1 INTRODUCTION

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The European Union has recognized the enormous potential for the development in the field of energy efficiency and renewable energy sources. The EU 2020 and EU2030 goals (the increase of renewable energy share to at least of 27 % of the EU's energy consumption) and the Roadmap 2050 defined ambitious EU goals with respect to the increase of renewable energy use; however, they did not define a common policy for the member states. EU27/28 defined their own contributions and tools for supporting RES development.

According to the EU energy statistics (European commission, 2017), the share of renewable energy sources in final energy consumption at the end of 2015 was 29% in Croatia and 14.5% in Hungary, respectively. The national target accounting for RES in 2020 is set to 20% for Croatia and 13.0% for Hungary, respectively. Although Croatia and Hungary are RES overachieving country, it needs to be emphasized that the majority of RES in Croatia comes from conventional hydro power plants and wind power plants located outside the cross-border region, while biomass is used mostly for traditional heating while it comes mostly from traditional biomass in Hungary. On the other hand, the cross-border area of Croatia and Hungary has a great potential of RES, especially of sun, geothermal and biomass energy in rural areas that can be used for power and heat generation.

The usage of RES and EE measures in a rural area is very important in achieving these targets. RES can be used for both heat and power supply of consumers not connected to an energy grid instead of using fossil fuels. RES can be used for electricity and heat supply of small agricultural economies and other objects in the rural area often not connected to energy grids or lacking economic sustainability regarding rising energy costs. The usage of RES and EE measures can help directly in CO2 emissions reduction replacing fossil fuels and lowering energy consumption.

The Faculty of Electrical Engineering, Computer Science and Information Technology Osijek (FERIT) and Hungarian Academy of Sciences, Institute for Regional Studies, Centre for Economic and Regional Studies (MTA KRTK) have already successfully implemented the REGPHOSYS project whose objective was to find an optimal configuration of PV systems for the cross-border Croatia and Hungary area according to regional technical, economic and meteorological conditions. Cooperation of these two institutions has been established through the successfully implemented REGPHOSYS project and substantial research in the field

of RES in the cross-border region has been conducted and published. The idea is to continue this cooperation through the RuRES project and extend the research to including a new partner, Kaposvar University. RuRES has included research in the field of RES and EE aiming to study rural development in the cross-border region. Introducing a new partner Kaposvar University, additional knowledge and experience is available and the team of experts are expanded. The Kaposvar University project team will help with research in the field of biomass and waste management, usage for energy purposes and development in the rural area. According to PV GIS, 2018, there is a significant solar energy potential with global irradiation on optimally inclined surface of approx. 1,400 kWh/m2 yearly. Geothermal temperature gradient in the Pannonian basin is significantly higher (approx. 0.049 K/m) than the world average with hot dry rocks and geothermal reservoirs present. The elaborated survey (Ivanović & Glavaš, 2013) indicates a significant potential of the biomass waste usage in the cross-border area of Croatia. A similar survey needs to be done for the cross-border area of Hungary. Since there is a great RES potential in the rural area of the cross-border region that has still not been used enough, it is important to investigate ways of RES usage in rural areas, develop typical energy system related technical solutions for specific conditions in rural areas, investigate how the use of RES and EE can influence rural development and study economic, social and environmental impacts.

The aim of this project is to undertake scientific research and propose RES and EE measures for rural development in the cross-border region.

There are three overall objectives of the project:

1. develop a typical RES system for energy supply in the rural areas;
2. provide a set of recommendations for EE improvement and waste management in the rural area;
3. investigate economic, social and environmental impacts of RES and EE in the rural area of the cross-border region.

A short-term perspective is to disseminate information on RES, EE and waste management in the rural areas of the cross-border region. A long-term perspective is to increase RES usage, improve EE, sustainable waste management as well as reduce fossil fuels usage, CO2 emissions and energy cost. The specific objectives are to expand cross-border innovation and a research network, develop typical RES systems for energy supply in the rural areas for specific conditions and foster cooperation between institutions engaged in the project.

The expected results of the project are as follows:

- a model developed for stakeholders/local governments which demonstrates their RES and EE potentials and provides suggestions for further development;
- newly purchased equipment settings and a simulator which can help demonstrate how to build a small-scale proper RES system in the rural area;
- a website where stakeholders can be informed on the most recent results of our measurements and research to be used for their purposes;
- a trilingual book summarizing the most important project results for the scientific audience and stakeholders;
- the final conference where the results will be discussed with both the scientific audience and stakeholders and research findings disseminated;
- trainings for local stakeholders in the rural areas, namely one in Osijek-Baranja County, one in Baranya County and one in Somogy County.

This book aims to summarize the main results of the RuRES project using a multidisciplinary approach. In addition to elaborating on the measuring results in the rural areas, the chapters provide an overview of the given and researched area taking into account the geographical, social and economic conditions analyzing the perspectives, attitudes and potential behaviors of everyday people. The book also gives a review of the potential impact of renewable and energy efficiency investments in a rural area.