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National Centre for Research and Application of Renewable Energy Sources

Slovak University of Technology in Bratislava acquired financial support from the European Fund for Regional Development for the establishment of the National Centre for Research and Application of Renewable Energy Sources in the framework of the "Operation Program Research and Development". Slovak University of Technology in Bratislava (STU) is a research oriented university contributing to the development and spreading of scientific knowledge. Paper deals with the presentation of the activities of the National centre for research and development of renewable energy sources.

Keywords: biomass, hydro energy, laboratories, solar heat

INTRODUCTION

The topic of renewable energy sources has gained so much attention as the internet and information and communication technologies in the 1990s – it has become the hottest and most discussed topic among global leaders, investors and in mass media. The change to renewable energy sources has no analogy since the industrial revolution.

Also problems with fossil fuel - their depletion, the dependence of the many European countries on their import and their price fluctuation increase interest in renewables. Usage of renewable energy sources could decrease aforementioned influence, moreover they influence on environment is no as significant as influence of fossil fuels.

The National Centre for Research and Application of Renewable Energy Sources was established at the Slovak University of Technology in Bratislava (STU). The National Centre is professionally guaranteed by four Faculties of STU:

- Faculty of Chemical and Food Technology
- Faculty of Electrical Engineering and Information Technology
- Faculty of Mechanical Engineering
- Faculty of Civil Engineering

The project implementation assumes configuration of equipment and research teams with variable use enabling very large application range for producers of energy from renewable sources. Variable instrumentation will enable a preparation of new projects in cooperation with business subjects among small and medium companies for production of new product or technologies.

RESEARCH ACTIVITIES OF THE NATIONAL CENTRE FOR RESEARCH AND APPLICATION OF RENEWABLE ENERGY SOURCES

The basic goal of centre of research activities of research teams will be focusing on new, ecological friendly renewable sources of energy, especially from biomass and solar energy. The Centre has three goals:

- establishment of centre of excellence as a network of research teams
- equipment of four laboratories at the faculties by special instruments,
- equipment of centre of excellence by efficient computers

The aim of the Centre is to increase the research and innovation potential of STU, and the integration of research teams concentrated

on new, ecologically acceptable renewable energy sources (RES). Essential subjects of the research are:

- energy and materials from biomass
- solar heat and electricity
- hydro energy

ENERGY AND MATERIALS FROM BIOMASS

Plant biomass is conserved solar energy bound by plant photosynthesis in organic matter. Plant raw materials can be utilized not only for energetic purposes (biofuel, biogas and ethanol production) but also for the production of valuable chemical compounds obtained mainly from crude oil at present. In biomass processing, these processes are employed, see table I.

TABLE I.
Biomass process and methods

Process	Typical methods
Mechanical	pressing, graining, mixing
Physical	distillation, extraction
Chemical	hydrolysis, pyrolysis, combustion
Biochemical	fermentation

In the field of biomass utilization, the Centre concentrates on the utilization of Slovakia's unique renewable raw material – wood. Solution of this problem includes also a technological project of a specialized workplace concerned with processing of wood raw material (graining, drying, mixing) and design of processed raw material pelletization technology for the preparation of pellets suitable for the use in pyrolysis tanks.

SOLAR HEAT AND ELECTRICITY

Sun is the biggest energy source in the Solar system. Solar energy captured by Earth in a minute would suffice for the whole mankind for a whole year. In numbers it represents the power output of 10 000 kW per person.

In the field of solar energy utilization, the Centre concentrates on the research of new semiconducting materials allowing production employing available solar cells with good efficiency. Concerning energetics, the Centre investigates possibilities of solar power plant integration into the electricity supply system. The inconsistency of solar radiation intensity in Slovakia requires an inclusion of energy accumulation equipment in bigger systems.

HYDRO ENERGY

Primary hydro-energetic potential is in the renewability of energy sources which belong to natural assets of every country. The technically exploitable part of the hydro-energetic potential is possible to be enlarged in two ways:

Considering existing water constructions with energy exploitation, it is mainly the optimization of the operating routine, when better manipulation with water is examined.

Another possibility is the design and realization of new waterworks on at present not exploited water courses. The choice of locations, especially on the river Hron and other smaller water courses has to respect not only the legislation specifications but also the protection of environment of the river and its surroundings.

The National Centre is engaged in the research of the primary hydro-energetic potential utilization increase considering Slovakia's water traffic safety.

National Centre offer cooperation in following research topics:

- utilization of biomass energy
- utilization of solar energy
- utilization of hydropower potential
- connecting of decentralised renewables into interconnected power system
- computer modelling and simulation of multiphysical tasks
- photovoltaic systems simulation

The National centre develops research activities in the field of renewable sources also via investment to the new equipments. More than 20 new apparatus, equipments and new software were already bought trough the implementation of the EU project which is supported by the Research and Development Operational Programme funded by the ERDF. Among these apparatus belong e.g. FTIR microscope, Laser doppler anemometer LDA, KATJA 25 CEC, and many others, software e.g. SimaPro, Cosmo, Efekt. List of all apparatus and equipments is available at centre web page: www.nc-oze.stuba.sk and their description is also available in booklet.

Other apparatus, equipments and new software were provided via other project, also supported by the Research and Development Operational Programme funded by the ERDF, named Finalizing of the National Centre for Research and Application of Renewable Energy Sources.



Figure 1. Apparatus of the National Centre - Cogeneration unit



Figure 2. Apparatus of the National Centre - Thermovision camera

ACTIVITIES OF THE NATIONAL CENTRE FOR RESEARCH AND APPLICATION OF RENEWABLE ENERGY SOURCES

Activities of the Centre contribute to the competition ability and success of STU in international research cooperation. Realization of top research also provides for the transfer of newest knowledge into the university's study programs educating young generation of specialists. Among the foreign institutions which cooperate with NC OZE belong e.g. Goce Dolčev University Stip in Republic of Macedonia, Instituto Superior de Engenharia do Porto in Portugal, universities in Czech Republic and Ukraine.

Cooperation between STU in Bratislava and Goce Dolčev University Stip in Macedonia is focusing on the smart grid technologies, via VEGA grant called 'Smart grid as part of power distribution networks - new measurement methods and consumption control methods. The project is aimed at complex analysis of possibilities of building intelligent networks. It analyzes and solves the issue from the point of view of network functionality, its elements, their mutual relations and the impact on electricity market. The project deals with the creation of a laboratory model of smart grid and solution for optimization of production, consumption and electric power accumulation (including accumulation in the form of hydrogen). Results of smart grid analyses shall be applied to definition of a new subject – Operator measured electricity consumption data and for the proposal of methodology of management and appraisal of energetic efficiency of lighting systems.

The project which The National Centre for Research and Application of Renewable Energy Sources prepared with Instituto Superior de Engenharia do Porto in Portugal is aimed at a bilateral cooperation between both universities in the field of renewable energy sources. Research is orientated at the comprehensive analysis of the renewable energy sources, which include the issue of the impact of RES to the environment, to the quality and reliability of electricity supply as well as an analysis of connecting these sources to the electricity system. The main objectives are common active participation at the scientific conferences and training courses focus on the RES in Slovakia and in Portugal and preparation of published output from joint activities focus on the RES. Young scientists will be involved in the project what can increase their professional knowledge.

OTHERS ACTIVITIES OF THE NATIONAL CENTRE FOR RESEARCH AND APPLICATION OF RENEWABLE ENERGY SOURCES

Except the research and development activities in above mentioned fields, the Centre is active in the educational activities for primary and secondary schools and also for public.

One of the activities is presentation at the Researchers' Night (figure 3). It is a European-wide project supported by the European Commission aimed on presentation of scientists and popularization of science. It shows scientists as ordinary people that have their hopes, dreams and families and contribute to welfare of the whole society.



Figure 3. Presentation of the National centre at the Researchers' Night

Among others activities belong seminars at primary and secondary schools where the renewable energy sources are presented in an easy and suitable way for students. It is possible to present them just small models therefore we organize also presentations in our laboratories. We offer them e.g. pumping power plant (figure 4), high voltage laboratory (figure 5) and many other models from our laboratory of the renewable (heat pump, wind turbines).



Figure 4. Pumping power plant at Faculty of Electrical Engineering and Information Technology of Slovak University of Technology



Figure 4. High voltage laboratory at Slovak University of Technology in Bratislava

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