding the tool sets. It is also expected that the know-how concluded in the course will inspire further innovation and improvement of the approaches.

### 6.4 Design4Energy Kits course

Covering the skill-based training defined in the scope, together with the objective to enhance the operation skill in energy efficient building design and the management of the tools developed in the project, a Design4Energy Kits course is created.

This Kits course is mainly dedicated to the training of tools operation, including the usage of the collaborative virtual workspace in new building design and retrofitting design, the operation of the database, decision support tool, eeBIM and interoperability suite. The course will rely massively on videos, from which users can get first views of the user interfaces and receive full operation of the tools. The operation of different functions designed in the tool will be presented with use cases and detailed explanations. Specifically, for the collaborative virtual workspace, intuitive manuals and case studies are included. On the other hand, for potential users who have no knowledge of the D4E project, an introduction of D4E concepts will be included aiming to help to establish a baseline.

The training course includes:

1. Design4Energy Concept
2. Collaborative Virtual Workspace: New building design
3. Collaborative Virtual Workspace: Retrofitting design
4. eeBIM - IFC based eeBIM approach
5. Energy efficient enabled BIM component library and database
6. Decision support tool for retrofitting
7. Interoperability Suite
8. Target setting tool and energy matching tool
9. Online Gaming for energy efficient building design

The training materials used in these sub courses are mainly from the list described in section 6.1.2 and the 3D online gaming in 6.1.3.

As aforementioned, the collaborative virtual workspace is an integrated platform, the database, target setting tool and energy matching tools are sub tools that help the end user to complete certain tasks defined in the D4E workflow. Detailed training of the usage of these sub tools are extracted as a kit course of the corresponding tools. Hence, to operate the Collaborative Virtual Workspace, it is important to manage the operation of the component library and database, target setting and energy matching tools. On the other hand, the purpose of extracting these sub tools is also to increase the exploitation potential and facilitate the user who has other needs in using the tools.

To reduce the complexity of the platform, the conversion tool, decision support tool and other functions are integrated to the workspace in a different way requiring no specific operations. These functions and tools show high potential in commercial and scientific exploitation. Standalone tools are also developed by the project partner. For users who are interested in
using the conversion tool, or the decision support tool for different purposes in project development or scientific research, specific training courses, like the Interoperability Suite and Decision support tool for retrofitting are made available.

6.5 Business opportunities course oriented to SMEs

During the co-innovation process in the project, user requirements and expectations have been studied. Moreover, before developing the abovementioned usage scenarios, building stock and market trends in building development were analysed to help the consortium in visualizing the potential demand of the future market. It is true that the market study and business opportunity go hand in hand with the technical development, aiming to feedback to the requirement specification and maximise the final value of the D4E methodology and tools. After having the final product, it is more common to have systemic studies on the market and business plan development base on the available resources. It is important to understand the market needs and learn the methodology in self-positioning, identification of values and design of a business model. Business development is not the core of the project and currently, there are plenty of courses in business training. However, to increase the potential expansion and further implementation or application of D4E solutions, it is worthwhile introducing the knowledge learned regarding the potential business opportunities, market situation, and methodology that are to be taken into consideration when defining the market strategy, and business model development when other opportunities emerge.

The sub courses in the business opportunities course includes:

1. Current market & needs
2. Value Proposition
3. Business Model

The training materials used in these sub courses mainly rely on the knowledge described in section 6.1.4 regarding the business development.

The consortium will also consider the elaboration of a simplified set of guidelines for the development of the business plan after finishing D9.3, expecting to contribute in a certain way and bring highlights for similar business cases together using the D9.3.
7. DESIGN4ENERGY WORKSHOPS DEPLOYMENT

From the beginning of the project, besides the main objective in demonstrating the innovative ideas and project concepts, the consortium also looked into the possibility of increasing the usability and exploitation potential of the final solution, industrial perspectives and insights for future market requirements and expectations integrated during the creation of the scenarios and technical development. The idea in involving SMEs and industrial stakeholders was seeded in the daily research activities. Each partner, when contributing to the scenario development, worked with their own network, having interviews and informal workshops with industrial partners to fine-tune function design. The effort not only brings more ideas to methodology development, but also benefits the spreading of the project concept and supports the objectives defined in 3.1.

To further exploit the project outcomes and follow the training plan, several workshops were organized. These workshops, on one hand serve as opportunities in demonstrating the D4E methodology and tools to the public and project partners, getting close to industry stakeholders, and also serve to collect feedback from the potential users. Moreover, they are important training processes for the industrial partners within the consortium, helping them in getting familiar with the functions of the tools and to be prepared for future evaluation activities, enriching the knowledge and increasing their skills.

In the following section, summaries regarding the deployed workshop will be given, showing the objectives and results obtained. Finally, a planning for the final workshop will be described.

7.1 Design4Energy workshops carried out

During the project, the training workshops, meetings and courses are very important parts of the training activities to make the stakeholders informed on the Design4Energy methodology and platform in development, and to help them use the platform and to improve the platform.

This section reports on the workshops related to training activities carried out during the project.

7.1.1 The first Public D4E Workshop in Madrid (Spain)

The first public workshop was held in Madrid (Spain) on November 10th, 2015.

Objectives of the workshop:

- To deliver the first version of prototypes, demonstrate the operation of the tool and train the partners to get familiar with the methodology and user interfaces,
- To get feedback and visions from external parties, principally architects who are envisioned as the main potential user of Design4Energy platform,
- To disseminate and exploit project outputs up to M24.

Target audience: Architects, Facility managers, Researchers, Consultants, Renewable energy engineer, MEP engineers.

Dissemination Channels:

- Social media: facebook (groups over 500 members like BIM forum, Revit Architecture Español, ArchiCAD, etc.), Twitter (more than 10 groups with over 5000 followers) and LinkedIn groups (2 groups of BIM with over 1000 members);
- Internal contact database by email (20 BIM experts, 37 energy efficiency engineers, 7 R&D engineers, 21 academic teachers, 20 persons of different associations and over 20 personal contacts);
- Networks of the partners GSM, Assignia and Ancodaq; and
- Col·legi d'Arquitectes de Catalunya.

Workshop content:
The workshop was mainly divided into four sections: (1) Design4Energy Approach far beyond a BIM design process, (2) Archiwizard and Open eeBIM platform, (3) Technical Workshop and (4) Design4Energy values and Business model workshop.

The first section is mainly knowledge based, aiming to introduce the theoretical outcomes of the project, including the methodology, energy efficiency enhanced design process, technical database, decision support tool and collaborative environment demonstration. The demonstration of the prototypes of the tools were limited to the mockups, initial functionalities and user interface, trying to give a concrete view for the presented methodology and research results.

The second section is to introduce briefly the potential platform that could collaborate with D4E platform and the Open eeBIM platform that D4E is a member of.

The third section is to have a technical discussion and collect feedback from the attendees, trying to understand if D4E can match the needs of the end user and other expectations from the industrial.

The last section is to present the analyzed result regarding the business opportunities, potential future business developments for the end users by using the D4E platform and to present potential avenues for developing the business model by doing the exercise together.

Feedback Quality:
As a first workshop, the training nature was limited due to the limited project outcome. The focus of the workshop was to attract attention from the stakeholders and to disseminate and exploit project outputs up to M24. Nevertheless, it is believed that it is also a good opportunity to train the participants in getting familiar with the prototype, design process, workflow methodology and theories developed in the project.

In total, 39 participants presented in the workshop, and during the informal interviews, we understood that certain functions could be improved or integrated. In general, they all showed high interest in having the Design4Energy platform as a tool and proposed improvements on the methodology and processes.

7.1.2 Remote training workshop
This internal remote training workshop was held on February 9th 2017 through the online Gototraining tool with participation from different partners.

Objectives of the workshop:
- To deliver the latest prototypes, demonstrate the operation of the tool and train the consortium in using the tools;
- To train the SMEs with the Demo building scenarios, support the D4E team, which is composed of the personnel of the partners, to perform the evaluation and validation of the platform;
- To detect technical problems of the D4E platform and prepare for the next public training workshop;
- To have a rehearsal of the prepared courses and encourage the consortium in thinking the theories and platform operation issues, so to prepare questions for the next workshop.

Target audience: Consortium partners.

Dissemination Channels: Internal communication by email and teleconferences.

Workshop content:

The remote training workshop aims at delivering the “Design4Energy Approach far beyond a BIM design process” section, which covers the methodology and knowledge related to the project, including (1) Design4Energy integrated solutions course, (2) Smart performance integration course, (3) Design4Energy Kits course. The workshop follows the first section of the agenda developed for the training workshop in Poland; detailed information will be given in the following section.

Feedback quality and conclusions:

In this internal training workshop, key outcomes were shared among partners and more importantly, the demonstration of the tool operation with demo buildings gave more intuitive instructions to the end users. Some technical questions on the usage of the platform were raised, which also served for refining the platform and preparing the next workshop.

7.1.3 Design4Energy Public Training Workshop in Warsaw (Poland)

This public training workshop was held on March 2nd, 2017, with the topic “Design4Energy Approach, methodology and new tools for designing energy efficient buildings in neighborhoods”, hosted by Iznab with support from Solintel and TPF

Objectives of the workshop:

- To deliver the latest prototypes, demonstrate the operation of the tool and train the stakeholder in using the tools;
- To support the D4E team, solve the questions and doubts that raised after the remote training workshop;
- To increase the skill of the target stakeholders by delivering the know-how obtained from the project the tools;
- To enable professionals to become trainers of D4E platform and all the tools integrated in it;
- Sharing the project outcomes and facilitating the further exploitation of the D4E platform;
- To get feedback and visions from external parties, principally architects who are envisioned as the main potential user of Design4Energy platform,
- To disseminate and exploit project outputs up to M24.
- To obtain feedback on the platform, tools and methodology developed.
- To enable the industrial executives informed of the business value of the D4E kits, helping them to create new building centered business and optimize the profitability.

Target audience: Consortium partners, architects, facility managers, researchers, consultants, energy experts, MEP engineers, ICT professionals etc.

Dissemination Channels:

- Social media: Facebook, Twitter, LinkedIn groups and ECTP platform;
- Internal contact database by email and phone call (over 1000 emails were sent to the contact and stakeholders, personalized call to the registered participants);
- Networks of the partners TPF, Iznab, Solintel.
Workshop content:

The workshop is mainly divided into four sections: (1) Welcome and introduction, (2) Design4Energy Approach far beyond a BIM design process, (3) Interactive training, (4) Exploitation and Business creation.

For the first section, a BIM expert Dr. inż. Zbigniew Kacprzyk from the Department of Structural Mechanics and Applied Informatics of Warsaw University of Technology was invited to give a speech about the BIM challenges and current situations.

Following that, the second section delivered the methodology and knowledge from the project, covering the first three main courses defined in chapter 6: (1) Design4Energy integrated solutions course: by delivering the main contents regarding project concept, KPI framework and Neighborhood data, (2) Smart performance integration course: by delivering the main contents regarding the novel work process in considering energy issues, best practice in preparing CAD models and guidelines, exploration of design options through simulations and workflows for new design and retrofitting design, (3) Design4Energy Kits course: by demonstrating the operation of the platform for new design and retrofitting with details steps.

The third section was designed to be an interactive training section, aiming to give an opportunity to the participants to practice with the tools and ask specific questions to the tool developers. This section was divided into seven groups, covering the (1) Technology database, (2) Decision support tool for retrofitting, (3) eeBIM, (4) Collaborative Virtual Workspace, (5) Interoperability Suite, (6) Target setting tool and energy matching tool, (7) Online gaming environment.

The last section, similar to the workshop held in 2015, delivered the main contents of the Business opportunities course, by presenting the current situation in the BIM market, challenges, limit and barriers, business opportunities and business models. Discussions on future expectations and the influence on the current business model were raised.

Feedback quality and conclusions:

As a public training workshop, the focus of the workshop was to transfer the know-how to the stakeholders, potentiating them to be a trainer and promoter of D4E methodology and tools. Unlike the workshop held in 2015, this workshop delivered the integrated solution and platform ready for evaluation and testing. Having the methodology “materialized”, it made it easier to understand, enabling the participants to visualize the interface with full functions and practice with the tool face-to-face with the help of the developers. The training workshop was more than just a simple training as it provided a good opportunity to discuss exploitation and search of cooperation opportunities.

The conversation continued with some of the participants after the workshop, testing links, and determining the training materials needing further study.

During the workshop, remote access was enabled. Some other external participants were also connected via the Gototraining session. The training workshop, also served as a good chance for the project partners to learn again the methodology and tools in a more structured way. I was very useful in solving some doubts that had emerged in the last remote training workshop.

Challenges in BIM implementation and energy efficient building design were further addressed, showing whether or not Design4Energy is in line with the needs of the sector and whether it will successfully contribute towards energy efficient design. The bilateral discussions between Consortium Partners and External Stakeholders have been focused on:
how the Design4Energy Platform matches the needs of Stakeholders; and what are the expectations and business opportunities that emerge through the design process.

At the end of the Public Training Workshop the Questionnaire on the Design4Energy Platform was circulated between the External Stakeholders, with the purpose of knowing: Business field and size; Level of satisfaction of technical content of Workshop; Usability and future possibilities; etc.

![Training workshop in Warsaw Poland](image)

**Figure 7 - Training workshop in Warsaw Poland**

### 7.1.4 Other workshops and meetings

Besides the formal workshop aforementioned, there are many other workshops and meetings held during the project that contribute to the training of the consortium partners and external stakeholders. Although it is known that the main purpose of these workshops and meetings were not for pure training, but to provide demonstrations of the platform and tools, discussions of the functions and outcomes also served as a good preparation in getting familiar with D4E methodology and tools. Among these workshops and meetings, the first review meeting and second review meeting in Brussels, where key project outcomes and prototypes were presented in a more structured way, where very important. Below are summarised some other main workshops and meetings that contributed to the training activities.

1. **Lectures**
   Several lectures based on the project concept, methodology, technical approaches and other key outcomes were delivered to different students. These lectures aimed to present the innovations and state of the art technologies from Design4Energy to students as part of their courses and increase their knowledge, awareness and skills in green building design.
   These lectures include:
February 27th 2015: Lecture for PhD students in the department of architecture at the Mediterranean university of Reggio de Calabria, held by SALD in Reggio Calabria in Italy,

April 13th to 21st 2015: Lecture for PhD students held by SALD in Italy, 6 International doctorate students attended the lecture.

Jun 3rd 2015: Lecture for MSc. BIM & Integrated Design Summer School, held by SALD in Salford in UK, over 40 attendees including MSc. and PhD students, guest lecturers, and staff.

February 13th 2016: Lecture for Department of Architecture Built Environment and Construction Engineering, held by VTT in Milano, Italy, over 20 PhD Students and researchers attended.

May 8th 2017: Lecture on Management of Information Systems using Design4Energy methodologies for School of Civil and Building Engineering held by LU, over 20 final year students attended.

2. 2nd annual BIM conference in Salford (UK)

The 2nd annual BIM conference was held in Salford (UK), in July 12th, 2016. About 120 delegates from both the industry and academia were received. Specific speeches about Design4Energy were given by Dr May Bassanino, from SALD, with the following topics:

- Overview of the Design4Energy Project.
- Current challenges to transfer Building Information Models to Energy Simulation Tools.

Important feedback was received. Inquiries regarding the technical details of Design4Energy platform and tools were raised, especially in terms of the converter of gbXML-IDF

3. Exploitation Strategy Seminar (ESS)

The ESS was held together with the 8th Technical meeting in Lisbon, Portugal, on 20-21. Jun. 2016. The purpose of the ESS was to deliver the methods in defining the exploitation strategy and potential ways in developing business opportunities through exploitation activities. During the seminar, the following contents were shared to the consortium:

- What is “Exploitation”/ Valorization & Value of Intellectual Capital
- Introduction of PUDF, structure and contents
- KER and Envisioned Business Model
- Commercialization of research results
- IP related issues


The Digital Design in Architecture Conference which took place on 27 June 2017 in Salford was a good channel to present insights into how the buildings of the future will be created and how digital design is changing work processes. Experts at the cutting edge of the built environment revolution presented relevant key innovations. D4E was also presented with the following topics:

- Overview of the D4E project
- Our approach to design energy efficient buildings and neighbourhoods
- Streamlining the Energy simulation for architects for new design and retrofit projects
- Our approach to considering energy trading and energy matching using optimisation and VR techniques

5. Individual remote training workshops
After the public training workshop, a set of extended and specific courses were held to train trainers from the D4E SMEs. This concerned mainly the architects, in order to perform the evaluation and validation of the platform using the demo building as case studies, showing examples in creating options for new designs or existing buildings with alternative retrofitting solutions. During these trainings, specific operational doubts encountered during the evaluation were addressed and solved. Technical issues and bugs were also corrected and valuable feedback for further refinement of the platform was collected.

### 7.2 Design4Energy final demo workshop

The demo workshops aim at showing to a wider public the main project concept as well as the Design4Energy methodology and tools in order to demonstrate the capacities of the platform and reach more potential users. Moreover, these provide great opportunities to train external parties, such as architects, AEC engineers, or students, who are envisioned as the main potential users of the Design4Energy platform.

This final demo workshop is scheduled to be held in collaboration with ThinkLab of the University of Salford, during the Digital Technology in Construction Conference on 14th September. This conference will be held as part of the Industry Day, which, in collaboration with the Greater Manchester Chamber of Commerce, will focus on a wide range of stakeholders and organizations in the construction industry.

Besides the time allocated for Design4Energy during the conference, a live demo of the D4E platform will be held in the lobby offering more interaction and demonstrating the operation of the tools and creating an opportunity for the interested stakeholders to further practice.
8. CONCLUSIONS

This report defines the training methodology, strategy, plan and training courses, which can satisfy the needs of key staff members, researchers, industrial executives (in particular for SMEs) and any potential users of the D4E solutions, in order to provide them more competencies, new knowledges and life-long learning systems. e-learning is a main training strategy of D4E, the relevant Moodle and 3D online gaming platforms enable different target groups to learn the knowledge and/or skills as they need. A wide range of training material is available for learners. The training activities have been carried out as planned and the further activities are scheduled.

8.1 Summary of achievements

Defining the training objectives and methodology, current training situation, common issues and challenges in training are analysed. Following this, the target groups for training are identified and internal and external groups, according to the roles of these groups. The group category is further classified into three types, the potential stakeholders of D4E solutions, the students and researchers and the industrial executives. By scanning different focus and interest points of these three types of training targets, the training needs and values are analysed, as well as the training scope is defined. Afterwards, four training forms are devised to fit the different requirements of the target groups. Taking into account current training challenges and consideration of continuous training activities beyond the project, two training strategies are developed, respectively, Moodle training strategy and Gamification training strategy, which are expected to contribute to the continuous social impact and reach wider public.

Based on the training forms and strategies, a training action plan is created including different activities, such as the development of training material, Moodle and 3D online gaming platforms and the deployment of training courses and workshops.

In the execution of the training plan, different training material in different format, such as presentation, document, tutorial videos, online gaming etc. and courses are created:

The created training material includes:

- Design4Energy methodology
- Design4Energy tools
- 3D online gaming
- Knowledge oriented training material

Four theoretical and practical courses are developed:

- Design4Energy Kits course;
- Design4Energy integrated solutions course;
- Smart performance integration course;
- Business opportunities course oriented to SMEs.

These courses were used the training workshops and can be served for other specific training beyond the project thanks to the e-learning strategy and the Web based distributed e-learning modules – the Moodle platform developed.

A set of workshops were held to train the stakeholders to transfer knowledge and skills to a wider range of potential users. These workshops proved to be a very successful to introduce and demonstrate the D4E concept and outcomes to the stakeholders. In general, the workshop
participants were informed about the background and objectives of the project and training to use the newly developed platform and methodology. The experiences and feedbacks obtained during the training can be used to further refine the tools developed during the project and constitutes the basis for further exploitation.

The main achievements of the work reported in this report can be summarised as the following:

- Defined the training objective and methodology
- Analysed the current training situation and challenges
- Identified the training target groups
- Identified the training needs and values
- Defined the training scope and training forms
- Developed the training strategies
  - Moodle training strategy
  - Gamification training strategy
- Developed a detailed Design4Energy training action plan
- Developed Design4Energy training material and courses
  - Design4Energy integrated solutions course
  - Smart performance integration course
  - Design4Energy Kits course
  - Business opportunities course
- Deployed Design4Energy workshops and scheduled a final workshop

8.2 Relation to continued developments

The training and education has been linked to the technical and non-technical developments in different work package. The main purpose of developing the training activities goes beyond the internal use, but to search synergy with dissemination activities and exploitation activities, workshops deployed and to be held, train more trainers to ensure a successful process of D4E training and use of all the collected learning materials, increase the project impact in different communities, wider exposure the project and increase the knowledge and skill of the stakeholders.

This work has a direct link with the other work packages, especially the technical implementation and optimization of the tools. The training materials and courses will be updated according to the research outcomes and published in the Moodle platform and project website for future use.

Furthermore, this work will continues contributing to the evaluation of the platform by providing training materials and necessary workshops to the project partners. On the other hand, the evaluation process will also enrich the training materials and course by providing use cases by the end of the project, which will be also available for public download.
# 9. Acronyms and Terms

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<thead>
<tr>
<th>Acronym</th>
<th>Explanation</th>
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<tbody>
<tr>
<td>AEC</td>
<td>Architecture, Engineering and Construction</td>
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<td>BEM</td>
<td>Building Energy Modeling</td>
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<tr>
<td>BIM</td>
<td>Building Information Modelling</td>
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<tr>
<td>CBP</td>
<td>Cross Organisation Business Process development</td>
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<tr>
<td>D4E</td>
<td>Design4Energy</td>
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<td>EeB</td>
<td>Energy Efficient Building</td>
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<td>eeBIM</td>
<td>energy enhanced BIM</td>
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<td>ESS</td>
<td>Exploitation Strategy Seminar</td>
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<td>ICTs</td>
<td>Information and Communications Technology</td>
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<td>IFC</td>
<td>Industry Foundation Classes</td>
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<td>IDM</td>
<td>Information Delivery Manual</td>
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<td>IP</td>
<td>Intellectual Property</td>
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<tr>
<td>KER</td>
<td>Key Exploitable Results</td>
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<td>KPI</td>
<td>Key Performance Indicator</td>
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<td>MDP2</td>
<td>Multidisciplinary Project</td>
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<tr>
<td>MEP</td>
<td>Mechanical, Electrical, and Plumbing</td>
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<tr>
<td>Moodle</td>
<td>Modular Object Oriented Dynamic Learning Environment</td>
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<tr>
<td>O&amp;M</td>
<td>Operation and Maintenance</td>
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<tr>
<td>PUDF</td>
<td>Plan for the Use and Dissemination of Foreground</td>
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<tr>
<td>RES</td>
<td>Renewable Energy Source</td>
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<td>SMEs</td>
<td>Small and Medium-sized Enterprises</td>
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<td>SOBE</td>
<td>the School of the Built Environment</td>
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10. REFERENCES