Renewable energy sources and energy efficiency in a function of rural development

Detailed work and research plan

RuRES

(HUHR/1601/3.1.1/0033)

Interreg V-A Hungary-Croatia Co-operation Programme 2014-2020

RuRES
Renewable Energy Sources and Energy Efficiency in the Function of Rural Development

A cross-border region
where rivers connect, not divide

CONTENT

1 GENERAL INFORMATION

Lead beneficiary:

Josip Juraj Strossmayer University of Osijek, Faculty of electrical Engineering, Computer Science and Information technology Osijek

Beneficiary 1:

Centre for Economic and Regional Studies, Hungarian Academy of Sciences

Beneficiary 2:

Kaposvar University

Website:

www.rures.eu

Facebook page:

https://www.facebook.com/RURESHUHR/

2 PROJECT ACTIVITIES, OUTPUTS AND INDICATORS

Project activities are:

1. Project administration and management
2. Information and publicity
3. Collection and analysis of technical, economic, social and environmental data regarding RES and EE
4. Elaboration of detailed research plan
5. Research and development
6. Evaluation of the research results and developed system
7. Investigating economic, social and environmental impacts of the research and development results
8. Documentation of results
9. Dissemination of gathered results
10. Implementation of developed typical system in rural area
11. Training for the stakeholders in rural areas
12. Study visit.

Expected project outputs:

- A model developed for stakeholders/local governments which shows them their RES and EE potentials and suggestions what to develop.
- 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 book in three languages, which summarizes the most important results of the project for the scientific audience and for stakeholders.
- The final conference at which the results will be discussed with both the scientific audience and stakeholders and when research findings will be disseminated.
- Trainings for local stakeholders in rural areas, one in Osijek-Baranja County, one in Baranya County and one in Somogy County.

In table 1. project indicators are presented.

Table 1. Project indicators

No.	Type	Indicator	Unit	Base-line value	Target value	Target value realized by LB/Bs
SO1	result	Number of entities participating in cross-border networks and bilateral co-operations	pcs	3	15	LB:5; B1:5; B2:5 entities will participate in workshops, trainings and final conference.
SO2	output	Number of institutions participating in JOINT capacity building activities	pcs	0	3	LB:1; B1:1; B2:1; institutions participating in the project for joint capacity building activities
SO3	output	Number of harmonized processes, shared initiatives, coordinated policies developed JOINTLY	pcs	0	4	LB:1; B1:2; B2:1: 1 scientific book, 1 developed research plan, 1 joint survey, 1 training material developed
SO4	output	Number of participants in JOINT capacity building activities	persons	0	30	LB:10; B1:10; B2:10; people will participate in trainings (and workshops) as the main activity of capacity building
G5	output	Number of project events (conference, workshop, meeting, seminar, study tour, exchange programs etc.)	pcs	0	14	LB:6; B1:5; B2:4; One Kick-off meeting, six project team meetings three workshops, three trainings and one final conference will ensure the joint cooperation in connection with the actions in the project.
G8	output	Number of newly established/developed JOINT project homepage	pcs	0	1	B1:1; MTA KRTK will host and all the beneficiaries will develop the project specific new webpage in 3 languages

G4	result	Number of people directly benefiting from the project (e.g. participants of events, trainings, workshops, etc.)	persons	0	100	LB:40; B1:30; B2: 30; people participating at workshops, trainings and final conference can benefit directly from the project getting new information.
G7	output	Number of newly elaborated/harmonised documents (development plans, studies, researches, surveys, technical and training materials)	pcs	0	4	LB:1; B1:2 B2:1; A 3 language scientific book; one research measurement; one survey and one training material will be developed.
H2	output	Number of locations where renewable energy resources are introduced by the project	pcs	0	1	LB:1; LB will establish RES for demonstrational and measurement/research purposes
H3	output	Number of awareness rising events (workshops, trainings, educational programmes) targeting or promoting sustainable development, environmental education and natural assets	pcs	0	6	LB1:2; B1:2; B2:2; each partner will organise 1 workshop and one training in order to promote sustainable development, small scale use of RES in rural areas
C1	output	Number of new methods and forums for knowledge transfer established by the project	pcs	0	1	B2:1; Jointly we develop a new method for training local stakeholders (e.g. farmers, local governments) how to start to use small scale RES and EE
C7	output	Number of capacity building training and educations for stakeholders delivering social	pcs	0	3	LB:1; B1:1; B2:1; There will be 3 joint two-day long trainings for local stakeholders how to use RES and EE and how to

		services (e.g. education, sport etc.,)				educate these to other actors in rural areas
PS1	result	Number of universities participating in the joint research project	pcs	0	2	LB:1;B2:1
PS2	result	Number of organizations utilizing new research function	pcs	0	1	LB:1; will use new RES technology for scientific and educational purposes
PS3	result	Number of SME-s benefiting from the Research & Development & Innovation of the project	pcs	0	15	LB:5; B1:5; B2:5; Workshops, trainings and closing conference, handout and scientific book will provide benefit for SME-s.

Project is divided in periods:

- 1st period (01/09/2017 – 31/12/2017)
- 2nd period (01/012018 – 30/04/2018)
- 3rd period (01/05/2018 – 31/8/2018)
- 4th period (01/09/2018 – 31/12/2018)

3 TASKS AND DEADLINES

For each project activity one of the project partners will be defined as an activity coordinator. In table 2 project activities coordinators and responsible partners are shown.

Table 2. Project activities coordinators and responsible partners

Activity No.	Coordinator	Responsible
1	FERIT	FERIT, MTA KRTK, Kaposvar UNI
2	Kaposvar UNI	FERIT, MTA KRTK, Kaposvar UNI
3	FERIT	FERIT, MTA KRTK, Kaposvar UNI
4	FERIT	FERIT, MTA KRTK, Kaposvar UNI
5	FERIT	FERIT
6	FERIT	FERIT, MTA KRTK, Kaposvar UNI
7	MTA KRTK	MTA KRTK, Kaposvar UNI
8	FERIT	FERIT, MTA KRTK, Kaposvar UNI
9	Kaposvar UNI	FERIT, MTA KRTK, Kaposvar UNI
10	FERIT	FERIT
11	Kaposvar UNI	FERIT, MTA KRTK, Kaposvar UNI
12	FERIT	FERIT

3.1 Tasks and deadlines regarding activity no. 1

FERIT will be coordinator for activity no. 1 - Project administration and management. According to Project Implementation Handbook responsibility will be shared among the project partners. FERIT will create google drive folder for purpose of internal documents exchange.

3.2 Tasks and deadlines regarding activity no. 2

Kaposvar UNI will be coordinator for activity no. 2 - Information and publicity. MTA KRTK will create project website – deadline November 15th, 2017. Website webmaster

will be György Váradi (varadi@rkk.hu). Each project partner will appoint one person as website administrator. Website administrator for MTA KRTK will be György Váradi (varadi@rkk.hu). Website administrator for FERIT will be: Mario Primorac (mario.primorac@ferit.hr). Website administrator for Kaposvar UNI will be Zita Peka (peka.zita@ke.hu).

FERIT will create Facebook (fb) page of the project. Each project partner will appoint one person as fb page administrator. Fb page administrator for FERIT will be: Matej Žnidarec. Fb page administrator for MTA KRTK will be: Sándor Zsolt Kovács (skovacs@rkk.hu) Fb page administrator for Kaposvar UNI will be Zita Peka (peka.zita@ke.hu).

Danijel Topić from FERIT will create project page on his Researchgate (scientific social network) profile for purpose of dissemination of scientific papers written during the project implementation.

FERIT will be responsible for visibility tasks according the AF – logo design, poster designs, and billboards for final conference. MTA KRTK will be responsible for editing, design and printing of the book.

To each event that will be organized during project, JS representative will be invited to attend. Project partner which organize event will be responsible for invitation.

3.3 Tasks regarding activity no. 3

FERIT will be coordinator for activity no. 3 - Collection and analysis of technical, economic, social and environmental data regarding RES and EE. FERIT will collect data about potential of renewable energy sources in primary energy for Osijek-Baranya County. MTA KRTK will collect data about potential of renewable energy sources in primary energy for Baranya County. Kaposvar UNI will collect data about potential of renewable energy sources in primary energy for Somogy County. Focus will be primarily on solar energy and biomass energy. Potential about biomass will be investigated for all three counties.

MTA KRTK will be responsible to make investigation about economic, social and environmental data about RES. Kaposvar UNI will be responsible for investigation data about waste.

FERIT will collect newest and most relevant literature regarding renewable energy sources and energy efficiency (scientific papers, books, reports). After collection of all

data, FERIT will be responsible for analysis of RES potential in rural areas of cross-border region.

3.4 Tasks regarding activity no. 4

FERIT will be coordinator for activity no. 4 - Elaboration of detailed research plan. This document is result of this activity. It will contain clear responsibilities among partners, schedules and methodologies. Project meetings will be organized in order to follow realization of this research plan. Each project partner will organize two project meetings. One project meeting will be organized in 1st period by FERIT. Two project meeting will be organized in 2nd period. One by MTA KRTK and one by Kaposvar UNI. One project meeting will be organized in 3rd period of the project by FERIT. Two project meeting will be organized in 4th period. One by MTA KRTK and one by Kaposvar UNI.

3.5 Tasks regarding activity no. 5

FERIT will be coordinator for activity no. 5 - Research and development. FERIT will purchase new equipment for purpose of research. Newly purchased equipment will be installed and tested. Also, equipment purchased in previous REGPHOSYS project will be used for research purposes. Measurements about power quality and electricity generation from photovoltaic systems will be conducted. Based on data collected and conducted analysis in activity no. 3 researchers from FERIT team will propose RES systems for application in rural areas and will propose measures for improvement of energy efficiency.

3.6 Tasks regarding activity no. 6

FERIT will be coordinator for activity no. 6 - Evaluation of the research results and developed system. Based on research results scientific papers and book will be prepared and published. Experienced researchers (prof. Šljivac and prof. Pelin) will evaluate research results and developed system.

3.7 Tasks regarding activity no. 7

MTA KRTK will be coordinator for activity no. 7 - Investigating economic, social and environmental impacts of the research and development results. Impact of research results on economic, social and environmental conditions in the rural area will be investigated. The impact evaluation is based on the situation analyses (especially in activity No.3) and additionally, we use the elaborated model for this purpose.

3.8 Tasks regarding activity no. 8

FERIT will be coordinator for activity no. 8 - Documentation of results. After research and analysis of obtained results, the whole process will be documented.

3.9 Tasks regarding activity no. 9

Kaposvar UNI will be coordinator for activity no. 9 - Dissemination of gathered results. Project team members will prepare scientific papers for three different conference:

- The 75th anniversary conference of the Transdanubian Research Institute – Pecs, April 2018 (2 papers)
- PLIN 2018 – Osijek, September 2018 (2 papers)
- SST 2018 – Osijek, October 2018 (2 papers).

FERIT will organize one workshop.
MTA KRTK will organize one workshop.
Kaposvar UNI will organize one workshop.
FERIT will organize final conference

3.10 Tasks regarding activity no. 10

FERIT will be coordinator for activity no. 10 - Implementation of developed typical system in rural area

3.11 Tasks regarding activity no. 11

Kaposvar UNI will be coordinator for activity no. 11 - Training for the stakeholders in rural areas.

Trainings for local stakeholders: 1st Training will be organized in Kaposvar with the field research (get feedback about needs from local stakeholders – training participants) (2nd period) – based on this experience one tra organize ining will be organized in Osijek (Croatia) and one training in Pecs (Kaposvar) (4th period).

3.12 Tasks regarding activity no. 12

FERIT will be coordinator for activity no. 12 – Study visit. Five researchers from FERIT will visit Gussing, place of good practice in renewable energy. After the visit FERIT members will share Gussing model experience to other project members.

4 RESEARCH PLAN

The research will focus on cross-border rural areas in regional level. There are three research territories: two counties in Hungary (Baranya County, Somogy County) and one county in Croatia (Osijek-Baranja County) that we are focusing on. Hungarian counties are located in the South-Transdanubia region in the Southwest part of the country which refer to their peripheral status. Their natural barriers are the Danube river in the East, Dráva river in the South and lake Balaton in the North. The terrain is well-divided and rich in groundwater resources. The settlement structure consists of extensive rural areas which located on the South part of Somogy and Baranya Counties (e.g. Ormánság, Belső-Somogy). The proportion of the small villages are high. These can be characterized by high level of economically inactive people so their economic competitiveness is low. Both counties have population decline with ageing population structure.

On one hand a detailed geography based research will be conducted based on statistical data analysis. On the other hand, we will conduct a representative survey to examine the habitant's attitude toward the use of renewable resources in settlement level. Additionally, taking into consideration spatial development plans, we will make an analysis about the potentials in the sense of planning activities and capability. Finally, we made case studies to gain empirical and more detailed results about the background of using renewable energy sources.
In the second phase of the project (activity No. 7) we are elaborating a model based on the preliminary investigations. The model can give an overview about the renewable potential in the analysed region, focusing on the rural areas. It also includes the potential impacts from different viewpoints.

The researches of MTA KRTK - besides additional investigations and the geographical description - are focusing on the following main tasks answering the following research questions:

KRTK's research questions

Q1 - What kind of renewable (not only theoretical but real) potential available in the research area?

Q2 - What is the attitude of households and local actors towards renewables and EE

Q3 - What is the role of (local) territorial management in renewable and EE investments?

Answering the first research question a detailed desktop research will be carried touching the above described area. Based on statistical data gathering. In the first step (activity No.3.), we will examine these territories' geographical background in general. We collect data about three aspects: environmental, economic and social indicators from HCSO (Hungarian Central Statistical Office) to strengthen the potential of renewable resources. For example: environmental (the number of sunny hours) social (demographics) and economic (the ratio of unemployment).

The use of renewable energy and energy efficiency in Europe is in the forefront on all policy and governmental level. However, RES investments are depending on the wider society, not only on major investors. Researcher have studied environmental attitudes for over four decades. Much of this research has sought to determine what factors are related to these attitudes. Past research has shown that certain social and demographic variables tend to have a positive influence on environmentalism. Hence, attitude, motivation of receiving society is crucial, especially in a backward region such as the target territories of the project. Therefore, we are conducting a representative survey focusing on the most underdeveloped micro-regions of Baranya and Osijek-Baranya counties in order to reveal local motivations, attitude towards RES and EE and to make a comparison between the two culture. The results can give input to the real RES and EE potentials of the regions rural area.

As a second step of social analysis we will analyse the environmental attitudes of settlement leaders/mayors in the rural areas of Baranya county. We will analyse 163 settlements in Baranya county which below 1000 inhabitants. We will compare the socio-cultural attributes (trust – generalized trust, institutional trust, educational level, sex, age) and environmental attitudes at the mayor of the small settlements.

Analyzation of LEADER Action Groups in Baranya and Somogy County (15-17 LEADER Associations) can answer the third research question.
The points of view of the analyzation:

1. ***Local Rural Development Strategies***: Is there appearing importance of energy efficiency and/or renewable energy in the local development concept? If there is, what is the local background, why the communities and the microregions think important this sector. If there is not, we would like to see the reasons.
2. Analyzation of the **project level**: The main question: Is there energy efficiency or renewable energy projects present by local actors in the development process. Base condition: Call for tenders in this topic on the base of the local development strategy.
3. Analyzation of the ***population's attitudes*** and the ***local elite's attitude*** about the importance of the renewable energy to know the local support of these projects.
4. We would like to know the ***influencing factors*** of the investment in the renewable energy sector (supports, attitudes role of local elite, engagement, presence of enterprises related on energy sector, impact of good practices)
5. What kind of ***support and local development policy*** can enlarge the investment in the renewable energy?

Methods

- Studying the strategy documents of the LEADER LAGs
- Picking the data bases of the submitted projects and comparison the winner projects. Analyse of data.
- Questionnaire (all members of the presidency of LAGs)
- Interview with
    - mayors of most important settlements

- leader of the work organization of the LAGs
- projects winners and implementers
- local rural development plan makers.

Modelling phase of RuRES project

Based on the above described complex analyses we are elaborating a ***model*** that can indicate the possibilities of RES and EE use in the region and their potential impacts. The RuRES's economic model will be developed for local stakeholders, which shows them their RES (solar, biomass, geothermal) and EE development possibilities. For the real results, our model contains the following different modules or methods:

a) data collection: the project team have to collect technical (parameters of equipment, types of RES systems for households, energy potentials and usefulness of different types of energy sources etc.), economic (prices, costs, benefits, previous local RES developments etc.) and social (e.g. local attitudes) data and have to measure and collect the local RES and EE potentials and technical, legal or economic limits (all members will collect data from own county).

b) data analysis: the model uses some methods for the evaluation of potentials and possibilities

c) suggestions: our model add some feasible development possibilities for stakeholders and these results will help for the comparison of different technologies (with tables, figures or other visual application) or consumption of other renewable energies (new technologies).

On the one hand this model will be a cost-benefit analysis of different RES potentials and technologies; on the other hand it shows some new local innovations, where the RES and EE opportunities are not exploited.

Kaposvar UNI

Objectives of the proposed research

There are two main sides of the research:

1. Public acceptance of renewable energy sources based on biomass in rural communities of Hungary

2. Assessment of the potential biomass supply for local communities in Hungary

Objectives for the "Public acceptance of biomass" part include the following:

- To reveal the attitude of rural stakeholders regarding renewable energy sources based on biomass and the level of their acceptance in a local society;
- To investigate the benefits and limitations of already existing biomass/biogas plants;
- To estimate the impact of biomass usage in energy efficiency improvement based on opinion (experience) of local actors (rural population, companies)

Research questions to answer:

- Do rural stakeholders accept the form of energy supply based on biomass?
- What positive aspects do they see regarding the biomass-use in the given region?
- What negative aspects do they see regarding the biomass-use in the given region?
- Are they willing to participate cooperative activities for energy efficiency improvement in a local community?

Objectives for the "Assessment of biomass potential" part:

- To identify possible sources for a biomass usage in rural areas (agriculture, households);
- To make an assessment of biomass and waste potential capacities for energy purposes on micro region level;
- To built comparison model between a different Hungarian regions and settlements accordingly the results

Research questions to answer:

- Do rural areas have a quality supply of biomass for use?
- What kind of sources can be used for biomass production in a particular territory?

- What is the biomass potential of the given rural area? (redistribution of resources, e.g. energy crops)
- Which region has a more preferable position/location in case of biomass supply?
- (comparison model)

Methods to be applied

Methodology of the research for the “Public acceptance of biomass” part:

A. Investigation locations and target auditory

It is supposed to select an appropriate rural communities in Hungary with the existing renewable energy sources based on biomass in order to investigate the experience of the rural stakeholders and other local actors regarding the energy efficiency improvement and environmental sustainability in a local community level.

At the present time, Törökkoppány village, located in Somogy county, is considered as the potential platform for the survey, it has an existing working biomass plant and other smallscale energy developments. The deep interview with the leader of the rural community was agreed.

B. Development and design of questionnaire

The basis of the questionnaire is expected to be designed according the appropriate literature previously tested the same methodology. As an exemplary scientific paper may perform the “Local acceptance of existing biogas plants in Switzerland” (M. Soland, et al., 2013).

Questionnaire description: range of potential factors that directly and indirectly influence local acceptance [8].

C. Procedure of the survey

Direct distribution of questionnaires among the respondents.

D. Data collection and measurement (primary research)

Respondents sample description: gender, average age, socio-economic status of the participants.

For collecting data regarding to technical issues we will use the following formats:

Solar radiation

For solar radiation potential we should use PV GIS.

Table 3. Global, direct and diffuse monthly and annual irradiation for Osijek-Baranya, Baranya and Somogy counties will be collected based on PV GIS

Location	Osijek-Baranya County			Baranya			Somogy		
Month	Global (kWh/m^2/day)	Direct (kWh/m^2/day)	Diffuse (kWh/m^2/day)	Global (kWh/m^2/day)	Direct (kWh/m^2/day)	Diffuse (kWh/m^2/day)	Global (kWh/m^2/day)	Direct (kWh/m^2/day)	Diffuse (kWh/m^2/day)
Jan									
Feb									
Mar									
Apr									
May									
Jun									
Jul									
Aug									
Sep									
Oct									
Nov									
Dec									

Biomass

Biomass can be divided by her origin. It can origin from agriculture, forestry or solid waste [1].

- Agriculture biomass

Agriculture biomass can be divided into following categories [1]:

- Farming (harvest and gardening remains, single-year or perennial energy crops)
- Cattle breeding (liquid and solid manure)
- Perennial crops – energy crops, tree branches, perennial crops maintenance (vineyards, orchards, olive groves)

Biogas

Biogas is a mixture of gases produced by anaerobic digestion of organic matter formed mostly of CO2 and methane. Average heating value of biogas is 21 MJ/m3. Biogas can be used for heat production, electricity production or combined heat and power generation. Biogas can be produced with mono-digestion of manure or co-digestion of manure and corn silage. Potential of biogas production can be calculated as in (1) [1].

where:

BP – energy potential of produced biogas

m – mass of cattle, pig or poultry manure which is produced in the county [t/year]

oST – dry matter content in fresh organic matter

p – methane yield per unit of dry matter in fresh organic matter [m3/t oST]

k – lower heat value of methane [kWh/Nm3]

Table 4. Annual energy potential of biogas production for.

Raw material type	Manure availability [t/year]	Theoretical energy potential [MWh/year]	Theoretical energy potential [TJ/year]
Biogas production in mono-digestion			
Cattle manure			
Pig manure			
Poultry manure			
Raw material type	Necessary growing area for corn silage	Theoretical energy potential [MWh/year]	Theoretical energy potential [TJ/year]
Biogas production in co-digestion with corn silage (mass ratio of silage is 30%)			
Cattle manure + silage			
Pig manure + silage			
Poultry manure + silage			

Liquid biofuels

Liquid biofuels are produced from biomass which are used for motor vehicle drive and can be derived as bioethanol and biodiesel. Most common raw matter used for biodiesel production are rapeseed and soy while for bioethanol are corn and sugar beet. Table 5 gives annual biofuel production potential in Osijek-Baranya county [1].

Table 5. Annual biofuel production potential

Raw material type	Raw material mass [t/year]	Biofuel quantity [t/year]	Lower heat value [GJ/t]	Theoretical energy potential [TJ/year]
Bioethanol				
Corn (a.v.) *				
Sugar beet				
Biodiesel				
Rapeseed				
Soy				

* Average value

Forestry biomass

Most commonly used wood biomass which are used for energy purposes are wood, wood chips, bark, sawdust, wood shawing, briquettes and pellets.

Table 6. Theoretical energy potential of energy production from wood biomass

Wood stock [m^3]	Total annual increment [m^3]	Annual allowed wood use (including conifers) [m^3]		Theoretical energy potential of annual allowed wood use (including conifers)			
				Planned cutting		Realised cutting	
		Planned cutting	Realised cutting	GWh	TJ	GWh	TJ

Solid waste biomass

Potential sources of solid waste biomass are biodegradable part of facility waste and food-processing industry like liquor industry, fruit processing, sugar refineries, slaughterhouses, grain processing, oil refineries and other primary processing and food industry. Furthermore, solid waste biomass can origin from wood industry like waste from wood processing, products from wood and plum and products from straw. Table 7. gives theoretical energy potential from solid waste biomass.

Table 7. Theoretical energy potential of energy production from solid waste biomass

Raw material type	Available waste [t/year]	Theoretical energy potential [MWh/year]	Theoretical energy potential [TJ/year]
Slaughterhouse waste			
Wood industry waste			