4.6. ENERGY SAVING PROJECT MANAGEMENT IN CONSTRUCTION AS A MEANS OF IMPROVING THE QUALITY OF PROFESSIONAL TRAINING OF SPECIALISTS

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Legislative acts and regulatory documents governing the formation of professional energy efficiency competence of construction industry specialists for the green recovery of Ukraine have been analysed. It is part of the European Competence Framework (GreenComp). In accordance with this competence framework, the implementation of energy conservation projects will contribute to the creation of conditions for the formation of environmental and energy efficiency competence among construction industry specialists, which will contribute to improving the efficiency of energy use in Ukraine, the rational use of state and local budget funds, and will contribute to increasing the energy independence and energy security of the state. Successful project management of energy conservation in construction as a means of improving the quality of professional training of specialists requires graduates of higher and professional education institutions to have integrated approach skills, where technical, economic, social and environmental aspects are considered as integral parts of a single plan for these projects. Participation in energy conservation projects in construction through the implementation of a flexible, qualified modular approach to the design of curricula and educational programmes contributes to the formation of professional competence in energy efficiency and energy conservation. Energy efficiency projects enable students to acquire practical skills and abilities to apply modern technologies and materials and are an effective means of improving the quality of professional training for specialists in the construction industry.

Keywords: *energy efficiency competence, energy management, energy efficiency standards, green transition*

The Association Agreement with the European Union defines Ukraine's goals and objectives in various areas. In particular, Chapter 23, “Education, Training and Youth”, Article 432 states that in the field of vocational education, Ukraine and the EU aim to develop vocational education and lifelong learning systems that respond to changes in the labour market, as well as creating national mechanisms that would make it possible to improve the recognition of qualifications and competences, using, where possible, the experience of the EU (Verkhovna Rada of Ukraine, 2014).

Green transition training helps learners of all ages to acquire the knowledge, skills and attitudes necessary for a more sustainable future, which manifests itself in changing

consumption and production patterns, adopting healthier lifestyles and contributing, both individually and collectively, to a more sustainable economy and society. It also promotes the development of skills and competences that are increasingly in demand in the labour market and helps to understand the interrelated global challenges that lie ahead – environmental degradation and biodiversity loss. All global challenges have environmental, social, economic and cultural dimensions (Council of the European Union, 2022b).

The green transition also involves energy savings, which leads to a reduction in harmful emissions and lower costs for the implementation of new energy capacities. Thus, the European Commission's report "Clean Energy for All Europeans" of 30 November 2016 proposed a fourth energy package, which envisages increasing the share of electricity production from renewable energy sources to 50% of total production by 2030 (European Commission, 2016). It was proposed with the aim of prioritising energy efficiency, achieving EU global leadership in renewable energy sources and ensuring fair conditions for consumers.

In accordance with the requirements of this energy package, Ukraine has introduced a new Energy Strategy until 2050 (Ministry of Energy of Ukraine, 2023). The document takes into account: the consequences of the Russian Federation's full-scale war against Ukraine (strengthening the role of energy security and the resilience of the energy system); the results of connecting Ukraine's energy system to the European network of operators; the introduction of the latest technologies, global trends and innovative solutions that meet the requirements of environmental safety in accordance with EU standards and Ukraine's international commitments on energy efficiency; the decentralisation of electricity generation throughout the country to improve the stability and reliability of energy supply.

The European Commission's energy package states that buildings account for 40% of total energy consumption. Therefore, developing the energy efficiency expertise of construction industry professionals for Ukraine's green recovery is becoming a strategic priority. This means training construction industry specialists who are competent in the thermal modernisation of buildings and bringing construction standards into line with energy efficiency standards.

Therefore, developing the energy-saving competence of graduates in higher and vocational education institutions in the construction industry is one of the main factors influencing the energy efficiency of the Ukrainian economy. This competence is part of the European Sustainable Development Competence Framework.

In 2022, the European Commission defined the European Competence Framework for Sustainable Development (GreenComp), which includes competencies organised into four areas (Bianchi et al., 2022, p. 2), see Table 4.1.

We will begin the formation of energy-saving competencies among graduates of the institution of pre-higher professional education in the construction industry with an analysis of the educational and professional programme (EPP): "Finishing of buildings and structures and construction design" (Chernivtsi Professional College of Lviv National University of Natural Resources, 2023) of the separate structural unit "Chernivtsi Vocational College of Lviv National University of Natural Resources" compiled in accordance with the "Standard of Vocational Pre-Higher Education (hereinafter referred to as the Standard): educational and professional degree – junior bachelor, field of knowledge 19 "Architecture and Construction", specialty 192 "Construction and Civil Engineering" (Ministry of Education and Science of Ukraine, 2021) and the educational program of vocational education in the profession "Tiler" (Educational content portal for vocational education, 2024) of the municipal vocational education institution "Novovolynsk Centre for Vocational Education" of the Volyn Regional Council, compiled on the basis of the "State Educational Standard" for the profession 7132 "Tiler", approved by Order of the Ministry of Education and Science of Ukraine No. 289 of 8 March 2024 (Ministry of Education and Science of Ukraine, 2024a).

Thus, in the institution of pre-higher professional education, the OPP developed by the working group adds to the competencies included in the Standard the general competency (GC 10) "Implementation of safe activities with protection of the environment. Understanding the need for and adherence to a healthy lifestyle" and special competencies (SC 13) "Ability to apply basic legislative provisions on occupational safety and environmental protection; apply basic methods of life safety and civil protection of production personnel and the population from the possible consequences of accidents, disasters, natural disasters, possession of a culture of safety, environmental awareness" (SK 14) "Knowledge and practical application of resource-saving and energy-saving technologies, alternative and renewable energy sources, understanding of the environmental consequences of one's professional activities". Unfortunately, the programmes of other institutions of higher vocational education in the speciality 192 "Construction and Civil Engineering" hardly take into account the "Energy Strategy of Ukraine for the period up to 2050".

Taking the example of the educational programme for the profession of "Tiler" at the Novovolynsk Centre for Vocational Education, a municipal vocational education institution of the Volyn Regional Council, we see that the Standard includes the key competence (KC6) "Environmental and energy efficiency competence". This

competency is also included in the standards for other professions (bricklayers, carpenters, joiners, etc.) and requires graduates to know: the basics of energy efficiency; regulatory and legal acts in the field of energy conservation; ways to use materials, resources and energy-saving equipment in a energy-efficient manner in professional activities and everyday life; regulatory and legal acts in the field of ecology; the basics of rational use, reproduction and conservation of natural resources; ways to preserve and protect the environment in professional activities and everyday life; modern eco-friendly building materials and ways to recycle and process construction waste, as well as be able to: use energy resources and consumables wisely in their professional and personal lives; use energy-efficient equipment and follow environmental standards in their professional and personal lives.

The Ministry of Education and Science of Ukraine is integrating the topic of energy efficiency into the school curriculum. This project is part of a broader initiative to introduce the topic of green energy into education as part of the LEARN project (Ministry of Education and Science of Ukraine, 2024b). There are plans to develop teaching modules and integrate them into the curriculum. The integration of the topic will not create an additional workload, but will offer materials for relevant topics in the curriculum to make them more relevant. Such integration is also recommended for the model curricula “Exploring Nature”, STEM, “Environment”, “Technology”, “Natural Sciences”, “Entrepreneurship and Financial Literacy”, and “Economics” (Shelimanova et al., 2025).

That is, applicants to higher education institutions with basic secondary education (while completing a two-year specialised secondary education programme) will additionally study energy efficiency and alternative energy sources in buildings. In addition, compulsory educational components that form general competencies (OK 7) through the study of the academic discipline “Ecology and Environmental Protection”.

Those seeking to become “Tilers” with basic secondary education receive a complete general secondary education in vocational education institutions and, accordingly, study educational modules on energy conservation, which are integrated into the curriculum for grades 10–11. In addition, the subject “Fundamentals of Energy Efficiency and Ecology” is studied as part of general vocational training, and interested graduates can develop additional competence by studying the subject “Advanced Systems for Thermal Modernisation of Buildings and Structures”.

Teaching young people about energy efficiency and energy conservation in pre-higher and vocational education institutions in the construction industry requires an interdisciplinary approach and interdisciplinary coordination. Currently, there is an

urgent need to make disciplines related to the interaction between society and the natural environment more environmentally friendly. This focus (educational modules on energy efficiency) needs to be strengthened in the study of educational disciplines, not only in compulsory educational components that form general competencies, but also in compulsory educational components that form special competencies, selective educational components and practical training in pre-higher vocational education institutions, as well as subjects of general professional training and professional-theoretical training and professional-practical training in vocational education institutions.

Thus, the environmental and energy efficiency competence of future builders is the key to creating energy-efficient, environmentally safe and modern buildings. Its formation should become an integral part of the educational process in vocational education institutions in the construction industry (Gerliand et al., 2025, p. 14).

According to the National Standard of Ukraine in the field of energy management DSTU ISO 50001:2020 (ISO 50001:2018, IDT), energy efficiency is a ratio (coefficient) or other quantitative relationship between the obtained performance indicator, i.e. between the work performed, services rendered, goods produced or energy generated, and the input indicator, i.e. the level of energy consumption (Ukrainian Scientific Research and Training Center for Standardization Certification and Quality, 2020).

Project management of energy conservation in construction is one of the effective means of improving the quality of professional training of specialists. This is the case with the project "Promoting Energy Efficiency and Implementing the EU Energy Efficiency Directive in Ukraine", which was implemented in Ukraine by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH on behalf of the German and Swiss governments. This project was implemented with financial support from Germany (€7.3 million) and Switzerland (€5.15 million), lasted five years (July 2020 – June 2025) and had the following components (GIZ, 2025):

- Energy efficiency reform component in Ukraine;
- Energy efficiency component in communities;
- Vocational training component;
- Energy efficiency consulting for businesses.

As we can see, the third component deals with qualifications and vocational training in the energy efficiency sector and bridges the gap between the needs of the private sector and labour market demand.

This means that specialists and students have broad access to qualifications in the field of energy efficiency, namely:

- the development of competencies provided for in the Green Deal;
- raising awareness of energy efficiency among various groups of young people, with a focus on students of vocational education institutions (VEIs), and especially on women and girls.
- creating an innovative space for learning, research and dynamic solutions in the field of energy efficiency, and building the capacity of educational institutions.

Energy Innovation Hubs have been established at three Ukrainian universities, equipped for practical training in energy efficiency and integrated into the university structures. These centres serve as places where schoolchildren, vocational school students and university students learn about energy efficiency, familiarise themselves with and test modern equipment and materials.

A course on "Supervision of Construction Works" has been developed, accredited by the Dnipro State Academy of Civil Engineering and Architecture, and included in the master's programme of the O.M. Beketov National University of Urban Economy in Kharkiv.

Training of junior bachelors competent in the basics of energy conservation management in construction is carried out under the educational programme "Engineering Systems and Energy Conservation of Buildings and Structures" of the Kyiv Professional College of Architecture, Construction and Management in the speciality G 19 "Construction and Civil Engineering". Thus, graduates acquire special competence SK 10 – "Understanding of technological processes during the construction, finishing, operation, repair and reconstruction of construction objects and engineering networks in compliance with occupational health and safety and environmental protection requirements", and in the learning outcomes RN 23, graduates must "Be able to effectively solve tasks and complex problems in the field of heat and gas supply, climate systems and energy conservation by applying knowledge on the use of renewable and non-traditional energy sources, the organisation of rational energy accounting and automated control of heating, ventilation and air conditioning systems to ensure optimal climatic conditions in premises".

The formation of special competence SC 10 is carried out through the study of academic disciplines that form both general and special competences: "Environmental monitoring and methods of biosphere protection", "Heating of buildings and their energy efficiency" and "Energy conservation of buildings and structures". In addition, at the discretion of the applicant for higher professional education, the academic disciplines "Use of Renewable Energy Sources" and "Management and Marketing" can be studied from the selective educational components of the OOP. A junior bachelor's degree in

construction and civil engineering provides the opportunity to continue studying for a higher education degree and take the course “Supervision of Construction Works” (Kyiv Professional College of Architecture Construction and Management, 2025).

Promotion of vocational education professions among women and girls through events such as Energy Days and Job Fairs.

Based on the results of a comprehensive study entitled “Involvement of women, girls and vulnerable groups in the energy-efficient restoration of Ukraine”, conducted in January–February 2025, the results of two surveys (3,995 and 211 women and girls, respectively) and a series of focus group studies (50 people) were summarised to identify the key factors influencing women's willingness to choose construction or technical specialities in the field of energy efficiency, the main barriers to their involvement, and the motivational factors influencing their choice. Recommendations were made to the Ministry of Education and Science of Ukraine, higher and vocational education institutions, local state (military) administrations, local self-government bodies, businesses and non-governmental organisations on improving the involvement of women and girls in training, upgrading their skills and expanding their participation in the field of energy-efficient reconstruction of Ukraine (Hubeladze et al., 2025).

Seventeen partner vocational education schools have been selected to receive technical support for the pilot implementation of four short-term training programmes, training for teachers, and cooperation with potential employers.

It is particularly important to focus on the aspect of training for teachers. They not only create an innovative space for learning, research and dynamic solutions in the field of energy efficiency, but also undergo practical training in energy conservation project management in construction. Thus, based on the results of the research conducted by our department, we identified the main pedagogical conditions that can effectively influence the development of energy efficiency competence in future construction industry specialists, namely: “The availability of teachers who possess energy efficiency competence and the improvement of their qualifications in the field of energy efficiency technologies”; “The use of active teaching methods (project-based learning, case studies, etc.) to develop energy efficiency competence”; “The creation of an appropriate creative educational environment that will influence the development of energy efficiency competence in students” (Kalenkyi, 2025).

In autumn 2022, vocational education institutions were given a unique opportunity to participate in a new project: “Energy-efficient educational institution. Thermal modernisation of vocational education institutions within the framework of developed energy efficiency courses”, which is being implemented by the Charity Fund Human in

cooperation with the Ministry of Education and Science of Ukraine and GIZ. Among the five winners of the competitive selection was the Zaporizhzhia Higher Vocational School. As part of the project, educational programmes were developed and approved at the college for short-term programmes to provide partial professional qualifications in "Window and Door Installation" and "Advanced Thermal Modernisation Systems for Buildings and Structures" (Department of Education and Science of the Zaporizhzhia Regional State Administration, 2023).

Thanks to the project "Just Transition of Coal Regions and Green Recovery of the Energy Sector in Ukraine" implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH on behalf of the German Federal Ministry for Economic Affairs and Energy, a Renewable Energy Centre has been established at the Chervonohrad Professional Mining and Construction Lyceum. The centre has launched the first solar panel installer training programme in the Lviv region. In the context of the energy crisis caused by the war, such initiatives contribute to energy security, integration into the European space and the just transition of coal regions. For the pilot Lviv region and the Chervonohrad micro-region, action plans are being developed and implemented, the main points of which are energy transformation and sustainable economic development, which involves professional retraining measures taking into account the needs of the local labour market, as well as "green" educational programmes for vocational education institutions. For example, about 300 people have completed vocational training and advanced training courses, of which about 50 have been trained in renewable energy at a vocational school. In addition, a concept for the creation of an industrial park has been developed, which is expected to create more than 3,000 jobs (GIZ, 2024).

Thus, participation in energy efficiency projects in construction through the implementation of a flexible, qualified, modular approach to the design of curricula and educational programmes contributes to the development of professional competence in energy efficiency and energy conservation. Energy efficiency projects enable students to acquire practical skills and abilities to apply modern technologies and materials and are an effective means of improving the quality of professional training for specialists. This requires graduates of higher and vocational education institutions to have skills in an integrated approach, where technical, economic, social and environmental aspects are considered as integral parts of a single plan for these projects.