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INTERDISCIPLINARY APPROACH TO SOLVING ENERGY PROBLEMS

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ABSTACT: In order to create stability in the energy supply based on the unsustainable (also unreasonably wasteful and inappropriate) use of energy and nature resources, as well as to protect nature and to maintain social well-being, it is essential to study and analyse the correlation of the findings of related scientific areas. Since the accession of Hungary to the EU more than a decade ago, it has been proven that the need for an interdisciplinary approach – in the area of sustainable energy, among others – is more and more justified and coming to the forefront, enabling us to apply the achievements and partial results of the specific scientific fields in various settings and in complex ways.This paper aims to present fields of study and major general achievements and methods which – although not without limits – help us study the interdisciplinary nature of energetics in the light of sustainable agricultural, environmental and social challenges. Based on the direct and indirect answers to questions of a focus group interview (16 focus groups – 172 people) it can be concluded how importantthe evaluation of the present as opposed to the future is, and how research and development in the field of energetics influence individuals (in their choice of devices, in their priorities concerning energy resources, etc).
Keywords: energetics, energy resources,general achievements and methods, sustainablechallenges

1. INTRODUCTION

As Comenius taught, "The foundation of human wisdom, that is, man's omniscience lies in the accurate definition of things." It is therefore both an opportunity and an obligation for us to briefly explain the origin, meaning (in the narrower sense) and role of this paper's basic concepts – i.e. energy and energetics – before we outline our research objectives and our main topic. The word "energy" is of Greek origin, meaning "action, operation, capability or opportunity for a change." Energetics is concerned with tasks related to the production, transformation, transport, storage and (end) use of energy. Energetics is essentially based on natural sciences, but because of ideas and guidelines coming from the fields of energy politics, environmental politics and social politics, it has a direct connection with other scientific areas, especially with environmental sciences, environmental risks and waste management, but also with environmental economics, environmental law and energy law, which belong to the social sciences. Even more so, because energeticsis not merely a technological concept, but energy being a "scarce commodity," it raises a number of issues and questions related to economics, ecology and sociology, the solution of which requires an interdisciplinary approach and attitude.

According to the above, we have chosen for our research objective the enhancement of the interdisciplinary nature of energetics in Hungary through a focus group survey, especially with regard to its effect on the environment and on agriculture, as well as in relation to social challenges. Note here that it is essential to cooperate under the principle of reciprocity[Axelrod et al., 1981]. The significance of our research is further emphasized by the fact that matters of sustainability and sustainable survival today are important not only for establishing stability in energy supply and for the protection of nature, but also for maintaining social well-being[Stiglitz

et al., 2009]. In order to achieve our research objectives we rely on previous findings, related mainly to the utilization of agricultural biomass for energetic purposes and the effects of such utilization. Also, preparing the research was facilitated by the analytic study and elaboration of innovative and systemic scientific work carried out by researchers working in the fields mentioned above.

2. PRELIMINARIES AND REASONS FOR TOPIC

The intensive and interactive relationship or interdisciplinary nature between energetics and the systems surrounding it allows for complex studies carried out by connecting different areas of science. Of course, in our changing world, an approach that involves more than one science or branch of science, based on the correlation analysis of their connections, requires the revision and re-evaluation of certain connections which are thought to be universal. The Interdisciplinary Section of the Hungarian Energy Association was established in 2014 exactly for the facilitation of such approaches. It thus attempts to introduce a novel, dynamic, progressive and complex approach in the field of energetics in Hungary. It aims to approach and develop controlling, technological, economical and other issues and phenomena characteristic of the industry in the scientific fields and branches related to energetics in a complex and interdisciplinary way [HTTP3].Interdisciplinarity is in fact an attitude which utilizes and analyzes the relevant results and/or methods of one or more sciences or branches of science, explores connections, and yields new scientific achievements or expands the scope of application for existing achievements.

The thought-provoking writings of Wanek, Dezső and Reményi[Wanek, 2011; Dezső, 2013; Reményi, 2014]also encourage the engineering community to include contemporary findings of the social sciences in their work, since this is the only way to reach up-to-date engineering solutions. Interdisciplinarity, however, needs to be narrowed down in a proper way: characteristics pertinent to correlation analyses should be enhanced, while others should be dismissed as unimportant. Wanek calls interdisciplinarity a “magic word” and asks who knows related professions relevant to the current question.

To answer questions of energetics and environmental protection related to the production and utilization of biofuels of agricultural origin (primarily biogas and biodiesel) and questions viewing agriculture from a regional and global perspective,call for the expansion of the scope of technological and agricultural studies, the latter having been our main field of interest so far. We need to address the issue of the unsustainable use of fossil energy sources (including overuse and inappropriate use), as well as renewable energy sources of agricultural origin to substitute them. We need to assess what agricultural, environmental, ecological, economical and social challenges they induce, because currently we satisfy our needs in an unsustainable way and thus we are pushing the boundaries of the system [Hankiss, 1979; Ostrom, 1990; Latouche, 2006;Liegey et al., 2013]. The resolution adopted at the UN General Assembly in 2005 identified three aspects of sustainable development, all of which are in a strong mutual and co-dependent relationship with one another: the economical, social and environmental dimensions. The Energy Trilemma of economic development, energy consumption and environment, however, leads us to the problems of sustainable “development,” where constituents (economy, environmental protection, social safety) are certainly co-dependent, determining and influencing one another[Sebestyén, 2011]. The predominance of any of these factors has a disruptive effect on the given system, and after a transitional phase a new system develops. It is wise to prepare scenarios for such cases, to prepare for the possible consequences. The greatest problem lies in sustainability, notably in our thinking. A possible solution may come from responsible thinking [Bereczki, 2011], which could be established by the aid of the awareness raising mix proposed by Csete and Baranyai also called as 6W (Why? What provider/receiver parties are concerned? What? By what means? In what ways?)

The National Council for Sustainable Development relied sustainability on the relationships between people, societies and the natural environment, where human actions are defined by following of norms[National Strategy for SD, 2013].

In the 7th iteration of the report on the problems concerning the world’s energetics[World EnergyIssues Monitor, 2015]the main factors of the Energy Trilemma are identified as energy security (providing energy to meet demands and the reliability of energy infrastructure); energy equity (accessibility and affordability of energy supply across the population);and environmental sustainability (efficiency, renewable energy), i.e. it believes that one of the greatest challenges governments and societies today face is the establishment and maintaining of a sustainable energy system. The report also helps create a global energetics program and forecasts the future of

energy issues.The objectives of comprehensive and sectoral strategic planning documents concerning the driving forces affecting the state of the environment (such as National Rural Strategy, National Energy Strategy, National Climate Change Strategy, National Transport Strategy, National Energy Efficiency Action Plan, Action Plan for the Utilization of Renewable Energy)[HTTP1;HTTP2]fundamentally define the actions and measures included in the National Environmental Program, since environmental aspects have been given a prominent role both in the comprehensive and sectoral strategic planning documents mentioned above[NKP, 2015].In order to establish an energetics system with an integrated approach which is capable of meeting environmental, social and economical challenges, it is essential for us to recognize our mutual interests, to co-operate with each other and to think together – to this end we need to change our attitude and our way of thinking. This idea is echoed in J. C. MacKay's book on sustainable energies. This book enlists the energy consumption of a large number of energy consuming activities, and then it presents energetics plans, giving a factual analysis, with a special regard to sustainable energy sources[JC MacKay, 2009].

Research carried out under Magyary Zoltán PostdoctoralScholarship(TÁMOP 4.2.4. A/2-11-1-2012-0001, A2-MZPD-13-0099) further revealed the importance and necessity of this subject: the cost- and energy-effective production of biodiesel contributes to the promotion of sustainable energetics. Research findings confirm the hypothesis that future adaptability lies in complexity.

3. MATERIALS AND METHODS

Energetics is a complex issue because it permeates our whole society, therefore the key to modern and successful engineering lies in approaching problems in a complex way. The method of the research subject can be basically described by the words of Mihály Csíkszentmihály, who said that "The most important quality of a creative person is his or her complexity."

Our objectives have been achieved by a focus group interview (a focus group survey with the participation of 172 persons divided into 16 groups; a quasi-representative sample based on an equal distribution of age groups of 14-18, 18-23 and 23-42 year olds; both genders, each county of Hungary and a wide layer of society have been represented) and its analysis. The so called focus group interview is an investigative research method used for the deeper exploration of a specific group of problems – in this case the interdisciplinary nature of energetics in the light of sustainability – facilitating the development of a larger picture and the formulation of hypotheses[Shamdasani et al., 1990].

The central topic of the focus group interview is the evaluation of the present as opposed to the future (from the viewpoint of energetics), as well as the identification of the components of the energetics system as a multivariable "equation". These components clearly define what scientific areas have questions to be answered and problems to be solved, knowing the relationships between these disciplines. Since it is helpful to build group discussions using blocks that are logically related to one another, during the preliminary research before the compilation of questions, we defined the boundary conditions for the establishment of a sustainable energetics system that can be interpreted as a multivariable "equation"; based on the "Ceteris Paribus" principle we chose the hypotheses supported by clear scientific evidence; and we analysed the problems of the "Energy Trilemma" and synthesized the relationships and connections based on factual data. In order to make unbiased conclusions we need to identify our expectations objectively, as well as define what the criteria of improving quality of life are.

One of the areas to be studied is the question of what the challenges of research aiming to stabilize energy supply and the establishment of the conditions for energetics "independence" are, in relation to adaptive agriculture, the rural areas, as well as environmental protection and legislators on both domestic and EU level.

The collection of answers is followed by their evaluation, and the results are presented by means of word clouds. (Word clouds essentially display the most frequent words or expressions with font sizes in proportion to the frequency of words.)

4. RESULTS AND CONCLUSIONS

The focus group survey proved that we can gain practically applicable data by connecting the different disciplines and by exploring and analysing the relationship between them, since the creative and systemic overview and linking of the various disciplines aim at creating resilience.

As a result, with Nietzschean strict thinking, careful estimates and accurate deductions, we may make suggestions concerning the specific components of the sustainable energetics system as a multivariable "equation" (Figure 1).

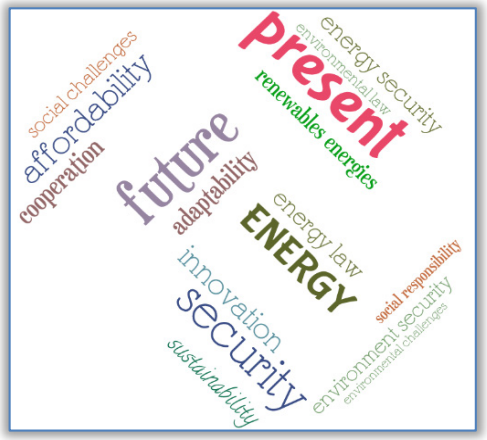

Figure 1. The results of the questionnaire survey displayed as a word cloud [HTTP4]

The survey conformed the assumption that the homo- or heterogeneity and awareness of a community influence sustainable use. (Note here that the social consequences of the overuse of resources – including energy sources as scarce commodities – are that it deprives developed countries from the use of these resources as well, inducing multicomponent changes.) 57% of those surveyed had already met – typically in their studies – with the idea of sustainability and the role of energy sources within humanity.

Concerns about the near future seem more pronounced than worries about how to avoid presumed problems of the distant future. Based on the answers given, it can be concluded that currently the present is considered more important (the dominant role of the present can be seen at 89% of subjects in one form or another) than the future, primarily because of affordability. Consequently, the frequent occurrence of words and expressions such as "safety", "energy safety", "safety of the environment" and "sustainability" refer to the protection of an environment capable of providing proper quality of life.On the other hand, the need for adaptability, constructive cooperation and responsible thinking also appears.

The symbiosis of fossil and renewable energies (or, as Reményi put it, direct natural energies) is now a mutual interest. It has been recognized that natural resources are non-substitutable key resources – ecological boundaries in our life. It is for this reason that the majority (91%) of the subjects indicated the need for defining the basic requirements of sustainable energetics based on energy models through an agriculture that focuses on the management of organic waste. It can be concluded that defining the (necessary and sufficient) conditions of sustainable farming is also important in order to minimize environmental risks and challenges. Principles to be considered when deciding on tasks and measures might be: the assessment of the situation and the local utilization of local resources.

The low (17%) occurrence of social engagement and adaptability makes it clear that change is needed in this regard. In this context the importance of participation, i.e. the assignment of roles and responsibilities, the sharing of information come to the forefront.

Answers also suggest that the legal environment (predominantly environmental law and energy law in the field of energetics) is considered dynamically changing and hard to follow by most of the subjects.

Findings of this exploratory research can and should be used partly for the facilitation of integrating the interdisciplinary knowledge (both theoretical and practical) acquired by university students, since the scientifically not well founded connections and correlations distort the possibility of an informed decision. Also, these research findings can help prepare materials for competitions in research, development and innovation, and may help to form the foundations for innovations in the energy industry.

5. PERSPECTIVES

By exploring the connection points of (sustainable) energy and the scientific areas mentioned above in the research objectives, it is possible to show the interactions between energetics and its immediate "surroundings" through the analysis of "input and output signals." And using the data of a well chosen indicator, „Energy Sustainability Index" enables the adaptation of energy model variations.„Meta-analyses" help to explore the possibilities of agriculture, the requirements of their utilization to an optimal degree and the use energy sources adapted to their possibilities (e.g. sustainable use by local communities).

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