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THE GENIUS CAMPUS – A COMPLEX SUSTAINABLE PRODUCT IN THE TRANSILVANIA UNIVERSITY OF BRASOV

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ABSTRACT*: Making a step forwards, Transilvania University of Brasov is developing a new research campus, GENIUS (Green, Energy Independent University Campus). The core of the GENIUS Campus is the RTD Institute, which infrastructure is developed within the frame of the project "RTD Institute: High-Tech Products for Sustainable development". The project develops the infrastructure for the human resources for RTD of excellence in the field of sustainable development. All the 12 buildings are designed by the university teams and represent, each of it, in-field testing stands hosting renewable energy mixes, implemented in low energy buildings that embed novel solutions for energy efficiency and energy saving. The paper presents the main design steps and gives answers to the major problems faced during implementing the "low energy buildings" concept in the mountain area that characterises the GENIUS Campus location. The data so far acquired on small scale solar-thermal, PV and heat pump systems implemented in the university show that most of the commercial design software is giving approximate solutions, usually rising the initial costs or failing in extreme weather conditions. Therefore, based on the data to be simultaneously acquired on the 12 buildings, optimised sustainable energy solutions can be developed and used, offering reliable design alternatives for implementing renewable, considering the specific location. The results are subject of technology transfer towards companies, individuals or sustainable communities, that choose to implement sustainable energy solutions in the built environment.*
Key Words*: GENIUS Campus, Transilvania University, Braşov*

1. INTRODUCTION

The competition among the economic leaders – Europe and USA - represents the most significant source for progress and development. Economists' analysis shows that for the 1870-2000 periods there was an average growth rate for USA of 1.87% while the corresponding value in Europe is of only 1.67; the period right after 1973 (the Oil Crisis) registered an even higher gap, [1]. The first major action in filling the gap was the European Union creation and the steps done in the past decades originate from a strategy targeting the leading role not only vs. USA but also in the competition with other dynamic Asian economies.

Switching from the industrial-based economy to the knowledge based society represented another step that allowed Europe to become the frontrunner in the economic growth competition, during the '90s. The "triple helix" governing the knowledge based economy involves universities (research and education), industry (manufacturing) and governments (decision making) and, proving to be functional, this concept emerged in Europe was largely adopted by all the developed countries, [2]. Economic growth mainly results from the new products and technologies, developed through interdisciplinary research, adopted by advanced industrial manufacturing processes, with new or strongly improved quality, that are cost effective and competitive in the market. The time needed for the optimized research result to be implemented in up-scaled process represents another feature of this novel approach. The results are new high-tech products that give a rational and efficient use of materials and energy that can fulfil complex

requirements (multifunctional) at advanced functional standards.

Integrated Product and Process Development, IPPD represents the path to the market-competitive high-tech products. The customer focused products result from a set of key characteristics, [3, 4], among which essential are: Concurrent development of products and processes; Early, continuous lifecycle planning; Flexible design and improved process capability; Multidisciplinary approach. Sustainability represents a major issue that must govern the high-tech products. Therefore, we consider that *Integrated Sustainable Product Design and Process* represents the concept for the future that must be formulated today. Minimal intervention in the nature's order, during product manufacturing, using and after disposal implies a deep understanding of the nature's mechanisms, thus the development of the future products requires a transdisciplinary approach.

To implement this complex concept in the field of renewable energy systems, Transilvania University of Brasov formulated and implemented in the past six years a development strategy, focusing on advanced human resources formation and research; the strategy aims to integrated development of education paths on subjects where research of excellence is promoted, in the area of Sustainable Energy.

In 2009, a major project was financed from EU and Romanian structural founds, along with the university contribution, for developing the *RTD Institute High Tech Products for Sustainable Development – PRO-DD*. The institute is the core of a new, green, research Campus, GENIUS. The paper presents the Campus concept and development, as an example of renewables implementation both for direct purposes (education and research) but also for promoting novel solutions for renewable energy systems integrated in the built environment, since all the Campus buildings are actually outdoor testing stands for various integrated sustainable energy solutions.

2. WHY (ANOTHER) UNIVERSITY CAMPUS?

GENIUS stands for Green Energy Independent University Campus, a new location dedicated to research on Sustainable Energy. The concept is of research *outside the buildings, within the buildings and using the buildings*, making this project one few of this kind in Europe, and – to the best of our knowledge, in the world.

Today, a sensible question is why to develop a new, or another new University Research Campus. What should this Campus involve? To whom is it open and which is the strategy which makes a difference? And, in the end what are we expecting from this Campus as middle and long term development strategy.

Why another new Campus?

To answer this question we have to realistically analyse which is the position and role of any university in the society. For many centuries, the universities functioned based on the axiom that "providing knowledge inevitably leads to social and economical development", thus the society investment is fully justified. This is an uni-directional approach and, now it may be not enough. It is not any type of knowledge that is needed, even of high-quality! The competition within the higher education area is stimulated by the quality offer of the university and – most important - by the final result: the position of the graduates in the labour market. The competition within the research area can be successfully approached when the knowledge is provided according to the needs.

Therefore, preparing for tomorrow, needs to consider two major key-words: *Quality* of the academic and research processes and *Relevance* of the results towards society needs and, specifically, towards economic growth. Simultaneously acting according to these keywords leads to the need for strong links between universities and society.

Actually universities must act as integrant part of the society, as front runners for: *Knowledge providers*, adapted to the society and economy needs and *Advanced knowledge developers*, stimulating novel requirements from society and economy

Quality insurance has two targets:

1. At the resources' level, within the university, with direct consequences on the results:

The human resources, must provide knowledge, dynamically adapted to the

research developments and to the needs of the economy actors;

The infrastructure has to be continuously adapted involving high-tech equipment able to offer to the graduates skills and competencies as required by the employers;

These are only possible if there is a permanent cooperation between universities and societal beneficiaries, because feed back is the driving force in structuring/restructuring the resources.

2. At the results' level, where quality implies relevance for the society needs.

2.1. The primary output of any universities, the graduates, with knowledge, skills and competencies according to the ever increasing needs;

2.2. At the same level of importance, the research results, expected to solve the today's problems;

2.3. Academic research has a supplementary task: to stimulate new demands in the society/economy and this is mainly attended by fundamental research, mirrored in advanced results and finally, in new products.

If both requirements are fulfilled, the society investment/input in the universities is completely justified by the outcomes and a long-standing, sustainable cooperation can be expected, [5].

Implementing these concepts needs action on both sides:

1. The universities must go through a deep restructuring process:

1.1. At the strategic level, for integrated development of

education, research *and* innovation/technology transfer;

1.2. Resources' planning, both human and infrastructure, for cost - and results efficient development;

1.3. Insuring competitiveness, in the academic area *and* in the

society.

2. Society, economy must be prepared for cooperation with universities.

2.1. Formulating demands toward universities for specific graduates qualifications; involving companies in knowledge providing represents a path that is already approached;

2.2. Formulating demands for product/process innovation; today, this is the usual cooperation frame. Still, the future must bring the reciprocal stimulation of frontier research and fast application of the advanced results;

2.3. Within this frame, the society investment must be dimensioned according to the results, (amount and relevance for present and for real future progress).

Considering this analysis, we started to develop a strategy in the Transilvania University of Brasov, considering the specifics, [6].

Transilvania University of Brasov is a state university, more than 60 years old, and is the largest university in the central part of Romania. According to the Romanian evaluations, Transilvania University of Brasov is a top university. Starting with 2010, there are 18 faculties, 9 of them of engineering and the other one of non-engineering profile; the university offers the 3 cycle education offer (Diploma, Masterate and Doctorate) as full time, part time and distance learning to more than 25000 students. Specific to the university is the variety; this represents a valuable resource, allowing inter- and trans-disciplinary approaches for large projects, of interest for the entire academic community. This variety also represents a complex problem, compulsory to solve when defining the university specific profile at national and international level.

In the past 6 years a deep restructuring process was set, aiming to realistically identify the existent and potential resources and to define a strategy, able to insure quality and competitiveness to the Transilvania University. It became soon obvious that a "common ground" is needed to harmonize the knowledge, competencies and already existent high quality results, aiming to:

1. Efficient resources use and development, valorising the experience, avoiding redundancies, and keeping track with the dynamic growth in science and technology. This issue becomes even more important in a time of economic crisis.

2. Quality research and education, integrated developed, on core subjects related to what represents the university "label".

To successfully face the competition, both among university and for the society

investment, this strategy had to answer, in a very concrete way:

- What is Transilvania University of Brasov?
- What specifically identifies this university among others?
- What is it done for a long – term quality development and competitiveness?

Two years of consecutive internal evaluation, showed that there is one major subject that can coagulate the university resources and experience: *The Energy*.

As the Nobel Prize winner, Richard Smalley stated, energy is the no. 1 problem of the humankind, in a top 10 ranking. Solving the energy problem gives hope for solutions to the other nine. On the other hand, energy is also the cornerstone of Sustainable Development. The energy problem rises from the scarce conventional resources and from the consequences of the energy production (pollution, climate change, security). Therefore, the answer was formulated on three directions: Energy Efficient processes, Energy Saving consuming and Renewable Energy Systems, replacing the fossil or nuclear fuels. This triangle is known as Sustainable Energy. Approaching Sustainable Energy seems to be an engineering problem, with a broad range of subjects, ranging from renewables production and optimisation, to clean transportation, green IT, sustainable forestry, bio-technologies, or industrial processes. But, promoting Sustainable Energy requires more than high-tech solutions. It requires changing the mentalities, it requires societal and economy acceptance, thus adequate communication, it requires markets for bottom-up pressure and it requires a legal frame for top-down approach. This is why, Sustainable Energy represents a hot topic for many other fields outside engineering. This is why, Sustainable Development through Sustainable Energy was identified as the major research subject in the Transilvania University of Brasov.

In 2007, the research structure of the university was formulated, for answering to the development strategy and to the Sustainable Energy priority, Fig. 1.

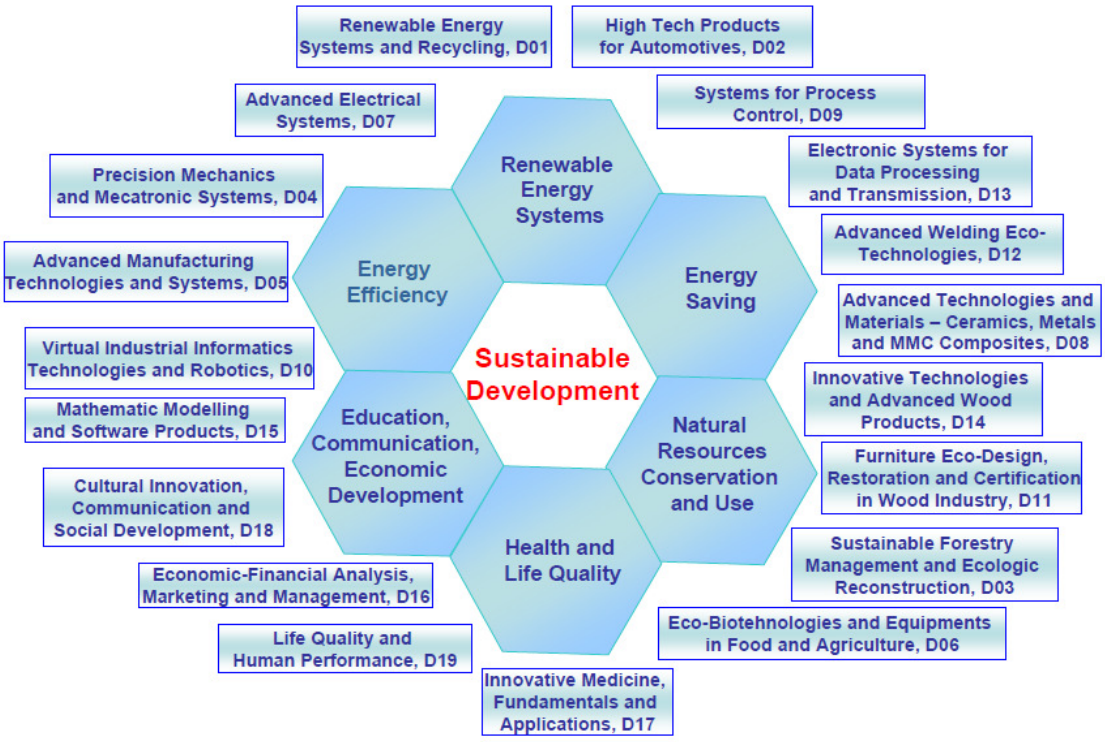

Figure 1. The research departments in the Transilvania University RTD Institute

The research resources were gathered in 19 departments: 14 of them of engineering profile, targeting high-tech products development, by respecting the Sustainable Energy directions

and requirements. Another 5 departments are active in various fields supporting Sustainable Energy and advanced products promotion, marketing, legal aspects, human resources' preservation and development. Each department has its own resources (human, infrastructure, documentation, partnership). The location of each department was, at the year 2007, quite scattered, Transilvania University being located in a Campus (Colina Hill) and in more buildings all over the city. This rises problems related to the efficient use of the infrastructure and the quality development of the study programs, especially for the 2nd and 3rd cycle. This is why, a joint location for research and advanced human resources education was needed. It was further the opportunity offered by the Structural Funds competition that completed our SWOT analysis and launched the project, now called GENIUS (POS-CCE, ID 123, SMIS 2637).

3. WHAT IS THE GENIUS CAMPUS?

So, what is the GENIUS Campus?
It is a 30ha area, dedicated to research and advanced human resources education and training, on Sustainable Energy, for developing high-tech products, considered in a very broad sense. The GENIUS Campus will consist of four major parts, Fig. 2:
1. The RTD Institute High-Tech Product for Sustainable Development, PRO-DD. The institute is under construction being financed by a 20 M€ Structural Funds project and by university funds;
2. The students residence area, having in the first step 2 residence buildings for M.Sc. and Ph.D. students and for the PRO-DD guests. In 2010 the buildings will start to grow being financed by the Romanian Ministry of Education and Research. This area will also involve sport and leisure grounds;
3. The education area, along with a conference area will be further developed;
4. Last but not least, the GENIUS Campus will host a specific area dedicated to direct cooperation with companies, as a Business Centre/Scientific Park and as jointly developed clusters between the research providers and research beneficiaries.

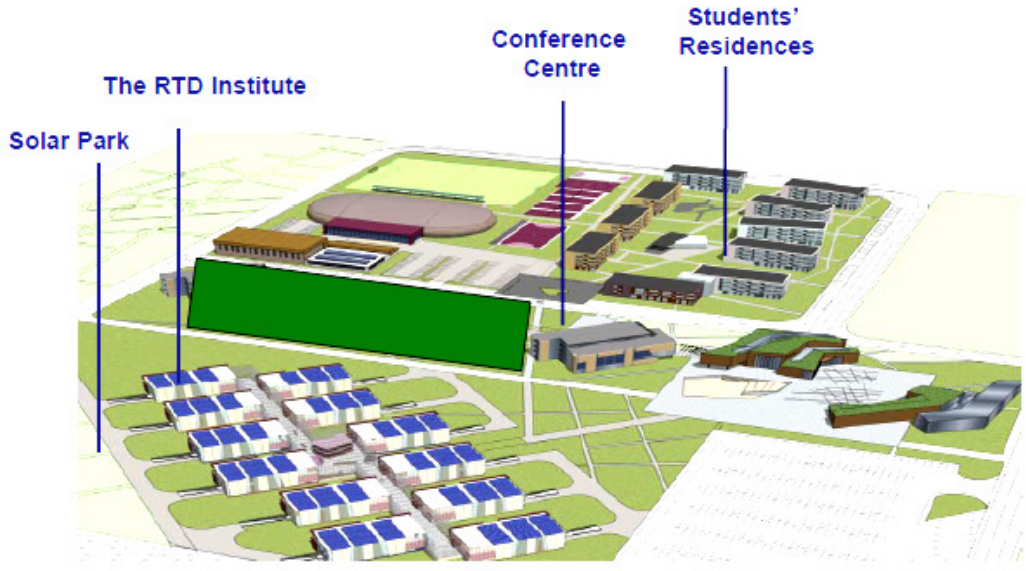

Figure 2. The GENIUS Campus

All the buildings in the GENIUS Campus will act as research stands, optimizing different mixed solutions for Sustainable Energy implementation.

In developing the buildings in the Campus the existent worldwide experience was investigated and used. Similar ideas are developed in Germany (Kaiserslautern University), UK

(Queen Margret College) and in US (as part of large colleges as MIT or Ohio State University). Combined solutions for energy independent regions are already a reality (as it is in the Eastern part of Austria) or in various parts of Germany.

Synthetically speaking, [7], for developing smart and independent energy buildings, the design must consider the drastic reduction of losses (especially heat but also useless power consumption), there must be given a maximal use of the existent natural resources (passive solar design), the energy consumption must be controlled and optimised by a sound management and, finally, renewable energy sources are implemented, Fig. 3:

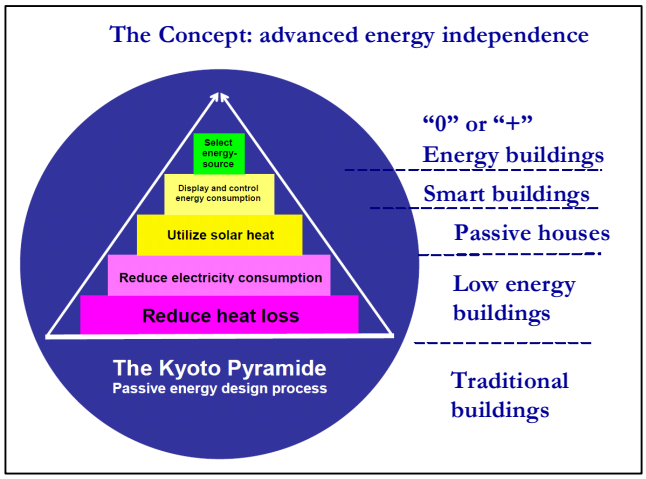

Figure 3. Energy independent buildings

For fulfilling the energy needs for the specific location of the GENIUS Campus (a temperate, mountain area, without any significant wind potential), a renewable energy mix should be considered, making use of sun, geo-thermal energy and biomass (both, for heat and power).

The RTD Institute, Fig. 5, was fully designed by teams from our university, and this was a challenge since all the 12 buildings will be, in the end, "0" energy buildings considering the regular consumption (for heat and power). Some specific features are characterising these buildings:

- they are N-S oriented
- the external envelope (glass and walls) has a very low heat transmittance coefficient
- heating during winter and cooling during summer is provided by heat pumps through novel solutions for floor and concrete heat transfer
- warm water is provided by solar-thermal systems
- beside their regular control, all the renewable energy systems and the buildings habitat will have special data acquisition facilities for monitoring, control and optimization, as research testing stands.

Near the buildings there is the Solar Park which will host the prototypes developed in the research projects (during August this year here there will be installed 4 PV platforms, testing different tracking systems). Residential buildings, involving sustainable energy solutions, will be built in the Solar Park, monitored, and the optimized solutions will be transferred into the market. The 4 ha Solar Park can include a 1MW PV farm.

The PRO-DD institute has 12 intelligent buildings, and the monitoring data are collected into the "Brain" which is the Data Center. Also, PRO-DD is a research area therefore, the Data Center will offer the facilities needed to insure the communication and data management, the security and safety. The Data Center, hosted in one of the buildings been designed as an Green Data Center, both for hardware (with low energy consumption and efficient cooling solutions) and for software (with Tivoli-based optimal management of processes). Besides its primary functionality, the Data Center represents an advanced training tool for M.Sc. and Ph.D. students.

Started in September 2009, the construction of the PRO-DD Institute will be finished in 2011. After that, the existent and the new research infrastructure will be installed. About 40% of the total investment is dedicated to advanced research equipment. By March 2012, the Institute will start to run.

4. WHO IS THE GENIUS CAMPUS?

The most important part of the PRO-DD Institute and of the entire GENIUS Campus are the people.

So, Who is the GENIUS CAMPUS?

The Campus is designed for advanced research and is open to all the research members: staff, M.Sc. and Ph.D. students, post-doc fellows.

Another important part of the GENIUS Campus life is designed through cooperation with companies. Companies involved in research for high-tech development are welcome to open branches in the Campus and to jointly develop research with the teams in the PRO-DD institute. Either as Ph.D. programs or as major projects, cooperation with the economical actors represents a key factor in valorizing and raising the institute. A spin-off result is expected form the youngsters which are supported to develop their own companies, in the Incubator PRO-ENRG, that is part of the PRO-DD Institute. In this view, specific entrepreneurship courses are already developed, and are delivered to the M.Sc. and Ph.D. students in the university.

For delivering quality knowledge, adapted to the university strategy and to the labour market requirements, a new approach of the study offer was implemented in the university.

Starting with 2009, integrated research and education training lines are running. They involve Diploma programs (3 – 4) which graduates can access M.Sc. courses, having a flexible structure; the 2 years master courses offer advanced lectures on the topics of interest (shaped according to the research departments profile) and, starting with the 3rd semester, the students can chose to follow a scientific program that prepares their access into the Ph.D. studies. The research master courses and the Ph.D. programs will all be located into the GENIUS Campus. So far, there are 29 integrated education and research lines. One example is the training line developed in the Department for Renewable Energy Systems and Recycling, Fig. 4:

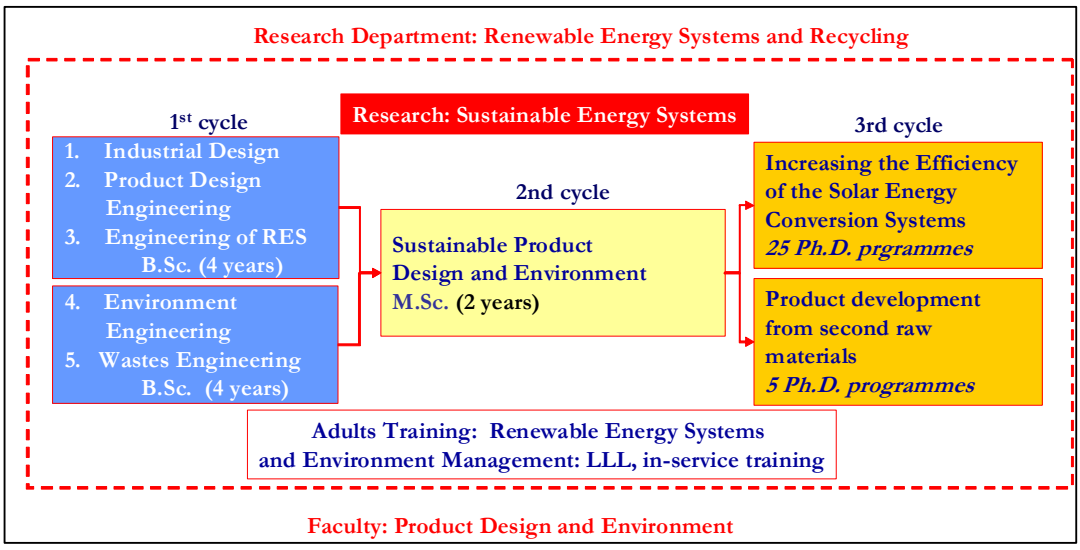

Figure 4. Integrated education and research on renewables and environment

Five 1st cycle programs are offering knowledge on product design, industrial design, renewable energy systems, environment and recycling. As designed, the curricula of all these programs targets to deliver knowledge and to develop basic competencies for new/innovative product development, by respecting the pre-requisites of sustainable energy and environmental

protection. The M.Sc. course has three optional paths, for Advanced Product Design, Design and Management of Renewable Energy

Systems and Environment Process Design. Following one path can be done simultaneously with other courses from the "sister" options, the students having a flexible study program. In the 2nd study year, research positions are available in the paths for Engineering Design and Management of Renewable Energy Systems or on Advanced Materials for Energy and Environment, which are the main research topics of the research department. For the best of the graduates, the Ph.D. programs are opened in these tow topics.

What gave us confidence that this approach is realistic? The research groups in the university have a good past performance, validated in hundreds of international and national joint projects, run with partners all over the world. This experience covers research, education and training projects, in multi-actor partnerships, with academia, RTD entities and companies.

We know that the most demanding but also the most resourceful cooperation is with the economic partners. This is why the university Incubator was launched in 2006 and has now 8 SMEs working on renewables (wind, biomass, sustainable building). This is why the university has strongly supported the development of the Center for Technology and Innovation, which is the prototype manufacturing section of the Institute. This Center has also developed in time specific and validated competencies on intellectual property and supports now all the patent submission process, developed by the university research staff.

Transilvania University is part of the society and acts like an active member in promoting economic growth. Therefore, in the beginning of 2010, Transilvania University, the Brasov Chamber of Commerce and The Brasov Metropolitan Region have developed the Regional Association Supporting Business for Sustainable Development in the 7-Center Region of Romania – ARMADA. This is active in regional projects development, involving industrial partners and not only. The Sustainable Energy Business Center is one of the major projects under development. The Center will be located near the PRO-DD Institute and represents a technology transfer path for the RTD results obtained in the GENIUS Campus. The ARMADA association and the Business Center project have the full support of the local and regional decision makers.

At international level, Transilvania University is part of the European Sustainable Energy Innovation Alliance, ESEIA, holding the vice-presidency of this structure. The Alliance gathers more than 130 members, from the economic area, from academia and RTD entities and acts for developing a frame for innovation and implementation of the research results on sustainable energy.

Staring with 2008, an FP7 program runs, aiming to develop functional clusters on Sustainable Energy, between research providers, research beneficiaries and administrative bodies; coordinated by the Regional Development Agency Centre-Romania, the project strongly involves Transilvania University along with the German Brandenburg Region.

5. CONCLUSIONS

Building a new research and education Campus is a society investment that must be fully justified by needs and projected results. We know that there is plenty of work to be further done and we know that Partnership is the main keyword from now on. Partnership has to be developed with front runners, leading companies, able to stimulate and accept advanced knowledge and progress.

There are many ways in which cooperation can expand: in education and training, in joint RTD projects/programs, in technology transfer or, on long term, in shaping the future society demands.

In the end, a final comment: yes, we all are facing a crisis, a crisis in economy and not only. But, it is the time of crisis when changes are expected to provide solutions. It is the time of crisis when building new strategies, new instruments, new institutions, even a new Campus represents a sustainable solution for our common future.

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GENIUS CAMPUS – UN PRODUS COMPLEX ŞI SUSTENABIL AL UNIVERSITĂȚII TRANSILVANIA DIN BRAŞOV

Rezumat: Universitatea Transilvania din Braşov face pasul în faţă prin dezvoltarea unui campus de cercetare de tip GENIUS (Green, Energy Independent University Campus). Elementul cheie al acestui campus GENIUS este reprezentat prin institutul RTD a cărui infrastructură este dezvoltată în cadrul proiectului "RTD Institute: High-Tech Products for Sustainable development". Proiectul dezvoltă infrastructura pentru resurse umane ale RTD de excelenţă în domeniul dezvoltării sustenabile. Toate cele 12 clădiri sunt proiectate de membrii ai universităţii şi reprezintă fiecare standuri de testare pentru mixuri de energii regenerabile, implementate în clădiri cu nevoi scăzute de energie realizate folosind soluţii moderne de eficienţă energetică şi consum scăzut. Lucrarea de faţă prezintă principalele etape de proiectare şi oferă soluţii pentru principalele probleme din în timpul implementării conceptului de "low energy buildings" în zona montană în care se află locaţia campusului GENIUS. Datele obţinute până în prezent de la sisteme la scară redusă de tipul solar-termal, PV şi pompe de căldură implementate la universitate demonstrează că majoritatea soluţiilor software de proiectare oferă soluţii aproximative, ridicând de obicei costul investiţiei iniţiale sau prezintă soluţii care nu fac faţă în cazul condiţiilor meteorologice extreme. De aceea, pe baza datelor achiziţionate simultan de la cele 12 clădiri, soluţii optimizate de energii sustenabile pot fi dezvoltate şi utilizate, oferind soluţii de proiectare alternative pentru implementarea energiilor regenerabile considerând particularităţile locaţiilor. Rezultatele obţinute fac subiectul transferului de tehnologie spre companii, indivizi sau comunităţi locale, care îşi doresc implementarea soluţiilor de energii sustenabile.

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