

ПРАКТИКА МІЖНАРОДНОГО СПІВРОБІТНИЦТВА

UDC 378:620.9

TITENKO G., KULYK M., UTKINA K.,

V. N. Karazin Kharkiv National University, Ukraine
titenko555@gmail.com mikkulik@mail.ru kate.utkina@mail.ru

STYLES P., WRIGHT J.L., WESTWOOD R.

Keele University, United Kingdom
p.styles@keele.ac.uk j.l.wright@keele.ac.uk
r.f.westwood@keele.ac.uk

ACADEMIC DISCIPLINE «ALTERNATIVE ENERGY»: A TUTORIAL ASPECT

The necessity to update academic discipline contents taking into account international experience is shown. At the School of Ecology in the framework of British Council project «Alternative Energy: Education and Science» (implemented together with Keele University, UK) the course «Alternative Energy» was updated: new topics were included, new methods of teaching were introduced. The content of the course is presented in details. Due to up-dating students receive new competencies which allow them to solve complex problems and to be more competitive on the labour market.

Key words: energy resources, alternative energy, energy potential, competencies

Тітенко Г., Кулик М., Уткіна К, Стайліз П., Райт Дж. Л., Вествуд Р. НАВЧАЛЬНА ДИСЦИПЛІНА «АЛЬТЕРНАТИВНА ЕНЕРГЕТИКА»: МЕТОДИЧНИЙ АСПЕКТ

Показано необхідність постійного оновлення навчальних дисциплін з врахуванням новітніх наукових досягнень. На екологічному факультеті в рамках проекту Британської Ради «Alternative Energy: Education and Science» («Альтернативна енергія: освіта та наука»), який було реалізовано спільно з британськими колегами із Кільського університету, оновлено зміст дисципліни «Альтернативна енергетика». Переглянуто та оновлено перелік компетентностей та методів викладання. Базуючись на закордонному досвіді, в дисципліну «Альтернативна енергетика» включено теми, які присвячені наступним аспектам: нетрадиційні джерела енергії, зокрема сланцевий газ, метан з вугільних пластів, а також вплив вітроенергетичних установок на довкілля, методи стимулювання розвитку нетрадиційної та відновлюваної енергетики та роль державної підтримки. У процес викладання запроваджено метод кейс-стаді.

Наразі навчальна дисципліна «Альтернативна енергетика» дозволяє студентам отримати нові компетентності, які допомагають приймати обґрунтовані управлінські рішення на локальному та регіональному рівнях, а також приймати ефективні рішення у сфері екологічного менеджменту й екологічної політики.

Ключові слова: енергетичні ресурси, альтернативна енергетика, енергетичний потенціал, компетентності

Титенко А., Кулик М., Уткина Е, Стайлиз П., Райт Дж. Л., Вествуд Р. УЧЕБНАЯ ДИСЦИПЛИНА «АЛЬТЕРНАТИВНАЯ ЭНЕРГЕТИКА»: МЕТОДИЧЕСКИЙ АСПЕКТ

Показана необходимость постоянного обновления учебных дисциплин с учетом новейших научных достижений. На экологическом факультете в рамках проекта Британского Совета «Alternative Energy: Education and Science» («Альтернативная энергия: образование и наука»), который реализовывался совместно с британскими коллегами из Кильского университета, обновлено содержание дисциплины «Альтернативная энергетика». Пересмотрены и обновлены перечень компетенций и методов преподавания. Основываясь на зарубежном опыте, в дисциплину «Альтернативная энергетика» включены темы, посвященные таким аспектам: нетрадиционные источники энергии, в частности сланцевым газ, метан из угольных пластов, а также влияние ветроэнергетических установок на окружающую среду, методы стимулирования развития нетрадиционной и возобновляемой энергетики и роль государственной поддержки. В процесс преподавания введен метод кейс-стади.

Сейчас учебная дисциплина «Альтернативная энергетика» позволяет студентам получить новые компетентности, которые дают возможность принимать обоснованные управленческие решения на локальном и региональном уровнях, а также принимать эффективные решения в сфере экологического менеджмента и экологической политики.

Ключевые слова: энергетические ресурсы, альтернативная энергетика, энергетический потенциал, компетентности

The level of energetics development has a decisive impact on the economy in the state, problem solving in social life and living standards of the society. The world economy must consume more and more energy for its development. At present in Ukraine and in the world, most energy requirements are met at the expense of fossil fuels, although the share of renewable energy sources is steadily growing. The impact of energy facilities on the environmental pollution is huge and generates global environmental problems. A world challenge is to increase the share of renewable energy sources, what is an important factor in increasing energy security and reducing human-made energy impact on the environment. For Ukraine, to increase the use of alternative energy sources is of particular importance. Therefore, there is a need for training specialists of environmental profile, who have knowledge about the state and prospects for development of fuel-and-power complex, traditional and alternative energy sources, which requires the inclusion of new courses combining the problems of power engineering, environmental sciences, economics and management [1-3] to the curriculum.

The main route of improving the quality of higher education is the formation of the modern outlook of the future professional in the light of competency-based approach by the processes of integration into the European higher education area (the Bologna process), where the formation of competencies and systems thinking is regarded as one of the main goals of training [2, 3], play an important role in this. Over recent years, the use of competency-based and multidisciplinary approaches becomes a standard practice in the training of environmental specialists in the higher education institutions of Ukraine.

Teachers of the School of Ecology, V. N. Karazin Kharkiv National University, respond according to the challenges of modern society and constantly update as the curriculum as well as syllabi and contents of the subjects within the curriculum. Among the disciplines that require constant updates and dynamic changes in their meanings there is «Alternative Energy», the content and structure of which are constantly changing. In particular, the content of this course has been updated under «Regional Seminar for Excellence in Teaching» (ReSET) Project [4] and during the implementation of «Alternative Energy: Education and Science» project (their results are partly set

forth in [5]), which has been funded by the British Council.

«Alternative Energy» is taught in a volume of 3 ECTS for 4-year students, education and qualification level of Bachelor, studying in the direction of «Ecology, Environmental Protection and Environmental Resource Management». The purpose of this discipline is to systematize general knowledge on the structure of energetics and trends in its development, technology, specific operating characteristics of traditional and alternative power energetic facilities, advantages and disadvantages of their use, and distribution of energy potential around the world.

The objective of this discipline is to develop theoretical knowledge and practical competencies in students regarding the use of power systems of traditional and alternative energy.

The results of learning «Alternative Energy» is knowledge of the basic concepts of the discipline, the structure and current state of the fuel and energy complex of Ukraine, the main types of energy sources and their potential resources, quantitative and qualitative characteristics of each energy source, the distribution of energy potential of various sources of energy around the world, operating principles, basic equipment units of thermal power plants and those, which use renewable and non-renewable energy sources, environmental problems associated with operation of all the above-mentioned energy facilities and ways to improve efficiency of their equipment [5– 9].

At Keele University (UK) for students enrolled in the Master's Programme «Environmental Sustainability and Green Technology» a number of subjects that are directly related to energy has been offered, at this such disciplines like «Clean & Green Technologies I: Power from above the Earth» and «Clean & Green Technologies II: Power from beneath the Earth» are the most relevant to the realities of the Ukrainian market and, respectively, to form specialists with the current level of professional competence.

After attending the former discipline, «Clean & Green Technologies I: Power from above the Earth», students receive 15 ECTS. In this module, students learn the range of technologies used for renewable energy sources, namely wind energy, solar energy (thermal and photovoltaic), the energy of sea tides, bio-energy, hydrogen energy and others [10].

Discipline «Clean & Green Technologies II: Power from beneath the Earth» gives

the student the opportunity to get 15 ECTS. Within this course students learn the range of technologies used and energy sources, which are found in the interior of the Earth. These are most of the so called traditional energy resources, but also alternative and renewable sources such as shale gas, methane from coal seams, geothermal energy, heat pumps and others are considered [7].

As in the first and as in the second case the special emphasis is made on the technological problems of their use, as well as their distribution and volume, the economic efficiency of their use at present and the problems how to stimulate the development of these technologies, possible scenarios of their development and their environmental performance.

Taking into account the experience of our British colleagues, we have introduced new topics and improved issues relating to alternative energy sources, including shale gas, methane from coal seams, and the impact of wind turbines on the environment and methods of stimulating the development of alternative and renewable energy and the role of government support to the content of discipline «Alternative Energy» [7, 10, 11].

The content and structure of the revised discipline are detailed below.

Module 1. Power in the Contemporary World

1.1. Power industry: peculiarities of its development and its place in the economic structure of the state.

The role of energy in the development of civilization. The historical review and current state of energy usage. Basic concepts: energetics (power), energy systems and power supply, power units. Energy consumption as a criterion for the level of development and prosperity of society.

1.2. Fuel and Energy Complex

The main types of fossil fuels. The structure of primary energy resources. World energy use. Energy resources of Ukraine: annual production and demand. Fuel industry. The main types of power plants. Power generating capacities.

1.3. Thermal Power Plants.

Arrangement of thermal power plants (TPP). Process regularities in generating environmentally harmful substances when burning fuel. TPP interaction with the environment.

1.4. Nuclear Power Plants.

Arrangement of nuclear power plants (NPP). NPP interaction with the environment.

Workshop «End of oil civilization»

Group assignments : students are divided on several teams. Each team chooses an energy station (based on renewable energy sources) and the hazardous impact of power-generating station, and the Life Cycle of power-generating units. A case study method will be utilized.

Module 2. Renewable and Alternative Sources of Energy.

2.1. Renewable sources of energy.

General quantitative indicators of alternative and renewable energy sources in Ukraine and in the world. The classification of renewable energy sources.

2.2. Hydraulic Power Plants.

Electricity generation in hydraulic power plants (HPP). HPP interaction with the environment. Small hydropower plants. The energy of the seas and oceans.

2.3. Helioenergy.

Getting heat through direct absorption of solar radiation. Direct conversion of solar energy into electricity.

2.4. Wind-Power Engineering.

The characteristics of wind and foundations of wind energy. The operating principle and the classification of wind turbines. Environmental problems and WPPs.

2.5. Biomass Energy.

The classification of biomass resources. The classification of methods of biomass recycling. The classification of products that can be derived from the recycling of biomass and their main energy characteristics. The distribution of the energy potential of biomass in the world and in Ukraine. The use of biomass products as motor fuels: ethanol and methanol, canola oil.

2.6. Geothermal Energy.

The classification of geothermal resources. Main characteristics and specific energy performance. The distribution of their energy potential in the world and in Ukraine. Methods and tools for converting geothermal energy. Combined geothermal & thermal power plant. The state and prospects for development of geothermal energy.

2.7. Ambient Energy.

Methods and tools to develop ambient energy. The calculation of the energy potential of the environment. Efficiency and prospects for use heat pumps to recover ambient energy in Ukraine. The state and prospects for development of ambient energy.

2.8. Hydrogen Energy.

Methods for obtaining hydrogen as a primary source of renewable energy. Methods

of hydrogen energy conversion into electricity and heat. The use of hydrogen as a motor fuel.

2.9. Alternative Energy Sources.

The classification of alternative energy sources. Off-balance and secondary energy sources. Their volumes and origin.

2.10. Legislative and Regulatory Framework of Alternative and Renewable Energy.

Methods of stimulating the development of alternative and renewable energy. The role of government support in the development of alternative and renewable energy.

Module 3. The Energy Potential of Regions of Ukraine.

3.1. The structure of the energy potential of fossil fuels.

3.2. The structure of the energy potential of renewable and alternative energy sources.

Workshop: «Optimisation of the energy situation of the region».

The workshop will be carried out as a business game. Students are divided in several groups. Each group represents different stakeholders and their interests. The aim of the game is to identify conflicts of interests and to simulate the decision-making process, and to find solutions that satisfy all stakeholders.

In addition to improving the content of the course, teaching methods were also revised. In particular, at present in class for better learning by students, the following teaching methods are employed:

- seminars and colloquia;
- work in groups (teamwork);
- case-study.

One of the promising methods used in the innovative education and training is the contextual approach in teaching, when the motivation to assimilate knowledge is achieved by building up relationships between specific knowledge and its application [4, 12–14]. The case method (or *the method of concrete/specific situations, the method of situation analysis* in Russian-language literature) is a modern teaching approach using the description of real economic, social, technological and business situations. The trainees should investigate the situation, to understand the essence of the problem, to propose possible solutions and choose the best of them. The case is based on the real factual material or brought closer to the real situations.

No less important is the study based on the experience, when students have the opportunity to associate their own experience with the subject of study [14].

The task-oriented approach to teaching allows students to focus on the analysis and resolution of any particular problem situation that becomes the starting point in the learning process. Sometimes it is important not only to solve the problem but to set up and formulate it correctly. The problem situation motivates students most to a conscious acquiring of knowledge needed to solve it [14].

In the training process the project-based approach designed to organise work in a team is of particular importance in the innovative education. At that conditions virtually identical to real activity are exerted, which allow students to gain experience in solving complex tasks in projecting with the distribution of roles and responsibilities between members of the team [13, 14].

As long as a modern trend of education is the distance learning (e-learning), materials for studying discipline «Alternative Energy» will be prepared and placed in a package of Moodle system. According to the existing requirements [Requirements to the Distance Learning Course approved by Order No. 0206-1/423 as of 12.12.2013, the Ministry of Education and Science of Ukraine], an e-learning course will include the following components:

1. Information and guidance part (title page, abstract, syllabus, the scenario of going on e-learning course, evaluation model, glossary, forum, chat, the list of literature);

2. The course content (texts of lectures, presentations, requirements concerning the execution of practical/laboratory works, themes of essays, test controls, video and audio recordings *etc.*).

Separately we dwell on electronic tests as a modern instrument for testing the knowledge of students. The electronic tests consist of the following types of questions:

- general questions (with yes/no answers);
- questions with multivariate responses (the student selects one or more correct answers from the proposed list);
- open questions, or questions like «enter the correct answer» (the student must insert one or several words);
- open-ended questions (the student must write a detailed response).

For teachers, electronic tests certainly facilitate their work because the program will check tests (except open-ended questions, the teachers check them on their own) and immediately rate them. Also, electronic test control allows the teacher without wasting time to

question all the students in all sections of the course and using the sums of their points to rank their results. Electronic tests attract students by their unusualness compared with the traditional forms of control, encourage the systematic studies on the subject giving rise to additional motivation for training.

Electronic control tests guarantee objectivity, show test results immediately and provide an opportunity to analyse wrong answers. The electronic testing allows to make changes in the nature of control of the level of learning and provide with flexible process management of student education. Using a computer during the test one can check all answers of each student and, in many cases, not only to fix the error, but also accurately determine its character.

However, the electronic testing has some drawbacks. Thus, the main drawback of electronic testing is formality, the strict boundaries and forms of questions, and lack of contact with the teacher. The shortcoming of questions such as «enter the correct answer» is their sensitivity to spelling, grammatical and semantic flaws. The electronic tests can only be employed in cases, when there is only one correct answer, since creative questions can not be formalized.

Among general requirements for the properties and qualities of the graduates of higher education institutions as social individuals, the list of competencies to address specific problems and tasks of social activity, instrumental, general scientific and professional competences in the field of alternative energy are of considerable importance. That is what allows to form the specialist «at the output». Such a specialist will be capable of effectively performing productive functions (doing certain types of activities) and solve typical tasks of professional activities within his/her competence for these functions.

During steps of studying the discipline the competencies of students take their shapes. These competences include: to be familiar with standard terminology that is utilised to define the key concepts of the discipline; to classify

types of alternative and renewable energy sources; to evaluate the role of traditional and alternative energy sources; to assess the benefits of alternative methods of obtaining energy products compared to traditional ones; to evaluate the overall energy performance of alternative energy sources; to assess the advantages and disadvantages of various methods of energy conversion; to estimate the fuel-and-energy potential of alternative energy sources, i.e. general, technically achievable and economically feasible potentials; to size up the impact that occurs in the use of each energy source on the environment; to use scientific, technical, and reference literature and to have skills to find necessary information in libraries and with the aid of the Internet [5, 8, 9, 12].

We believe that owing to these improvements the following topical professional competences can be formed in students majoring in environmental sciences:

- the ability to utilise modern energy-saving technologies in the field of environmental protection;
- the ability to detect trends in the state of the environment and its components, which are caused by the operation of facilities of the traditional and alternative energetics;
- the ability to take part in the energy audit of facilities used for economic activities followed by corrections in their environmental and energy activities;
- the ability to organize and carry out comprehensive energy saving measures at different facilities, sites and areas within the environmental impact assessment, or other forms of environmental control;
- the ability to use knowledge of the characteristics and consequences of functioning the facilities of alternative energetics to justify management decisions at the local and regional levels;
- the ability to make effective decisions in the field of environmental management and environmental policy allowing for the use of various renewable energy technologies.

Conclusions

At present an important issue in higher education is the on-going renewal of subjects taking into account the latest scientific achievements. Being guided by this principle, in 2014, within the British Council project «Alternative Energy: Education and Science» the Department of Environmental Sciences updated the content of discipline «Alternative

Energy». In cooperation with British colleagues from Keele University, the contents of disciplines, in the frameworks of which various aspects of alternative and renewable energetics are considered, and the lists of competencies and teaching methods were compared.

Based on wide international experience, topics that focus on: alternative energy

sources, including shale gas, methane from coal seams, and the impact of wind turbines on the environment, methods of stimulating the development of alternative and renewable energy and the role of government support were included in the discipline “Alternative Energy”, which is taught to 4-year students of the Department of Environmental Sciences. Also, there have been expanded and revised content for practical work. Due to materials obtained and involved in the process of teaching, the case study mix was expanded.

Thus, the improvement of the course enables students to acquire new competencies for energy saving features and effects and consequences of the functioning of alternative energy that will allow to make informed management decisions at the local and regional level, to make effective decisions in the field of environmental management and environmental policies that will help to future professionals to be competitive in the labour market in Ukraine and abroad.

References

1. Chevallier T. Higher education and its clients: Institutional responses to changes in demand and in environment./ Higher Education. – 2002. – Vol. 33. – P. 303-308.
2. Philip Jennings New directions in renewable energy education / Renewable Energy. Volume 34, Issue 2, February 2009, Pages 435–439 (<http://www.sciencedirect.com/science/article/pii/S0960148108002115>)
3. Bhattacharya S. C. Renewable energy education at the university level / Renewable Energy. Volume 22, Issues 1–3, January–March 2001, Pages 91–97 (<http://www.sciencedirect.com/science/article/pii/S0960148100000112>)
4. Governance of Global Environmental Change: Towards a multidisciplinary discussion in tertiary environmental education (a short description of the ReSET seminar). URL: <http://reset.qualimet.net/mod/forum/discuss.php?d=3>
5. Кулик М. І. Методичні аспекти розробки дисципліни «Renewable Energy Governance» // Проблеми сучасної освіти: збірник науково-методичних праць. – Харків: ХНУ імені В.Н. Каразіна, 2013. – Вип. 4. – С. 183 – 187.
6. Luke T. W. Education, environment and sustainability: what are the issues, where to intervene, what must be done? // Education Philosophy and Theory. 2001. – Vol. 22. – No. 2 – P. 187-201.
7. Master of Science «Environmental Sustainability and Green Technology». Course Handbook. – Keele University. – Електронний ресурс. Режим доступу: <http://www.keele.ac.uk/regulations/>
8. Варламов Г. Б. Теплоенергетика та екологія / Г. Б. Варламов, Г.М. Любчик, В. А. Малярченко. – Х.: Видавництво САГА, 2008. – 234 с.
9. Ігнатюк О. А. Модернізація змісту дисципліни «Основи управління в енергетиці» у фаховій підготовці енергетиків-менеджерів / О. А. Ігнатюк. // Теорія і практика управління соціальними системами. – 2011. – №2. – С. 66 – 75.
10. Styles P., Westwood R., Toon S. 2012. Low Frequency Vibrations Generated by Wind Turbine Farms: Their effect on the CTBTO IMS station at Eskdalemuir, Scotland. EAGE. Електронний ресурс. Режим доступу: <http://www.earthdoc.org/publication/publicationdetails/?publication=61876>
11. Westwood R., Toon S., Styles P. 2011. Studies of Vibrations from Wind Turbines in the Vicinity of the Eskdalemuir (AS104) IMS Station. Vienna: CTBTO. Електронний ресурс. Режим доступу: <http://www.ctbto.org/specials/ctbt-science-and-technology-20118-10-june-2011-vienna-austria/ctbt-science-and-technology-2011/>
12. Копыльцова С.Е. Опыт разработки и внедрения междисциплинарного курса в сфере высшего экологического образования «Внедрение эко-инноваций в управление городской средой» / С. Е. Копыльцова, М. И. Кулик, М. А. Фалалеева, О. В. Хандогина, И. В. Шилова. // Электронный научный журнал НИУ ИТМО. Серия «Экономика и экологический менеджмент». 2014. № 2. – С. 230–248. Електронний ресурс. Режим доступу: <http://economics.ihbt.ifmo.ru/file/article/10511.pdf>.
13. Тітенко Г. В. Модернізація змісту дисципліни «Альтернативна енергетика» у фаховій підготовці екологів / Тітенко Г. В., Кулик М. І. // Збірник тез доповідей XVII Міжнародної науково-практичної конференції «Екологія, охорона навколишнього середовища та збалансоване природокористування: освіта – наука – виробництво - 2014». м. Харків, 13–14 листопада 2014 р. – Х.: ХНУ імені В. Н. Каразіна, 2014 – С. 81 – 84.
14. Управление в энергетике / С. П. Кундас, М. И. Кулик, О. А. Кучинский, Л. Молиторис, К. Павличкова и др.; под ред. д. т. н., проф. С. П. Кундаса. // Учебное пособие – Минск: МГЭУ им. А. Д. Сахарова, 2014. – 259 с.

Надійшла до редколегії 22.09.2015



This publication is prepared and published in the framework of project «Alternative Energy: Education and Science» (financed by British Council). This publication reflects the views only of the author, and the British Council cannot be held responsible for any use which may be made of the information contained therein.