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European Educational Concept in Environmental-, Nature- and Climate Protection to Safeguard a Cross Border Sustainable Development. Geothermal Education in the Course of the Erasmus+ Project

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ABSTRACT

In view of climate change and responding to political, economic and ecological challenges the number of "green" jobs are expected to rise. It will have an impact on the education and training process. The joint German – Hungarian – Polish – Romanian Project EUBILD-UNAKLIM (2016-1-DE02-KA204-003254) in the ERASMUS+ Founding Scheme designs an international adult-learning furthering education course. The main objective of the project was the creation of a curriculum concept in the topics of environmental-nature- and climate protection. The paper presents the research issues in the field of geo-engineering and the use of renewable energy sources. The idea of the project is to open new chances on a future-oriented segment of the labor market for unemployed academic graduates, university dropouts and unemployed professionals, who have gained a multidisciplinary and yet very specific knowledge. Developed geothermal training letter will provide a broad understanding of geothermal energy utilization which will prove useful in the practice.

1. INTRODUCTION

Nowadays, in view of climate change, increasing environmental pollution and scarcity of resources, it is necessary to educate and rise the qualification in this topics (Jiricka et al. 2016, Ocetkiewicz et al. 2017, Lohse 2018). The use of existing human resources in Europe becomes an essential issue in this context. Underused human resources, affected by unemployment, can evolve into valuable protagonists of society and economy by qualification (Tomaszewska, 2018). An impact on education and training, and also on the long-life learning process is expected. According to that an international adult-learning furthering education course concept has been implemented within Erasmus+ Project "European educational concept in environmental- nature- and climate protection to safeguard a cross border sustainable development" by the consortium of five partners from four countries (Germany, Hungary, Poland and Romania) in the period: September 2016 – February 2019. The works embraced: 1. Creation of a curriculum concept with the participating countries in the professional advanced education is, in the topics: environmental-, nature-, and climate protection, based on research about existing furthering education programs and experiences in the participating countries; 2. Design of innovative training methods and the combination of theoretical knowledge with particular key skills; 3. Preparation of the first test run of the course by exchanging potential trainers and trainees with the participating countries. The project goals were to opening new chances on a future-oriented segment of the labour market for unemployed academic graduates, university dropouts and unemployed professionals, who have gained a multidisciplinary and yet very specific knowledge through establishing the curriculum in the participant countries' national educational structures in the long run. The project course is addressed to unemployed people with diverse background: long-term unemployed people of all ages, or working in inadequate positions compared to vocational training, people in orientation phase after vocational training, with different background grades, complementary work experience and interest for green jobs. Within the framework of the project, the following tasks were carried out: 1. Study on national activities and funding opportunities of furthering education programs for unemployed academics in green jobs, 2. Curriculum to international course, 3. Model Training Letter on Topic - Geothermal Energy and Photovoltaic, 4. Online platform for e-learning tools and topics, 5. Experiments of a model pilot plant to use as a field laboratory.

2. STUDY ON NATIONAL STUDIES ON ACTIVITIES AND FOUNDING OPPORTUNITIES IN FURTHERING EDUCATION PROGRAMMES

Comparative study of national activities and funding opportunities in furthering education programs for unemployed academics in green jobs have been conducted in each of participant countries. The labour market analysis in the field of green jobs, especially in the field of geology, geophysics, environmental protection, and renewable energy usage have been performed (Rahner et al. 2018). Surveys were conducted using a specially created open-source platform run on SRH Hochschule Berlin surveys. The objective of the survey was to find if the curriculum would have to be adapted to the commercial and labour market environments. The research included two main research methods to obtain necessary source data and information: quantitative (questionnaire surveys), and qualitative – open opinion, structural interviews. Qualitative methods were used to emphasize experts' personal experiences and interpretation over quantification in an efforts to understand the meaning of the quantified social responses; to place and interpret the investigations and understand their results. The structural interview (five in each country) role was to objectively assess the state of national activities and funding opportunities of furthering education programs in green jobs. The structured interviews results were inserted into the statistics. The objective of the questionnaires was to find if the curriculum would have to be adapted to the commercial and labour market environments. Significant country-specific differences and gaps between employer and furthering education provider/financing body respondents were found. According to that, the course design will put more emphasis on the topics which were important for the employers also by adding new modules, if necessary. A long-term goal will be establishing official certificates, acknowledged in the partner states or on a European scale if possible. These works are continued within the Erasmus+ project entitled "From Massive Open Online Course to Practice for Environmental-, Nature- and Climate Protection with

4 Consortium Countries: Creation Environmental Courses using Blended Learning" implemented in the period from October 2019 to April 2022 (Project: 2019-1-DE02-KA204-006106).

3. INTERNATIONAL COURSE CURRICULUM

The change of energy policy and the overall energy consumption model presumes a holistic approach which should consider and manage a series of parameters such as technology, the economy, politics, society, and education. That is why the curricula proposal (see Figure 1) contain wide aspects to cover all important elements to introduce the fundamentals of geothermal resources system in the energy sectors and to a better understanding of the resources use and technology, economic and environmental impact. Renewable energy sources, i.e. solar, wind, biomass, hydropower and especially in our case - geothermal, are nowadays widely being recognized as an effective response to the global issue of climate change.

Elaborated under project concept based on research about existing furthering education programs, experiences, needs and requirements in the partner's countries and respect to the future needs of an UE-wide approach. The design of the curriculum set up innovative training methods in a combination of theoretical knowledge, case studies, and practical key skills. The programme structure is presented in Figure 1. The total length of the course will take 6 months. The course consists of 6 modules that cover 32 topics in total. The course programme is implemented in a follow-up ERASMUS project: MOOC4all (www.mooc4all.eu).

4. TRAINING LETTER ON GEOTHERMAL ENERGY

Under the project, the training letter on Geothermal Energy, District Heating and Cooling have been developed. The main aim of it is to introduce to the participants the potential of geothermal resources and systems in the energy sectors by building a general understanding of the resources use and technology approach. Participants will be able to understand the economic and environmental impact of geothermal resources usage in projects with district heating and cooling (small, medium and big scale). The module covers information on the natural conditions, production, and utilization as well as the economic and environmental impact of geothermal energy. The main purpose of the module is to provide a broad understanding of geothermal energy utilization which will be useful in the practice. A detailed outline of the module includes four specific topics:

1. Introduction to Geothermal Energy:
   - Geology and Earth heat
   - Basics of geothermal systems
   - Energy reservoirs and energy network
   - Investments, operating costs, costs of current production, efficiency
   - Case studies and reference installations
   - National and international utilization potentials

2. Introduction to District Heating:
   - Concept and Components of District Heating and Cooling Systems
   - Calculation of energy prices and cost-effectiveness
   - Case studies and reference installations
   - Local and regional utilization potentials and impact

3. Introduction to Air Conditioning and Cooling:
   - Heating pumps and Air condition
   - Basics of Air condition and Cooling
   - Case studies and reference installations
   - Local and regional utilization potentials and impact

4. Best-practice and Environmental Impact of Geothermal use in energy systems:
   - Best practice
   - Environmental Impact of geothermal exploration
   - Environmental Impact of Geothermal energy utilization
   - Environmental Impact of District Heating and Cooling Projects
   - Environmental Impact of Geothermal water utilization

Course participants are expected to work on the material outside the class as well as to take an active part in the discussions. These discussions will enhance the learning process and allow the sharing of experiences. The learning goal is to teach the participants to understand and implement current technical concepts of the geothermal use in energy concepts and solution. Therefore they will be able to achieve commerciality while meeting legal, social and environmental challenges from the aspect of geothermal resources and use it in the local and regional matter. The lectures want to build an understanding of: Basic concepts of exploration and use of geo-thermal resources, the characterization of geothermal reservoirs and the production of heat and power; Integrated management techniques to deliver a geothermal energy project; Present and future potential of geothermal energy in the global and regional energy resource portfolio; District heating and cooling concepts, projects and best-practice; Environmental aspects of geothermal water and energy utilization.

The planned duration of the module will take 5 days with a total workload of 40 hours (respectively 20 hours for lectures, 12 hours for workgroup and 8 hours for self-work). As a part of group exercises, participants will consider the regional and local examples of the use of geothermal energy as well as to prepare a short characteristic on the given topics. During the course, a virtual trip to geothermal heating plant and laboratory of heating pumps will be provided.

COURSE OVERVIEW "Environmental-, Nature- and Clima Protection - Professional"															
Module	Module no		Month 21 days/m = 168 hrs/m					Workload = 1.512 hrs				Workload 40 Credits (1 Credyt=30 hours)			Contribution to final certificate
		ECTS	1	2	3	4	5	6	7	8	9	hous on campus	group work in project	self-study hours	
Section I: *Fundamentals, Methods and Tools*															
Introduction to Sustainability in Environment, Renewable Energy and Grow	M 01-01	0	16									12		4	1.1%
Urban Sustainability Assessment Framework	M 01-02	1	32									20	4	8	2.1%
Green Marketing and Services in Environment and Renewable Energy	M 01-03	1	24									16	4	4	1.6%
Career Opportunity in Green Economy / Job Coaching	M 01-04		8	4		4						8	4	4	1.1%
Sustainability Finance and Funding in Urban, Environmental and Renewable Energy Projects	M 01-05	1	24			8						16	8	8	2.1%
Project Management in Environmental and Renewable Energy Projects	M 02-01	3	64									32	32	16	5.3%
GIS in Urban, Environmental and Renewable Energy Projects	M 03-02	4										42	48	32	8.5%
TOTAL		*10*	*168*	*84*	*32*	*44*	*0*	*0*	*0*	*0*	*0*	*152*	*100*	*76*	*21.7%*
Section II: Clima-, Environment and Nature Protection															
Facts in Environment and Nature Protection (EU- and National Framework)	M 04-01	0		8								8			0.5%
Circular Economy – Act and Law	M 04-02	0.5		16											1.1%
Ecological footprint	M 04-03	0		8											0.5%
Water management, Protection and Law	M 04-04	0.5		16											1.1%
Waste Management, Separation and Recycling	M 04-05	1		32											2.1%
Soil Management, Protection and Law	M 04-06	1			32										2.1%
Emission and Pollutants in soil, air and water	M 04-07	1		4	28										2.1%
Environment in Logistic and Packaging	M 04-08	0			4										0.3%
Landfill – Management and Law	M 04-09	0			4										0.3%
Environmental criminal law	M 04-10	1				16									1.1%
Nature protection – Management and Law	M 04-11	1			32										2.1%
NATURA 2000 Directive, Water Framework and Stakeholders	M 04-12	2			36	28									4.2%
Project work in Environment and Nature Protection	M 04-13	2				80									5.3%
TOTAL		*10*	*0*	*84*	*136*	*124*	*0*	*0*	*0*	*0*	*0*	*156*	*120*	*68*	*22.8%*
Section III: Sustainability in Renewable Energy															
Introduction to EnergyDistribution, SmartGrid and Future Mobility	M 05-01	0					16	16				20	8	4	2.1%
Introduction to Photovoltatics and Storages	M 05-02	1					40					24	12	4	2.6%
Introduction to Solarthermal Energy and Storages	M 05-03	1					24	8				24	4	4	2.1%
Introduction to Wind Energy and Power – to – Gas	M 05-04	1					24	8				20	8	4	2.1%
Introduction to Bioenergy, Bio-Fuels and Storages	M 05-05	1					24	8				20	8	4	2.1%
Introduction to Water flow energy, Hydro Power and Storages	M 05-06	0						8				8			0.5%
Introduction to Geothermal Energy, District Heating, Climatization and Cooling	M 05-07	1					32	8				20	12	8	2.6%
Sustainability in green energy-efficient building	M 05-08	1						32				24	4	4	2.1%
Sustainability in energy-efficient production with energy management	M 05-09	1						32				24	4	4	2.1%
Study project in green energy and energy-efficiency	M 05-10	3						40				8	24	8	2.6%
TOTAL		*10*	*0*	*0*	*0*	*0*	*160*	*160*	*0*	*0*	*0*	*192*	*84*	*44*	*21.2%*
Section IV: Profile and Practice - Intership															
Language In-Depth Training / Internship	M 06-01	2							40	40	4	40	4	40	
Company Project / Internship	M 06-02	10							132	132	132	16		400	
Course Final / Project Kolloquium	M 06-03	0									20	8	12		
TOTAL		*12*	*0*	*0*	*0*	*0*	*0*	*0*	*172*	*172*	*176*	*64*	*16*	*440*	*34.4%*
workload / month		**168**	**168**	**168**	**168**	**160**	**160**	**160**	**172**	**172**	**176**				**100%**

Figure 1: Curriculum overview.

5. CONCLUSION

The sustainable development of the countries presumes a holistic approach which should consider and manage a series of parameters such as technology, the economy, politics, society, and education. Education is an essential element and crucial to any nation's development. For adult-learning furthering education course stimulates scientific endeavor, enhances livelihoods, and injects a skilled workforce into the resultant modern job market. Investigating the knowledge, perceptions, as well as attitudes of the public concerning various aspects of environmental issues is of great importance to sustainable development.

The Erasmus+ project presented an education course which will take place in the participating countries (Germany, Hungary, Poland, and Romania). The training languages will be held in national languages and English. Environmental and cross-sector topics will be addressed, which can be helpful in exchange of experiences, the use of good practice and bilateral exchange the participants from the project partners. These activities contribute to the development of knowledge and improve teachers collaboration.

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REFERENCES

Jiricka A., Formayer, Schmidt A., Voller S., Leitner M., Fisher T.B., Wachter T.F.: Consideration of climate change impacts and adaptation in EIA practice – Perspectives of actors in Austria and Germany. Environmental Impact Assessment Review **57**, (2016), 78-88.

Lohse C.: Environmental impact by hydrothermal energy generation in low-enthalpy regions. Renewable Energy **128**, (2018), 509-519.

Ocetkiewicz I., Tomaszewska B., Mróz A.: Renewable Energy in education for sustainable development. The Polish Experience (2017), 92-97.

Rahner S., Winter I., Hartmann M., Wittich F., Kasztelewicz A., Tomaszewka B., Pająk L., Dendys M., Operacz A., Mraz M., Nistor S.: Study on national activities and funding opportunities of furthering education programs for unemployed academics. E3S Web of Conferences **66**, 03004 (2018).

Tomaszewska B.: Sustainable Energy: Human Factors in Geothermal Water Resource Management. Advances in Human Factor in Energy: Oil, Gas, Nuclear and Electric Power Industries, (2018), 60-71.