STATE AGENCY
ON ENERGY EFFICIENCY
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OF UKRAINE



Deliverable D6.1

Teaching Model

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List of Acronyms

Acronym	Meaning
BNES Center	Scientific and educational center for design and research of buildings with close to zero consumption
ECTS	European Credit Transfer and Accumulation System
EE	Energy Efficiency
EED	Energy efficiency directive
EU	European Union
GDP	Gross domestic product
HEI	Higher Education Institution
PJSC	Public Join-Stock Company
RES	Renewable Energy Systems
SDG	Sustainable Development Goal
TPP	Thermal Power Plant
UA	Ukraine

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Executive Summary

The UKRENERGY Teaching Model has been developed within the framework of the Erasmus+ KA2 project to support Ukrainian Higher Education Institutions (HEIs) in establishing master programs aligned with European Union standards and the principles of the Bologna Process.

This model is based on the successful implementation of four new master courses in Ukrainian universities, focusing on energy efficiency in buildings—a critical area for sustainable development and energy transition.

The document provides a structured methodology that can be generalized and adapted by other Ukrainian universities, even in different disciplines. The approach emphasizes compliance with the Bologna Process, which promotes harmonization of degree structures, adoption of a three-cycle system, implementation of the European Credit Transfer and Accumulation System (ECTS), and a shift toward student-centred learning. These principles ensure transparency, comparability, and quality assurance across the European Higher Education Area (EHEA), enabling mobility and international recognition of qualifications.

The UKRENERGY framework consists of four interconnected phases:

1. **Stakeholder Engagement** – Universities collaborate with industry representatives, public authorities, and professional associations to identify labour market needs and define the competencies required for graduates. This participatory approach ensures that programs are relevant, practical, and aligned with employment opportunities.
2. **Development of Program Handbooks** – Based on stakeholder input, comprehensive program handbooks are created to outline learning outcomes, curriculum structure, assessment methods, and quality assurance measures. These documents serve as the foundation for transparent and standardized academic offerings.
3. **Didactical Support** – The model includes re-training of teaching staff, development of innovative teaching materials, and establishment of laboratories to bridge theory and practice. This phase enhances the learning experience and equips students with hands-on skills essential for professional success.
4. **Delivery of Master Courses** – The final phase involves implementing the programs, integrating modern teaching methodologies such as case studies and problem-based learning, and incorporating guest lectures from international experts to strengthen the global dimension of education.

A key feature of the UKRENERGY Teaching Model is its cyclical nature. The framework is designed for continuous improvement, requiring periodic updates to curricula and teaching resources to reflect technological advancements, regulatory changes, and evolving market demands. This iterative process ensures that programs remain dynamic, relevant, and responsive to societal needs.

By adopting this model, Ukrainian universities can achieve several strategic objectives: alignment with European standards, enhancement of graduate employability, promotion of international cooperation, and contribution to national sustainability goals. The UKRENERGY experience demonstrates that collaboration, innovation, and adaptability are essential for building resilient academic programs capable of meeting global challenges.

This document serves as a practical guide for institutions seeking to modernize their educational offerings. It provides actionable recommendations, templates, and best practices

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that can be replicated or adapted across disciplines. Ultimately, the UKRENERGY Teaching Model is not only a blueprint for program development but also a catalyst for transforming higher education in Ukraine toward excellence and international integration.

1. Introduction

Sustainability has emerged as one of the most pressing global challenges, influencing policies, economies, and educational systems worldwide [1]. Among the various dimensions of sustainability, energy efficiency in buildings plays a pivotal role due to its significant impact on energy consumption and carbon emissions. The building sector accounts for a substantial share of global energy use and improving its efficiency is widely recognized as one of the most cost-effective strategies for reducing greenhouse gas emissions and achieving climate targets.

The growing demand for energy, coupled with limited resources, has prompted governments and international organizations to prioritize energy efficiency measures. There is consensus that an enormous potential for energy efficiency is available in the building sector [2]. In the European Union (EU), this priority is reflected in directives such as the Energy Efficiency Directive (EED) and the Energy Performance of Buildings Directive (EPBD), which set ambitious goals for reducing energy consumption and improving building performance. These regulatory frameworks have created a strong need for highly skilled professionals capable of designing, implementing, and managing energy-efficient solutions. **Figure 1** illustrates the targets set for the revised Energy Efficiency Directive.

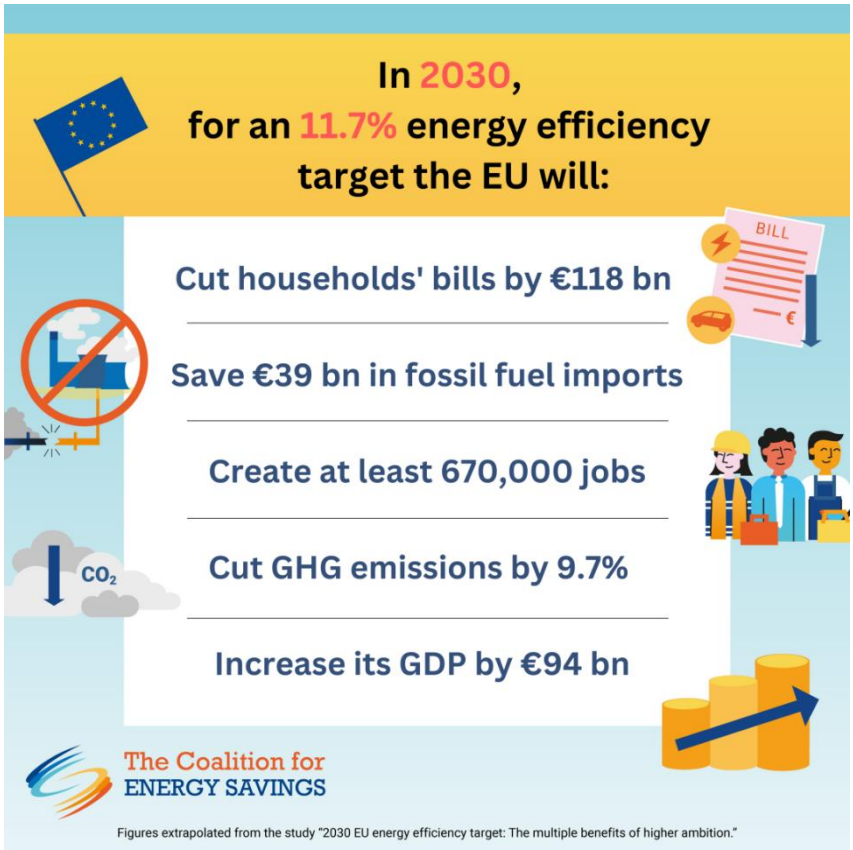

Figure 1. *Goals of the Revised Energy Efficiency Directive (Source: European Commission)*

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Universities play a critical role in meeting this demand by preparing future engineers and specialists equipped with the knowledge and skills required to address complex energy challenges [3, 4]. However, designing effective educational programs in this field is not straightforward [3, 5]. Energy efficiency is inherently multidisciplinary [3, 5], encompassing aspects such as:

- **Building and system design** (architecture, HVAC systems, renewable integration);
- **Energy management and planning** (optimization, monitoring, policy compliance);
- **Economic and environmental analysis** (cost-benefit evaluation, sustainability metrics).

A well-structured master program must strike a balance between theoretical foundations and practical applications, ensuring graduates can operate in diverse contexts and adapt to evolving technologies and regulations. Furthermore, as highlighted by international studies, universities must embrace student-centered approaches, foster stakeholder engagement, and integrate innovative teaching methodologies to remain relevant and competitive in a globalized education market.

The UKRENERGY project, funded under the Erasmus+ Key Action 2 framework, addresses these challenges by supporting Ukrainian Higher Education Institutions (HEIs) in establishing master programs aligned with EU standards and the Bologna Process principles. Through a collaborative effort involving European and Ukrainian partners, UKRENERGY has successfully developed and implemented four new master courses focused on energy efficiency in buildings. These programs not only comply with international quality assurance requirements but also incorporate best practices in curriculum design, stakeholder involvement, and practical training.

This document presents the UKRENERGY Teaching Model, a generalized framework derived from the project's experience. Its purpose is to serve as a reference guide for other Ukrainian universities—and potentially institutions in similar contexts—seeking to design and implement master programs that meet European standards. The model outlines key phases, including stakeholder engagement, program handbook development, didactical support, and course delivery, offering practical tools and templates to facilitate adoption.

By following this model, universities can:

- Align their programs with the **European Higher Education Area (EHEA)** requirements.
- Enhance the employability of graduates through market-driven competencies.
- Promote international cooperation and mobility.
- Contribute to Ukraine's sustainable development goals and energy transition.

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In the following sections, the document provides an overview of the Bologna Process, details the methodological framework applied in UKRENERGY, and offers actionable recommendations for replicating and adapting this approach across disciplines and institutions.

UKRENERGY accomplished the establishment of four new master courses in four different Ukrainian universities, namely Kyiv National University of Construction and Architecture, Ukrainian State University of Science and Technology, Lviv Polytechnic National University, and Odesa State Academy of Civil Engineering and Architecture on the topic of energy efficiency in buildings.

2. Overview of the Bologna Process

The Bologna Process, initiated in 1999 in the city of Bologna, marked a turning point in the history of European higher education. Its primary ambition was to create a unified and coherent European Higher Education Area (EHEA), enabling students and academics to move freely across borders while ensuring that qualifications were recognized and respected throughout Europe. This reform was not merely administrative; it represented a profound cultural shift in how universities conceive and deliver education. The ministries of education of 29 countries met and agreed on five objects:

1. Harmonization of study titles;
2. Adoption of a three-cycle system for the higher education (e.g. bachelor, master, doctoral degrees);
3. Introduction of a credit system;
4. Support for students and professors mobility;
5. Introduction of quality assurance measures of the study courses.

Before its introduction, European higher education systems were highly diverse, making it difficult for students to transfer credits or for employers to understand qualifications obtained abroad. The adoption of a three-cycle system—Bachelor, Master, and Doctorate—provided a common framework that simplified recognition and facilitated mobility. Alongside this structural change, the European Credit Transfer and Accumulation System (ECTS) was introduced to standardize the measurement of student workload and learning outcomes. This innovation allowed students to accumulate credits that could be transferred between institutions, thus promoting flexibility and lifelong learning.

Another fundamental principle of the Bologna Process was the promotion of mobility for both students and academic staff. As pointed out in Fabricius et al. [6], since 1999, a main aim of the Bologna Process has been to improve actual opportunities for mobility for educational purposes in order to promote transnational European higher education in the contiguous European Higher Education Area (see www.ehea.info). According to Watcher [7], the original Bologna declaration represented a sharp break with past practice. It was concerned with a movement

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away from *"convertibility"* between essentially diverse national educational systems toward a *"harmonization drive"* which instead sought to eliminate diversity.

By encouraging exchanges and joint programs, the initiative aimed to foster intercultural understanding and strengthen academic cooperation across Europe. Equally important was the emphasis on quality assurance. The process introduced mechanisms to ensure that programs meet agreed standards, thereby safeguarding the credibility and competitiveness of European higher education globally.

Probably, the most transformative aspect of the Bologna Process was its call for a shift from a staff-centred approach to a student-centred approach. This change requires universities to design curricula around the needs and aspirations of students rather than the convenience of academic staff or institutional traditions.

Programs must clearly articulate learning outcomes, define competencies, and adopt teaching methods that prepare graduates for the realities of the labour market. In this sense, the Bologna Process is not only about structural alignment but also about pedagogical innovation and responsiveness to societal needs.

Figure 2 depicts the main changes introduced by Bologna Process, which can be summarized as a change of paradigm in the design of study courses, from a *"staff centered approach"* to a *"student centered approach"*.

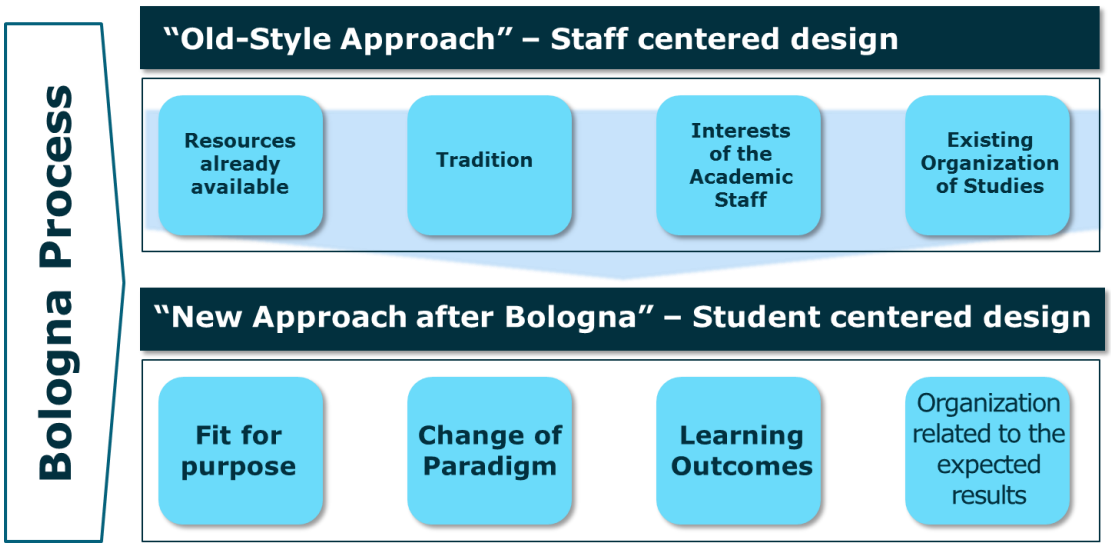

Figure 2*. Main changes introduced by Bologna Process.*

This simple statement implies a change of mindset of academicians in the design of study courses and a re-organization of teaching activities at the universities.

In particular, *"student centered approach"* means that study courses have to be designed and conceived according to the students' needs (e.g. simplicity in finding a job) and not based on

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the interest of the academic staff or on the resources available in the higher education institutions.

This means that for the academic staff a continuous update and interaction with external stakeholders is necessary, in order to keep the courses updated; thus, to satisfy the students' needs.

On the other hand, this also calls for the mobilization of resources by the higher education institutions, who should support this continuous process.

Ukraine joined the European Higher Education Area in 2005, committing to implement these principles. For Ukrainian universities, this alignment is crucial for international recognition, student mobility, and modernization of academic programs. However, the transition involves more than adopting new terminology; it demands a rethinking of curricula, assessment methods, and quality assurance practices. It also calls for stronger engagement with stakeholders to ensure that programs reflect labour market requirements and global trends.

The UKRENERGY project embraces these principles by supporting Ukrainian institutions in developing master programs that comply with Bologna standards. Through its methodology, the project demonstrates how stakeholder engagement, structured program handbooks, and innovative teaching approaches can translate Bologna ideals into practical outcomes. By embedding these principles, the UKRENERGY Teaching Model ensures that new programs are not only academically rigorous but also internationally competitive and relevant to the evolving energy sector.

3. UKRENERGY Framework

The UKRENERGY project adopted a structured framework to guide the development and implementation of new master programs. This framework is organized into four interdependent phases:

1. Stakeholders engagement;
2. Development of program handbooks;
3. Didactical support;
4. Running of the Master Courses.

These phases are interconnected with each other, and each phase plays a critical role in ensuring that the programs are aligned with the principles of the Bologna Process and meet the evolving needs of the labour market.

The process begins with **stakeholder engagement**, which involves identifying and consulting key act12ors such as industry representatives, public authorities, and professional associations. Their input is essential for defining the competencies and skills that graduates must acquire to remain competitive in the job market. This collaborative approach ensures that the curriculum is not only academically rigorous but also practically relevant.

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The second phase focuses on the **development of program handbooks**, which serve as the backbone of the academic offering. These documents translate stakeholder feedback into structured learning outcomes, curriculum design, and assessment strategies, all in compliance with Bologna standards. By clearly defining program objectives and module-level outcomes, the handbooks provide transparency and consistency across the educational process.

The third phase addresses **didactical support**, encompassing the preparation of teaching materials, the re-training of academic staff, and the establishment of laboratory facilities. This step is crucial for bridging the gap between theory and practice, enabling students to gain hands-on experience and apply their knowledge in real-world contexts.

Finally, the framework culminates in the **delivery of the master courses**, where all previous efforts converge to offer a high-quality learning experience. This phase includes classroom teaching, laboratory work, case studies, and guest lectures from international experts, reinforcing the global dimension of the program.

A schematic of the framework is reported in **Figure 3**. It can be observed that it represents a circle, as each couple of years the process must be repeated, in order to update the courses and make them as much as possible close to the needs of the job market, which continuously changes. In fact, every couple of years or when a relevant change/event occurs, it is necessary to update the competences and, therefore, re-calibrate the program handbooks and didactical supports. This is necessary for pursuing a virtuous implementation of the Bologna Process.

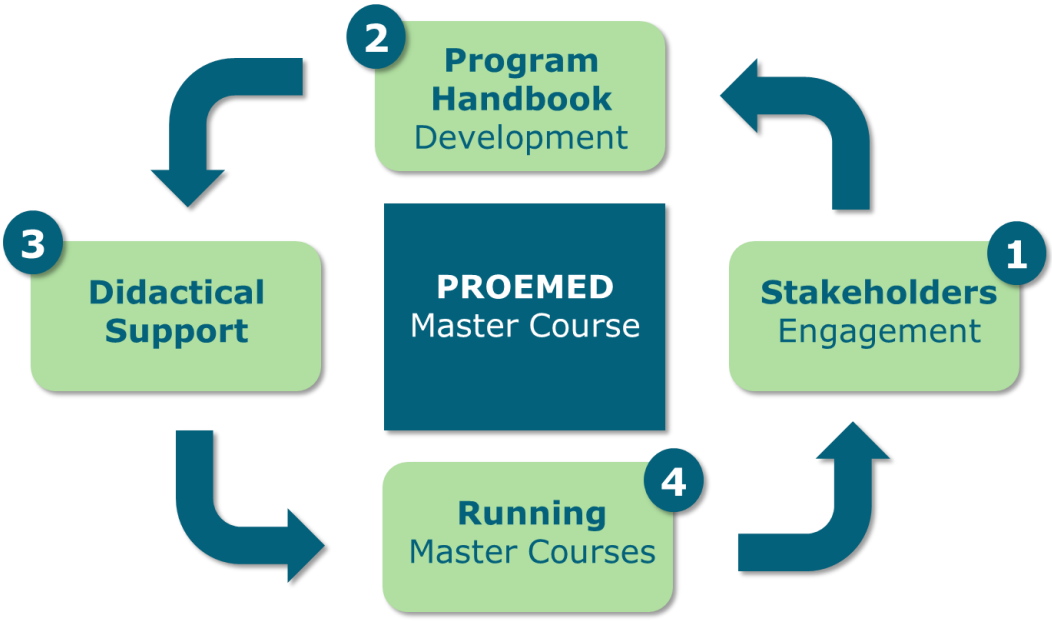

Figure 3. *Schematic of the PROEMED working framework.*

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3.1. Stakeholders' Engagement

Phase 1 is represented by the "Stakeholders Engagement", which means identification, classification and involvement of the stakeholders in the design and development of the master courses. The process can be formal or informal according to the number of parties involved, anyhow UKRENERGY adopted the logical structure reported in **Figure 4** to establish and maintain the relationships with stakeholders.

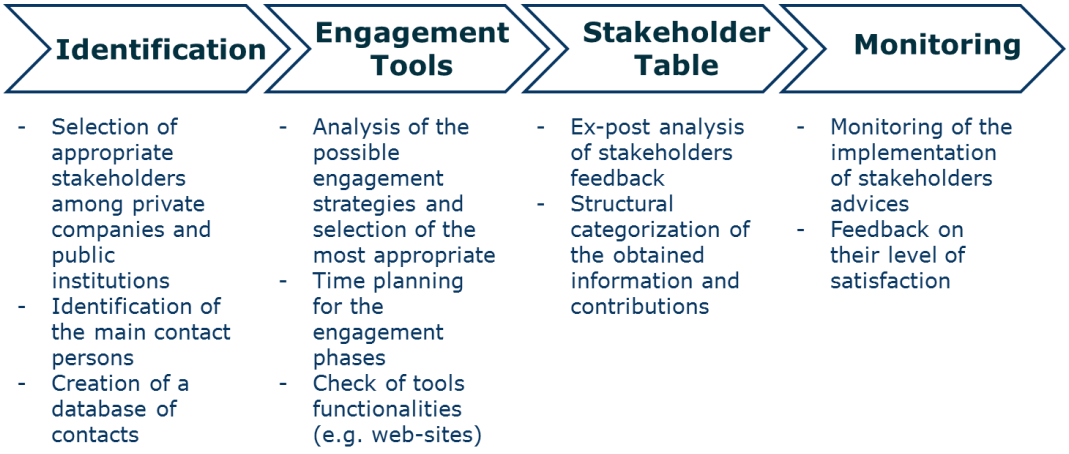

Figure 4. *Logical process for the stakeholders' management.*

Most of the stakeholders are represented by companies and institutions involved all along the buildings value chain, namely design companies, construction companies, energy service companies, technical offices of local authorities, etc.

They represent the expected employers of the graduates from the upcoming master courses; therefore, it is fundamental their involvement for the definition of the expected competences that the future graduates should possess.

According to UKRENERGY framework, stakeholders' engagement has been performed by implementing a twofold strategy, namely organization of *"face to face"* meetings and *"on-line"* consultation. A schematic of the model is reported in **Figure 5**.

"Face to face" meetings have been performed by organizing roundtables with direct interaction among the universities, public institutions and companies, which, in turn, expressed their opinions on the competencies to develop within the master programs.

Such a form of engagement is of fundamental importance in order to stimulate discussions among the parties and to gather "formal" as well as "informal" feedback, which are relevant to obtain detailed qualitative information for the design of the study courses. Furthermore, the organization of open discussions create a climate of cooperation among the involved stakeholders and represent the premise for long standing cooperation.

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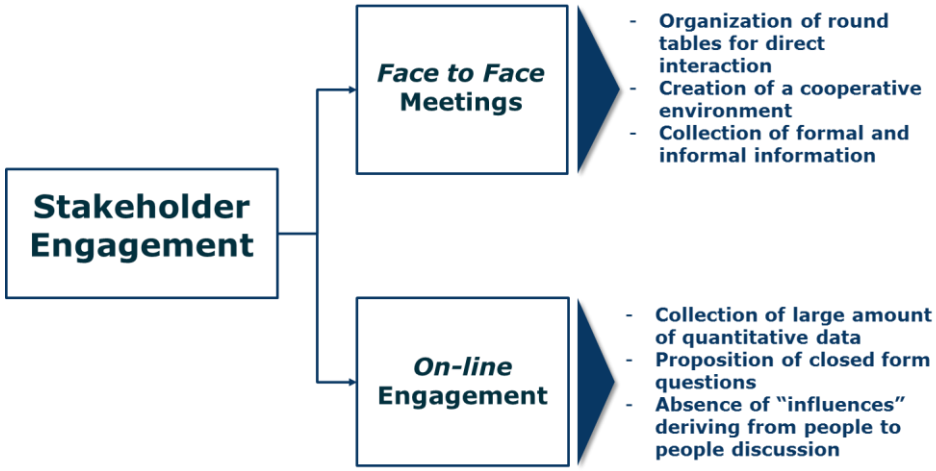

Figure 5. *Strategies for stakeholders' engagement.*

After the meetings, a table can be compiled to categorize the information provided by each stakeholder and to take track of their criticalities and possible further contributions, as shown in **Table 1**.

Table 1. *Example of categorization table for stakeholders' analysis.*

Stakeholder Name	**Contact Person**	**Impact** *How much does PROEMED influence them?*	**Influence** *How much influence do they have on PROEMED?*	**What is important to the stakeholder?**	**How could the stakeholder contribute to PROEMED?**	**Strategy for closer involvement of the stakeholder**
Stakeholder 1	*Example*	*High*	*Medium*	To recruit engineers with financial analysis capabilities	By providing internship to students	Possibility to invite stakeholder's representative to provide seminars

Another level of engagement, more analytical, has been represented by the organization of an online survey with closed form questions, in order to get precise indications on the knowledge to develop.

The proposed questionnaire is divided in two main parts: the first part contains general questions regarding the typology and dimension of the organization answering the questionnaire, whereas the second part includes specific questions aiming at identifying the expected competences that students are supposed to acquire after finishing the master course.

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This information is fundamental as it supports the definition of the learning outcomes and contents of the course and of the corresponding modules. In other words, it contributes to the implementation of the "student centred approach".

Furthermore, based on the meetings results and online consultations, stakeholders are categorized in different categories according to their level of influence and interest regarding UKRENERGY, as shown in **Figure 6**.

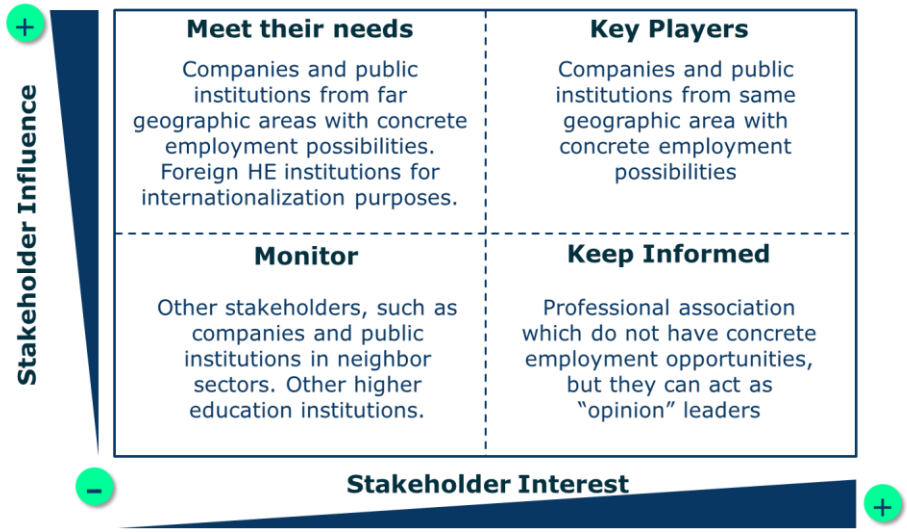

Figure 6. *Categorization of stakeholders according to their influence and interest in UKRENERGY project.*

3.2. Programme Handbooks Development

During this phase the design of the study program is accomplished. This procedure consists in elaborating the input obtained from the stakeholders' engagement phase and framing them in an appropriate academic context by following the prescription of the Bologna Process.

In this phase, the main duties of the academicians are to analyse the competences required by the labour market and to formulate the corresponding learning outcomes which allow to reach the outlined level of competences.

Learning outcomes can be divided in two categories, namely Programme Learning Outcomes (PLOs) and Module Learning Outcomes (MLOs). PLOs are the learning outcomes reached after the successful completion of a study program (e.g. bachelor, master or doctoral program), whereas MLOs are the learning outcomes reached after the successful completion of a single module.

It can be said that the MLOs are the "building blocks" to reach the PLOs. Graduation mark and module mark represent the extent at which PLOs and/or MLOs are achieved (i.e. the level of achievement).

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Learning outcomes, both PLOs and MLOs, must be "SMART", which stands for Specific, Measurable, Achievable, Relevant and Time-Related. These adjectives refer to the following requirements:

- **S**pecific: it is necessary that PLOs/MLOs are contextualized and deeply defined by avoiding general statements.
- **M**easurable: properly detailed in order to favour the understanding of the depth and extent of expected learning and objectively assessable.
- **A**chievable: consistent with the institutional context and the available resources.
- **R**elevant: only the 'key' learning outcomes should be mentioned.
- **T**ime-related: plannable and achievable in the available time.

UKRENERGY has proposed a template for the development of the master courses, which include all the relevant information to consider, in order to be compliant with the Bologna Process. The structure of the UKRENERGY template is provided in **Table 2**.

Table 2. *Structure of the UKRENERGY template for Programme Handbook.*

Section	**Information Contained**
General Information	• Full Name of the study programme • Cycle/Level of the study programme • Type of degree (e.g. joint degree) and duration • Institution(s) participating in the degree • Purpose of the study programme • Disciplines and subject areas • Typology of focus (e.g. general or specialistic) • Orientation (e.g. research or professional oriented) • Teaching and learning approach (e.g. brief explanation of the teaching methodology considered for the program) • Assessment methods (e.g. which are the main assessment methodologies considered and applied) • Distinctive features (e.g. which are the main differences with respect to similar programmes)
Educational needs of the labour market and other stakeholders	• List of organizations consulted as well as methods and schedule of consultation • List of identified educational needs of the labour market • List of identified educational needs of other stakeholders
Educational objectives	• List of the main educational objectives of the programme

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Section	Information Contained
	• List of the main areas in which graduates can find employment
Learning outcomes	• List of the PLOs in general comprised between 15-20 in order to be credible and achievable
Curriculum	• Course table with the corresponding semester, number of credits, etc.
Course Units	• All the relevant information connected with the course units, including MLOs, assessing and teaching methodologies, etc. • It can be provided in form of attachment
Admission, Recognition, Progression and Attestation	• Formulation of the criteria to be admitted to the study programme • Definition of the rules for the recognition of prior learning • To provide the criteria to ensure students' progression (e.g. minimum number or credits necessary to be enrolled in the next year of the course) • To provide the students all the documentation after the completion of their study
Teaching staff	• To provide the list and qualification of the teaching staff involved in the programme • To make available the resumes of the teaching staff
Facilities	• List of the available facilities, namely libraries, laboratories, computer rooms, etc.
Partnership	• List of partner institutions for internship experiences of study exchanges • To make available and transparent the rule of participation in any initiative

The proposed scheme allows to furnish all the relevant information necessary for the development of a new master course.

Together with the framework to develop the main part of the program, also a framework for the description of the single modules has been developed. The teaching modules are seen as the "building blocks" for the realization of the master course. In particular, the PLOs can be seen as the "sum" of the MLOs, which are acquired after finishing a single module. **Table 3** reports the structure of the table for the description of each single module.

During specified interval of time (e.g. every three years) the contents of Programme Handbook should be revised or confirmed according to the changing in the "external" socio-economic

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environment. This can be done through confrontations with stakeholders and/or peer review from external experts.

Table 3. *Structure of the UKRENERGY module description.*

Name	***Module 1***
Year / Semester	*I /1°*
Lecturer	*Name of the Lecturer*
Specific learning outcomes	List of the Module Learning Outcomes
Contents	Detailed contents of the module
Schedule	Schedule of the module
Teaching and learning methods	Indication of the teaching methodology
Teaching techniques	Didactical approaches utilized
Assessment methods	Methods utilized in the assessment
Assessment criteria	Definition of the assessment criteria
Assessment metrics	Metrics utilized to assess the level of achievement of the learning outcomes
Criteria of attribution of the final grade	Criteria utilized in the final evaluation of the module
Preparatory course units	Possible pre-requisite modules
Educational material of reference	List of bibliographic references and study material

3.3. Didactical Support

Phase 3 is related to the development of didactical support for the implementation of master courses. It is divided into three main tasks, namely re-training of local teaching staff, development of teaching material and setting-up of didactical laboratories.

a) Re-training of local teaching staff

As highlighted in [3], it is of fundamental importance to propose approaches to the implementation of energy efficiency measures already in use in other countries and EU is one of the leaders in terms of regulations and implementations of energy efficiency measures, as demonstrated by the emanation of the *Energy Efficiency Directive* and of the *Energy Performance Buildings Directive*. For this reason, it was necessary a re-training of the Ukrainian teaching staff on these topics, so that they can transfer this knowledge to their students.

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On this point it is important to stress the fact that, according to Bologna Process, study courses must be “student centered”, therefore it is fundamental to provide an up-to-date learning experience dealing with the latest trend of the considered subject. In order to do so, it is necessary that the academic staff is always aware regarding the new tendencies, therefore it appears relevant to promote strategic partnerships among EUs and partner institutions in order to enhance the exchange of information. Local ministries could think to support mobility schemes for local lecturers as well as guest-lecturing of foreign professors to develop the skills of the local teaching staff. This process was successfully implemented during the UKRENERGY project.

In particular, Ukrainian junior teaching staff attended an intensive course at Slovak University of Technology (Bratislava), then at University of Genoa focused on Energy Efficiency in Buildings. The course was also supported by the participation of the other EU HEIs partners.

This course was aimed at providing the Ukrainian junior teaching staff advanced knowledge regarding design of study programmes according to EU regulation, broad engineering knowledge (e.g. project management, investment evaluation, etc.), theoretical background to study energy efficiency (e.g. advanced heat transfer, advanced thermodynamics, etc.) and energy efficiency background (e.g. design of heat pumps, evaluation of energy efficiency intervention, energy planning, building physics, etc.).

In this framework the junior teaching staff of partner universities had the opportunity to acquire new knowledge of the subjects, as well as they improved their teaching skills by acquiring new methodologies, in particular the so-called “case study” education.

UKRENERGY project shares the view of Carnegie Mellon University, according to which *case studies bridge the gap between theory and practice and between the academy and the workplace*. *They also give students practice identifying the parameters of a problem, recognizing and articulating positions, evaluating courses of action, and arguing different points of view* [10].

This is particularly true when a multi-disciplinary approach is needed, as is the case of the study of energy efficiency in buildings, which involves the application of engineering knowledge, financial/economic background and regulatory/policy information.

To improve the learning experience, partner universities junior teaching staff was divided in groups and asked to solve a case study under the guidance of a Professor of University of Genoa. On the basis of this they directly appreciated the power of this learning experience. Therefore, in order to improve their teaching experience, the groups were asked to create their own case studies to be proposed to the students of the master courses developed in the framework of UKRENERGY.

Moreover, 24 partner universities junior teaching staff took part in the second stage of the internship, organized by the State Agency on Energy Efficiency and Energy Saving (SAEE).

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The trainees were divided into 9 teams, each of which was given a separate task aimed at developing practical skills in implementing various energy efficiency measures based on existing civil and/or historical buildings in their region.

During the internship, the participants had the opportunity to systematize and deepen their theoretical knowledge of the basic principles of energy efficiency in buildings, including the analysis of the regulatory framework and European standards, to establish cooperation and exchange experiences with specialists from the SAEE, colleagues from other universities and stakeholders.

b) Development of teaching material

Teaching material can support student learning and increase their success. Ideally, the teaching material will be tailored to the content in which they are being used, to the students in whose class they are being used, and the teacher.

According to the UKRENERGY view, teaching aids are to be developed in order to complement the contents which are found in internationally recognized textbooks, as well as they have the aim to provide specific exercises and case studies for home assignments and group works.

Teaching aids are not substitutive of *classic* textbooks, since, according to our view, the consultation of well-structured books supports the development of the critical thinking as well as the synthesis capabilities of students.

On the other hand, when subjects become very specific and narrow, it is difficult to find appropriate textbooks, therefore it is necessary to provide complementary material.

The aim of UKRENERGY teaching aids is to provide complementary notes which can improve the learning experience of the students by proposing up-to-date contents taken from the professional and research experience of academics belonging to the consortium.

c) Setting up of didactical laboratories

The setting up of didactical laboratories represents one of the fundamental milestones of the UKRENERGY project, as the consortium firmly believe that they provide an enhanced learning experience, which supports the bridge between theory and practice. According to Carnegie Mellon University [8], *laboratories provide opportunities for students to learn procedural skills in a setting where they can observe, practice, explore, solve problems and gain mastery through hands-on use of disciplinary tools and techniques. Labs come closer than conventional classroom teaching to replicating a traditional apprenticeship model of learning, in which the instructor models expert practice (through demonstrations), coaches as students practice, and gradually fades his/her own participation to allow students greater and greater independence.*

UKRENERGY laboratories are composed by experimental instrumentations and software applicable to the analysis of issues in the field of energy efficiency in buildings. In particular,

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instruments such as infra-red cameras, special loops for heating/cooling, thermocouples, etc. as well as software facilities such as TRNSYS, EnergyPLUS, etc. are included in the teaching laboratories.

Students will be gradually guided by lecturers in the utilization of these facilities up to the reaching of an independent utilization, for example in the development of their final thesis work.

3.4. Running the Master Courses

In this phase, master courses will be delivered to the enrolled students according to the developed programs. All the didactical supports will be utilized in this phase with the adding of visiting lectures of the EU teaching staff.

In particular, the visiting lecturers allow to enforce the international dimension of the courses, and the local ministries may think to support and to promote such kind of activities in the future.

Furthermore, it must be highlighted that the re-trained junior teaching staff has a main role in supporting the didactical activities, especially with reference to the new teaching methodologies to implement (e.g. case studies education) and to the running of laboratories activities.

4. Impact of the Russian Aggression War

While the UKRENERGY Teaching Model provides a robust framework for aligning Ukrainian higher education with European standards, it is important to recognize that this document does not account for the extraordinary circumstances created by the ongoing war in Ukraine. The conflict has introduced severe disruptions to the educational system, which significantly affect the feasibility of implementing the model in its entirety under current conditions.

One of the most immediate impacts concerns the delivery format of lectures. Due to security risks and displacement, many universities have adopted blended or fully online teaching approaches. Although digital platforms enable continuity of education, they cannot fully replicate the benefits of in-person learning, particularly for programs that require practical training. The establishment and use of didactical laboratories, a cornerstone of the UKRENERGY model, is especially challenging in regions heavily affected by the war. Laboratories demand physical infrastructure, specialized equipment, and stable conditions, resources that are often unavailable in war zone.

Another critical challenge lies in stakeholder engagement and cooperation with industry partners. The war has disrupted economic activity, forcing many companies to scale down operations or relocate. This situation complicates the process of involving employers in curriculum design, organizing internships, and maintaining strong university-industry linkages. These partnerships are essential for ensuring that academic programs remain relevant to labour

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market needs, but they are currently constrained by the instability and uncertainty of the business environment.

The war has also accelerated the phenomenon of ***brain drain***, as a significant number of students, academics, and professionals have been displaced or have left the country. This loss of human capital poses long-term risks for the Ukrainian higher education system, reducing its capacity to deliver high-quality programs and weakening its research and innovation potential. Reversing this trend will require strategic measures to attract talent back to Ukraine once conditions stabilize.

Given these realities, the UKRENERGY Teaching Model cannot be fully implemented under the current circumstances. However, it can be considered a valid support for a post-war recovery. Aligning Ukrainian HEIs with EU standards will position them to offer internationally recognized qualifications and foster academic mobility. For example, the establishment of double-degree programs with European universities could serve as a powerful incentive for displaced students to return, reconnect with their home institutions, and contribute to national reconstruction. Furthermore, the model's emphasis on stakeholder engagement and quality assurance can help rebuild trust between academia and industry, supporting economic recovery.

5. Conclusions

The UKRENERGY Teaching Model represents a comprehensive and adaptable framework for the development of master programs aligned with European standards and the Bologna Process. Its design is rooted in the recognition that higher education must evolve continuously to meet the demands of a rapidly changing labour market, particularly in sectors such as energy efficiency and sustainability.

By synthesizing best practices from European institutions and tailoring them to the Ukrainian context, this model provides a practical roadmap for universities seeking to modernize their curricula and strengthen their international competitiveness.

One of the most significant achievements of the UKRENERGY approach is its emphasis on stakeholder engagement. Involving industry representatives, public authorities, and professional associations ensures that academic programs are not developed in isolation but reflect real-world needs and expectations. This collaborative process fosters trust between universities and employers, enhances graduate employability, and creates opportunities for long-term partnerships in research and innovation. It also reinforces the principle of student-centred learning, which lies at the heart of the Bologna Process.

Equally important is the structured development of program handbooks, which serve as the cornerstone of academic transparency and quality assurance. By clearly defining learning outcomes, competencies, and assessment methods, these documents provide clarity for students, faculty, and external evaluators. They also facilitate mobility and recognition of qualifications within the European Higher Education Area, opening doors for Ukrainian graduates to pursue careers and further studies across Europe.

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The model's focus on didactical support underscores the need to bridge theory and practice. Through the re-training of teaching staff, the creation of innovative teaching materials, and the establishment of laboratories, UKRENERGY ensures that students acquire not only theoretical knowledge but also practical skills essential for professional success. This investment in pedagogical innovation strengthens the capacity of universities to deliver high-quality education and adapt to emerging technologies and methodologies.

Finally, the cyclical nature of the framework guarantees its sustainability. By promoting regular updates to curricula and teaching resources, the model acknowledges that education is a dynamic process. Technological advancements, regulatory changes, and evolving market conditions require universities to remain agile and proactive. The UKRENERGY Teaching Model provides the tools and processes to achieve this, fostering a culture of continuous improvement and responsiveness.

In conclusion, the UKRENERGY project offers more than a set of guidelines; it delivers a vision for the future of higher education in Ukraine. By embracing this model, universities can align with European standards, enhance their international profile, and contribute meaningfully to the country's energy transition and sustainable development goals. The experience gained through UKRENERGY demonstrates that collaboration, innovation, and adaptability are the keys to building resilient and forward-looking academic programs. This teaching model is not only a product of successful implementation but also a catalyst for broader transformation in the Ukrainian higher education system.

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