Photovoltaic Systems as Actuators of Regional Development OF THE HUNGARY-CROATIA IPA CROSS-BORDER CO-OPERATION PROGRAMME 2007-2013

Acronym:

REGPHOSYS HU-HR

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Detailed research plan

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Hungary-Croatia IPA Cross-border

Co-operation Programme 2007-2013

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Background,

With the strengthening and far-reaching effect of the environmental policy the idea of environmental policy integration (EPI) has come to the front in the last decades. The fifth EU Environmental Action Programme urged the assessment of the environmental impact in policy planning, consideration of environmental costs and benefits, monitoring of environmental effects, co-operation with environmental authorities and public availability of environmental information (Lenschow, A. 1999).

Since 1987 the well known idea of "sustainable development" (WCED, 1987) has played an increasingly important role in policy making. In regional policy, in regional planning several evaluating tools are used in order to obtain a better development plan, programme or policy. First in 1988, during the reform of Structural Funds the ex-ante and mid-term evaluation was drawn up and became obligatory in programs and plans. Then between the period of 1994 and 1999 the concept of ex-ante and ex-post evaluation in members' programs was defined. Parallel with these evaluation tools – which are mainly focusing on economic aspects – environmental evaluation was coming into the forefront. (Thérivel, R.–Partidário, M. 1999).

There is a commonly accepted approach in literature that landscape is an extremely complex category. Landscapes do not only have a physical reality, but also mental, social and cultural. Therefore it should be considered as holistic and dynamic entities. (Antrop, 2000; Antrop and Van Eetvelde, 2000; Tress et al., 2001; Van Eetvelde and Antrop, 2004; Van Eetvelde and Antrop, 2009). Based on this approach, the hypothesis of project is that geographical environment/location, the land-use/landscape forms of a given area/region, also landscape as a footprint of social and economic peculiarities can influence the local decision-making. If a landscape and land-use forms relate to a nature-close environment, it would influence the governing/decision-making forms, it would facilitate a more environmental-friendly decision-making and would result a deeply integrated environmental policy in regional development. It means that in order to achieve the mentioned goal an environmental friendly operation of the economy and society is needed. Energy efficiency and the use of renewable energy is a key issue to achieve environmental-friendly decision making.

Preventions and solutions to environmental problems require the understanding and prediction of natural and social patterns. Development activities, tourism development decision making and land use planning can cause changes in landscape; hence focus should not be only on conservation and protection, but also on sustainability. Analysis of landscape allows to define potentials for, and obstacles to development (Senes and Toccolini, 1998; Steinhardt and Volk, 2003; Van Eetvelde and Antrop, 2009, Varjú et al. 2013, 2).

Being a border river, the Drava cuts the study area into a Hungarian and a Croatian part. The Hungarian part of the study area covers 14 230 km2 in the South-Western part of

the country, including Baranya, Somogy and Zala counties, while the Croatian part (Međimurska, Koprivničko-križevačka, Virovitičko-podravska, Osječko-baranjska, Varaždinska, Bjelovarsko-bilogorska, Požeško-slavonska and Vukovarsko-srijemska counties) covers 16 757 km2. This research is primarily focusing on the two neighbour county of Baranya/ Osječko-baranjska.

Along the Drava River, both sides of the border area are historically peripheral, characterized by poor economic performance. During the soviet era both countries were subject to socialist ideology, however, former Yugoslavia was not part of the Soviet ascendancy area. The whole area had a very unfavourable position in terms of investment due to the geopolitical risks on the Hungarian side and the Yugoslav civil war in the 1990's. The area is still representing an underdeveloped and increasingly backward region with GPD per capita levels deep under the national averages (Croatia 73% (2006); Hungary (72%) (2007); Source: Hungarian Statistical Office, Croatian Statistical Office.)

The number of settlements on the Hungarian side is very high (803 in a 14231 km2 area), however, with remarkably uneven distribution of population. A greater part (79,33%) of the settlements in this rural area has less than 1000 inhabitants, hosting a total of 23,20% of the population of the whole area. The majority of these villages have an ageing demographic structure; the population is decreasing dramatically in most of the villages and the education and adaptability level of the active population is relatively low. The distinct problem in this size category is accompanied by the increasing ratio of Roma population. In many cases the expression "inactive settlement" has been coined where the overwhelming majority of the population has neither salary nor wage, but lives on different types of allowances (Hajdú, 2003). The EU planning period and its funding round of 2007-2013 has had little if any impact on the general state of development in the region. Subsidies have been concentrated in urban areas leaving henceforward blank rural areas especially close to the border.

The weak access to transport infrastructure in the region is to be explained by its geographical as well as macro-regional location, being left intact by European mega-corridors and peripheral for South-Eastern countries (Erdősi, 2003). Insufficient local road and rail infrastructure is also a result of weak economic performance stemming from the border side position.

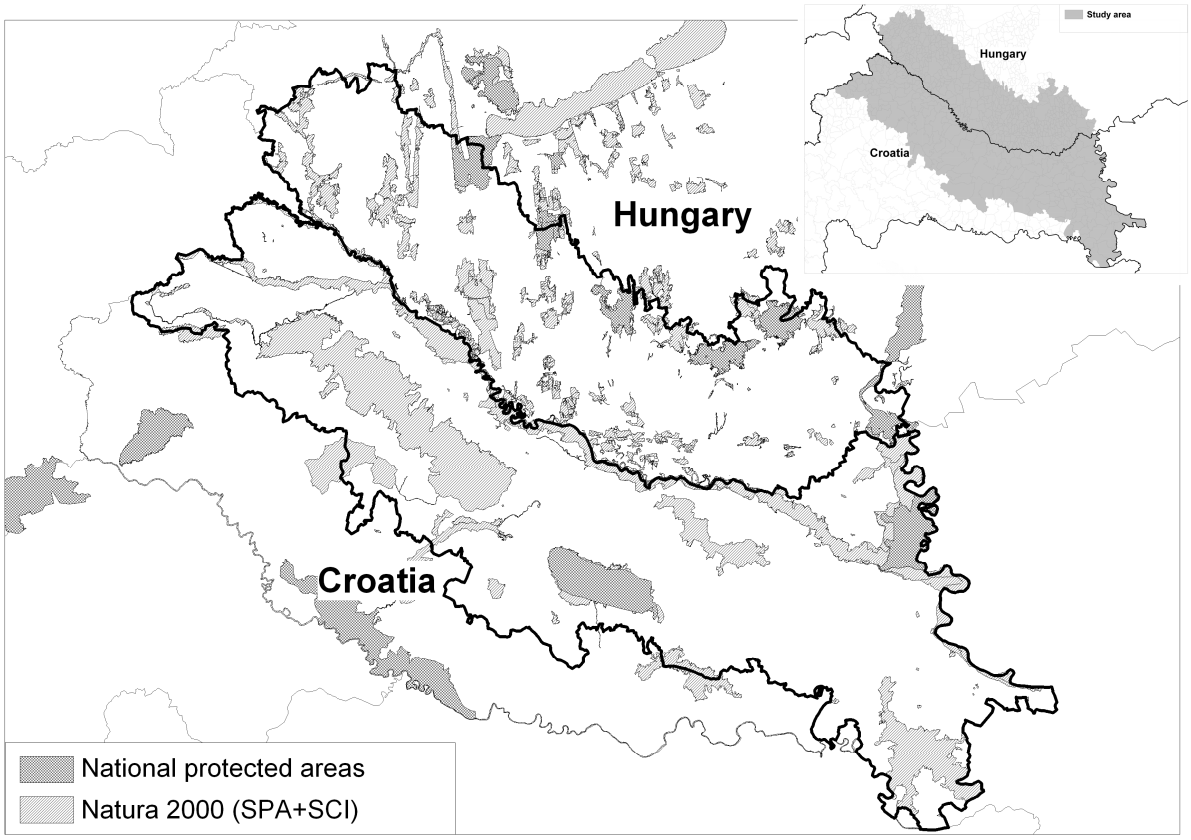
Due to the above historical reasons natural assets remained in good state. From the 1990s high attention has been drawn to the natural protection in this area. On the Croatian side Kopački-rit was designated on the List of Ramsar areas in 1993. On the Hungarian side Danube-Drava National Park (and Directorate) was established in 1996 in order to pay high attention on the natural heritage. In the 2000s, between the two states several attempts can be detected in order to create an extended common natural protection area, however the conception is still an idea as economic interests (Croatia would like to build another hydroelectric station on the Drava) hamper the feasibility. Despite all these – especially on

the Hungarian side –, several visitor centres, thematic (geological, biological) trails were established by the National Park Directorate in order to exhibit the natural heritages of the region.

Tourism has a varying economic significance within the area. The role of tourism is relatively high in the bigger cities due to their heritages (e.g. Pécs, Osijek). Some areas have higher role due to wellness and bath sites (e.g. Harkány) or being a quality wine area (e.g. Villány-Siklós wine area) (Aubert et al., 2010; Somogyi, 2003). Owing to the adjacent draining systems, to the level of pollution and to relatively heavy water-borne freight, the Danube is less attractive for water tourism, whilst on the Drava, one of the most pristine waterways of Europe, water tourism is on the increase in co-operation with natural protection authorities. On Drava River the traffic load of large motorboats is minimal due to strict environmental protection and the lack of river regulation on the one hand, and to water level fluctuation and bed motion caused by the daily performance variability of water power plants situated on the upper sections of the river on the other.

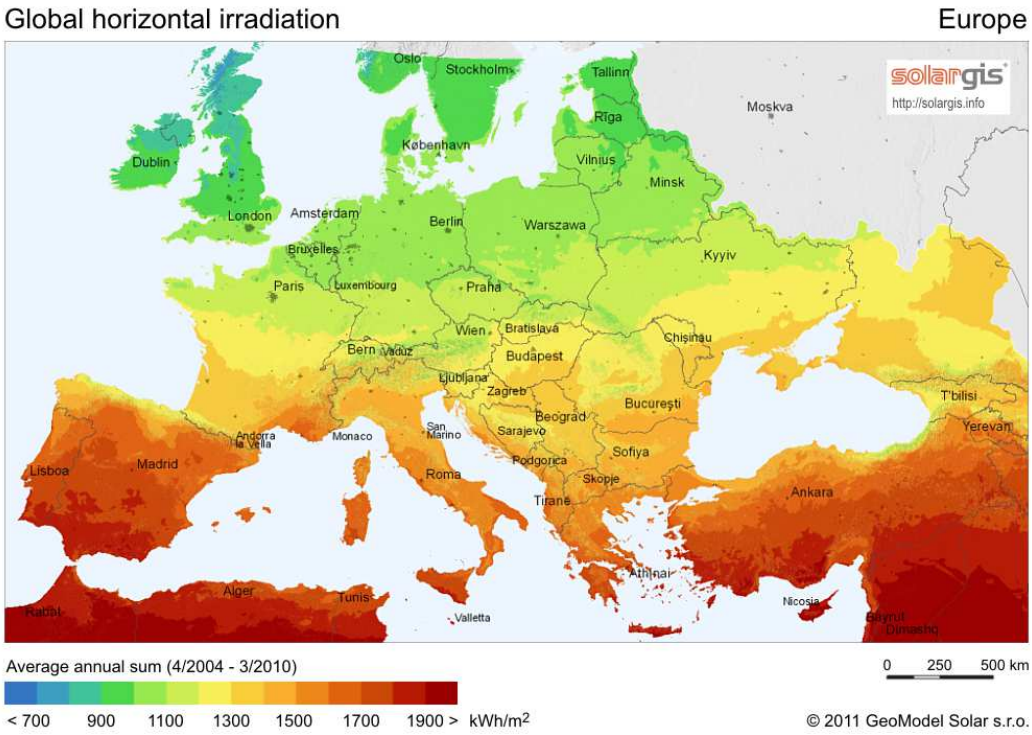
Protection of natural assets and biodiversity is essential in this region. The Danube-Drava National Park established along the two rivers is the largest protected area of national importance in the region. Wetlands are ex-lege protected, waters are continuously monitored under the umbrella of the European Water Framework Directive (EC 2000/60). Not only is the Drava under national natural protection for-and-aft on the Hungarian side. Almost 20% of the study area is NATURA 2000 area, 6.6% is under high national protection and 1.1% is under strict national protection totally closed from the public (Fig. 1.) Varjú et al. 2013, 4-5).

Figure 1: Protected areas in the region



Solar energy has a good potential in the region. On the other hand it also can be said that solar potential is more than enough for the energy consumption, however, efficiency of the recent technology is low, and expensive, the share in the Energy Consumption is also low. Average insolation is 1200 kWh/m2/year. Solar yearly potential is 2500 higher than the recent consumption (in Hungary and also in Croatia).

Fig 2. Global horizontal irradiation



Source: http://re.jrc.cec.eu.int/pvgis

Sun radiation energy E0 coming to the other edge of Earth atmosphere depending on the Sun-Earth distance: E0 =1307-1399 W/m2 on optimal angle surface (vertical to Sun radiation direction).

There are major problems in Sun radiation usage (in electricity production). These are the following:

1. Small density of energy flow,
2. Oscillation in radiation intensity during the day, season,…
3. Dependence on climate conditions,
4. Radiation intensity (noon) is not coincident to electicity consumption intensity (evening),
5. Impossible or very expensive storage,
6. High specific investment costs (PV particularly) compared to conventional (fossil, nucler, big hydro) or even non-conventional (wind, biomass, geothermal) energy technologies.

Summarising the above factors it can be said, that photovoltaic (PV) electricity production is very expensive, unefficient and still very small compared (even) to other RES in electricity, but high incetives are resulting in the fastes increase!

Context and research goal

Overall objectives of the project are development of optimal photovoltaic system configuration for climatic conditions of the cross-border region and investigating the impact of photovoltaic systems on the electrical power system, economics and environment. During the project a common knowledge database about area characteristics significant for application of photovoltaic systems will be developed and cross-border innovation network of research teams for development of photovoltaic systems will be established. Furthermore, photovoltaic system will be optimized for climatic conditions of the project impact area in terms of selecting solar cells technology and inverter topology. Co-operation between scientific institutions and actors of the economy on both sides of the border interested in application of photovoltaic systems will be enhanced. Location of the project in terms of research and development will be Osijek and Pecs. Location of project impact will be North-Eastern Croatia and South-West of Hungary.

In the strategy of EU2020 the use and application of renewable energy is essential. Photovoltaic systems are less popular then biomass in Hungary, in the South-Transdanubian Region, however its potential is high.

The goal of the IPA REGPHOSYS project is the development of optimal photovoltaic system configuration for climatic conditions of the cross-border region and investigating the impact of photovoltaic systems on the electrical power system, economics, environment and on the society.

The significance of the research is that through using an appropriate tool we can move on from economic growth towards a real/strong sustainable development.

The research may also contributes to the reparation of the environmental and territorial legal regulation in Hungary and in Croatia and it may determine more precise tasks for authorities and local governments, stakeholders in order to obtain higher efficiency in economic and environmental sense as well.

The hypothesis of the research project is that - taking into consideration of the above detailed circumstances – the use of photovoltaic system can be a good solution in a backward area as a basis for regional development and environmental-friendly decision making.

Experimental design and methods to be used

Collection and analysis of the Hungarian, Croatian and international literature will continuously be carried out during the research period. Besides the fundamental theoretical literature, Europe related literature will also be the object of the literature review in order to map the role of renewable energy and solar systems. We will use the information published

on their websites and we will also collect the relevant documents from the parties. Besides the synthesis of theoretical literature we will also rely on information of empirical researches and case studies in order to present some peculiarities.

Using interviews and secondary sources we will build up the action arena, the social network of the topic which show what the main intervention points are in order to green regional development policy on territorial and institutional level as well.

The partners would like to focus on the local level not only to survey this level with questionnaire but to deeply analyse their development strategies (plans, programmes etc.) including their environmental protection and energy programmes. Here we use content analysis in order to unfold that how sustainability is appeared. Does strong or weak sustainability appear in local development plans (Pearce and Atkinson, 1992)? SNA and interviews can reveal the actors and their roles and their relationships in the action arena of regional development focusing on the application of solar. Interviews will help define and map the key stakeholders and the most relevant problems and conflicts.

Empirical results will also be the basis of the social network analysis (SNA) and the construction of the action arena. The SNA helps to reveal the most important interactions which determine the formulation of environmental policy in action.

Regarding the analysis in connection with landscape and decision making GIS application will be used. The data collection and systemisation phase will be followed by data analysis using statistical and mapping methods, respectively mapped visualisation of data will be an important tackle of the following publications. In mapping, next the basic state of the environmental condition of different territorial levels (based on data from Statistical Office and TEIR) through summarised data from questionnaire, interview and SNA assessment will be visualised using SPSS and GIS.

A major part of the research is the measurement. Using different tools solar insolation, efficiency of different PV systems, inverters and other equipments will be used for measurement purposes. The results of the measurement will be available for the Hungarian part and also for students.

Expected results

The expected results of the research are twofold. There are publications/disseminations and there are tools which help engineers and students in their learning and work.

Expected results:

- Edited book in English
- Hungarian and Croatian journal articles
- Potentially English language journal article
- Presentations in national and international conferences

- Thematic maps
- SNA network map/Action arena map
- Website
- Photovoltaic system and tools for measurement and learning
- Measurement database
- Complex database with measurement and environmental/geographical/economic/social data

Research steps/plan – Work plan

1. Trimester (01.03.2013-30.06.2013)

Task list:

- Data collection
- Analyses of the documents
- Collection and process of the Hungarian, Croatian and the European literature. Collection and analysis of the Hungarian and international literature will continuously be carried out during the research period. Besides fundamental theoretical literature, Europe related literature will be the object of the literature review.
- Interviews with stakeholders. Interviews will help define and map the key stakeholders and the action arena. Interviews can reveal the most relevant problems and conflicts. These are not available in literature.
- Preparation for and chose of the established mix of PV equipments
- Project meeting in order to fine the research tasks
- Dissemination.

2. Trimester (01.07.2013-30.10.2013)

Task list:

- Collection and assessment of the regional development plans, environmental programmes and strategic environmental assessment in order to get information relating to the current situation of development vision focusing on renewable and solar energy.
- Continue of the collection and analysis of technical, economical and environmental data
- Comparison of the legal framework
- Online questionnaire survey. Questionnaire survey. Next the assessment of the regional/urban development strategies and environmental programmes the goal of the questionnaire survey is to gather information on environmental policy strategies from different territorial levels.
- Evaluation and analysis of questionnaire
- Interviews with stakeholders. Interviews will help define and map the key stakeholders and the action arena. Interviews can reveal the most relevant problems and conflicts. These are not available in literature.

- Setting up of the complex PV measurement
- Starting the measurement
- Starting the comparison of different equipments (polycristal vs. monocristal panels etc.)
- Setting up and programming of different inverters
- Setting up of different testers
- Project meeting in order to refine the research tasks
- Dissemination
- Workshop and presentation of the equipments in Osijek
- Updating of the webpage

3. Trimester (01.11.2013-28.02.2014)

Task list:

- Dissemination
- Workshop and presentation of the findings in Pécs
- Mapping of the results of the questionnaire survey and interviews.
- Mapping the basic data. Data collection and systemisation phase will be followed by data analysis using statistical and mapping methods, respectively mapped visualisation of data will be an important tackle of publications. In mapping, next the basic state of environmental condition of different territorial level (based on data from Statistical Office and TEIR) summarised data from questionnaire assessment will be visualised using SPSS and GIS.
- Project meeting in order to refine the research tasks
- Complex measurement
- Complex evaluation of the measurement results
- Updating of the webpage

4. Trimester (01.03.2014-30.06.2014)

Task list:

- Dissemination
- Setting up of complex database
- Summarising research results in an English language scientific book
- Finalisation of the webpage
- Documentation of the process and findings
- Project meeting in order to refine the research tasks
- Closing Conference – disseminating the research results

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