Local economic development based on renewable energies and energy efficiency in rural areas

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Abstract
At the beginning of the 21st century, sustainability based solutions became increasingly important in local economic development, and further growth of these developments and innovative investments is expected. Two of the three basic (economic, ecological and socio-cultural) functions of rural areas are in close relationship with the renewable energy production and consumption. The essence of economic function is the marketable (mainly agricultural) production, which involves the diversification of activities, technical development and innovations, and alternative economic production forms, emphatically renewable energy innovations, and biomass based energy production. The ecological function of these areas means the protection of environment and natural values avoiding pollution. The importance of social function is reflected in the acceptance and understanding of local society.
In addition to theoretical approaches, the knowledge and collection of local resources are important tasks. This paper examines the basic potentials of solar, biomass and geothermal energy sources in the South Transdanubian Region and INTERREG HU-HR areas and presents some case studies about the different possibilities of renewable energy based development paths.

Keywords: renewable energies, energy efficiency, rural areas, local development

1. Relations between local economic development and renewable energies in the rural areas

1.1 Multifunctional rural areas and agriculture

Of the three basic functions of rural areas (economic, ecological and socio-cultural), two are closely connected to the production and the use of renewable energy.
The essence of economic (or productive) function is marketable and profitable production of (primarily) agricultural goods (foods, raw materials for industry) and the provision of adequate incomes for producers. A part of this is technological development and innovation that allow the increase of both productivity and the

diversification of production. Elements of the economic function include the support for the introduction of alternative economic activities, with a special emphasis on developments related to renewable energy and the improvement of biomass-based energy production which perfectly fit into goals aiming at the increase of the diversity of agricultural activity, are adequate measures for the optimum utilisation of less favoured agricultural areas and the maintenance of the civilised look and the environmental potential of the landscape.

The strengthening of the economic function requires a sort of rural re-industrialisation, whose pillars, in addition to small-sized processing industry plants, may include the penetration of the smaller-scale versions of manufacturing related to renewable energy, but also energy production itself [1].

Another factor that is closely connected to the economic function is that cheap energy produced by local energy production systems can also support the cost.-efficient operation of rural enterprises (farms, manufacturing plants), and public and private services.

The ecological function involves, among other things, the protection of the elements of nature (water, soil, air), which is synchronised with the energy production goals of the economic function. The penetration of the use of clear sources of energy also promotes the protection of the elements of nature [1], [2].

In agricultural lands, the use of arable land for energy production is also becoming more and more widespread, which of course is a positive phenomenon, but, due to the sectoral correlations (multi-functional agriculture), in rural areas intensively utilised by the agricultural sector the sophisticated use of agricultural and forestry by-products enjoy priority during the use of arable land for energy production, as does the inclusion of areas that are uncultivated (or can only be utilised with significant financial investments) in energy production. The utilisation of lands excellent for food production in energetics should be seriously considered, and rather be dispreferred.

1.2. Strategy based local development

The first step of a rural development (settlement and territorial development) strategy is the exploration of the local endowments and resources supporting the strategic objectives [3]. One of the values of rural development built, among other things, on the development of renewable energies is that it also allows regions less abundant in traditional resources to succeed (Fig. 1.). In regions with multiple deprivations, most of the (complex) indices indicating the quality of life are bad and still worsening, and the halt of this tendency of decadence is hardly possible without integrated rural development methods. One of the foundations of such methods is the harmonised development of economic and environmental elements. In order to use local resources adequately after their exploration, it is training, infrastructure development, local services, cooperations etc. that are necessary. In these regions, opportunities

offering progress include, in addition to organic agriculture, food processing, water management (enlargement of the possibilities of irrigation farming) and tourism, may be green energy investments that may even have a selected role. In these regions there is no chance for development in the absence of external economic assistance, but it does matter in which structures these external assistances come and how they are utilised. For this, conscious planning is a prerequisite.

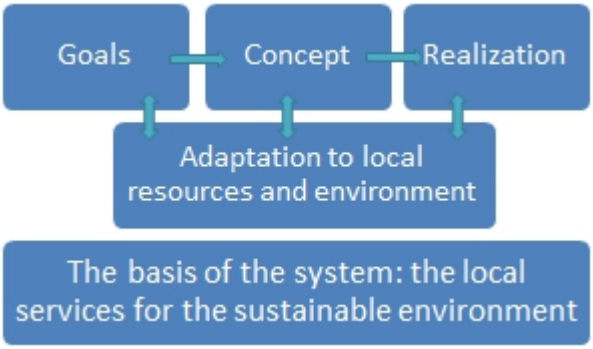

Figure 1. Concept of local strategic planning
Source: Own editing

Rural areas require a consequent, long-term renewable energy programme – a programme that is legally and economically well-established and for which the financing background conditions are given. An emphatic element of such a programme is the survey of the chances of local-regional green energy production and utilisation.

Local economic development is one of the most important tools for the economic progress of regions struggling with economic difficulties. Local market requires local agricultural goods producers, handicraftsmen, small-scale industrial producers and retailers, and so it is capable of providing a significant part of local employment. Local economic development definitely means the intensification of local market. Local economic development is a tool suitable for the promotion of the economy and the economic resources of regions and settlement where the general tools of economic development have failed to succeed. In addition to economic recovery role it has an auxiliary advantage of mobilising local communities, enlarging the local cooperation network, strengthening local identity and renewing urban-rural relationships. A balance must be reached in the utilisation of external and internal resources. In each and every region, successful local economic development my have different foundations, the composition and the “mixing ratio” of the respective “ingredients” may differ. There are, on the other hand, aspects that should be taken into consideration and there is a wide, comprehensible inventory of “ingredients” [4]. A

prerequisite of the success of local economic development is successful community development, and the building out of local capacities, knowledge and cooperation networks.

The foundation of sustainability is always an existing market demand, which in the case of renewable energy projects is a component that relatively reliably exists or can be created. The major opportunities lying in green energy are as follows:

- Creation of long-term employment by the production of biomass,
- Utilisation of the employment effects of the operation of alternative energy production systems,
- Reduction of the costs of the energy supply of local institutions by the utilisation of locally produced biomass or other sources of renewable energy,
- Utilisation of uncultivated land areas for energy production (labour intensive),
- Meeting a growing market demand in urban areas (biomass heating plants and power plants).

1.3. Regional conditions for the development of renewable resources

Developments related to this technology that is innovative in many respects, and the operation following the investments raise several societal issues, from the demographic situation of the region through economic activity, schooling level and educational structure right to the existence and development capacity of vocational training and adult education base. The consideration of these issues cannot be neglected during developments [5]: partly because if examinations explore a structure and quality problems that do not allow the further development and subsequent sustainable operation of the investments, then the socio-economic risk may be decreased by the investor seeking nearly similarly favourable physical geographical endowments in another region. Also, this analysis cannot be neglected because it highlights those elements in which there is a possibility of and a need for progress so that an innovative investment or development can settle down in the region, take roots and, in the better case, induce significant development [6].

The concerned regions in both Hungary and Croatia are characterised with similar socio-economic problems, but the severity of these problems shows significant differences, this region is not homogenous in this respect [7]. Although both Pécs and Osijek are in a peripheral position within their countries, their socio-economic indices are outstanding relative to their narrower regions. The areas in the worst situation are the Ormánság and smaller parts of Inner Somogy where, knowing the tendencies, it is especially hard to find a way out. The problems are manifested in the processes of demography, in the unfavourable age structure, in the economic

activity, in the labour market situation and also in the indices of schooling. These are the challenges to face, and these are the endowments that must be taken into consideration when planning innovative developments in the region [8]. This challenge concerns the cooperation system of local economic actors, the actors of local development policy, above all the institutional system of vocational training capable of the foundation of the necessary base of skilled labour force. Even if the cooperative relations of these stakeholders are created, it may still be a problem that in the region, especially in some of its micro-regions the situation of employment and employability is extremely hard, and there is an unfavourable age structure which is exacerbated by a migration loss typical of the area for years, in addition to the negative index of natural increase. These problems, besides their social consequences, also decrease the capital absorption capacity of the region, as the socio-economic environment is not favourable either for large-scale investments or the related supplier companies.

The Hungarian side of the area is characterised by small villages and the distribution of the population is uneven, too. Settlements typically have an ageing demographic structure, population decrease is fast and the average schooling level of the population is also falling (caused by out-migrations), which sets back adaptation capacities. The large proportion of the Roma population, their alternative lifestyle and culture and inadequate skills further exacerbate the situation. The impact of the Structural Funds and Cohesion Funds of the EU is hardly measurable, the bulk of the supports is concentrated in the urban areas; also, the proportion and volume of supports per capita is one of the lowest in a national comparison (Bálint, 2018).

All these indicate that although possibilities exist, rural areas can be diversely dynamised by projects and developments related to renewable energy, the condition of this must be improved or, in some places, created. We need as many developments built on renewable energy as possible, because they create jobs, meet the interest of environmental protection and also increase the security of energy supply. It is important thus to have support systems aiming at the acceleration of the return of the investments.

2. Renewable energies and their local and regional applicability

Below we demonstrate the energy production methods most widespread (efficient on the basis of the endowments) in Hungary and the region in the focus of the survey of the RuRES project: different uses of solar energy (solar collectors and PV panels), and the diverse possibilities for the utilisation of biomass and geothermal energy.

Renewable energy sources are a good opportunity for the implementation of decentralised energy supply, which also results in the significant decrease of local energy dependency. As regards decentralised energy supply, the utilisation of the sources of energy listed above is economical. Not going into the details of the technologies, we prove, by demonstrating good local practices for each energy carrier, that in rural areas, even in the majority of backward settlements in unfavourable situation, it is feasible to have good results with projects related to the development of renewable energies and to have a significant contribution to the development of the area.

The physical geographical endowments of the region of South Transdanubia offer many possibilities for the region to found a significant part of its energy production on renewable energy. The agricultural potentials and the proportion of forested areas already allow the use of the biomass produced in the area for energy production. The biomass power plants operating in the region already use this opportunity. It is already visible, however, that the resources are overexploited and so other issues raise (e.g. fertilisation) and social resistance is growing (the problem of “burning the forests”).

Both Hungary and especially the region of South Transdanubia abound in geothermal energy. Climatic natural endowments of the region are especially favourable for the use of solar energy, as the amount of solar radiation reaching the surface is especially large in South Transdanubia. The region has favourable potential for the settling of both solar connector and photovoltaic panel systems.

3. Case studies

3.1 Solar energy best practice – Nagypáli

Nagypáli is a small Zala county village, 10 kilometres from the city of Zalaegerszeg, with approximately 500 (and growing) population. Its natural endowments are by and large the same as those of an average Zala county village, and so the list of its advantages should not be found in mineral sources or its natural environment, rather in its good geographical position and the special philosophy of the settlement management and development. The proximity of the county seat and the state borders, and the social capital and strategic view of the leader of the village allowed the settlement to become the headquarters or location of businesses operating at international level and having international recognition. The name of Nagypáli is now almost a synonym of green based energy production and sustainable development.

The first investments for the use of solar energy realised in 2007 have been followed by several other projects, a series of real estates owned by the municipality have

been equipped with solar collectors and photovoltaic panels, and so have the local tourist centre and apartment building. In 2014 the so-called Community Energy Court was built, including 12 solar trackers with a total output of 17 kW, and in 2017 an experimental investment was made: a hybrid device using both solar and wind energy [9].

The total investment value of developments utilising solar energy in the village is almost 920,000 EUR, in which the largest proportion is financed, due to the considerable tendering activity of the municipality, from tenderable resources of the EU and other actors, and a smaller share was paid as the financial contribution of the municipality.

Although solar energy is not the only renewable energy utilised in Nagypáli, still this is the most importance by its investment values and the number of developments implemented. Consequently, the 99% fossil and 1% renewable ratio measured in thermal production in the village changed to 10% and 90% for the favour of renewables by 2016 and plans calculate with a 100% share of renewables by 2020. As regards the use of electricity by the municipality, the proportions were also 99:1 in 2000, while in 2015 the use of electricity from fossil sources made one single per cent from the total use, only, besides feeding an amount of energy equivalent to 30% of the total consumption into the central electrical grid, above the total of the local needs. All this means that in Nagypáli the volume of environmental stress decreased by 2015 to 40% of the level measured in 2000, and the plans calculate with a further decrease to 20% by 2020.

3.2 Biomass and Biogas – Bicsérd

The Arany-Mező Co. of Bicsérd is an agricultural business active both in animal husbandry (pig farm and cattle farm) and crop growing. The business cultivates more than 2,000 hectares of plough land, of which 1,100–1,200 hectares are necessary for producing the fodder base of animal husbandry. An important part of developments implemented in animal husbandry is the adequate treatment of organic manure and slurry generated, and so for this purpose a biogas plant was built in Bicsérd (Biogáz Unió Co.) form approximately 2.5 million EUR with 50% EU contribution and 50% own resources and bank credit. The plant realised in 2011 operates with a 95% capacity utilisation. The system uses an annual volume of 40,000 tons of organic substance, 90–95% of which is slurry and manure produced by animal husbandry. This production capacity allows the generation of 4.3 million kWh-s of electricity (approx. yearly electricity needs of 950 households) and 5.1 million kWh-s of heat (approx. yearly heat demand of 450 hoseholds) annually. A basic condition for the

good operation of the biogas plant is the avoidance of poor quality and mixed raw materials, as the fermentation processes going on in the plant make a complex biological system that is disturbed by the constant change in the raw materials of different characteristics. It is also important from an agronomical aspect that the fermented liquid generated as a by-product of biogas production is utilised as fertiliser in plant cultivation. As this means savings of fertilisers, it also improves the profitability of biogas production.

3.3 Geothermal energy and local development – Bóly

There are several signs both in Hungary as a whole and in South Transdanubia that municipal self-governments have realised the potential lying in initiatives utilising renewable energy sources. The town of Bóly for example, in addition to the utilisation of thermal water, has become a real model town by the application of a range of innovations, and although several sources of renewable energy are now used in the town, the first and undoubtedly most successful project is connected to the complex use of geothermal energy.

A complex project was elaborated and in Bóly for the utilisation of thermal water discovered in the early 1980s. The objective was the solution of the heating of municipal institutions. The solution promotes the meeting of energy- and financial efficiency requirements at the same time. The investment consisted of the following elements: drilling a 1,500 metres deep thermal well, the creation of a facility for the re-injection of used (cooled) water, and the construction of a heating centre, control room and the pipelines. Following the development implemented in several phases, the municipality now provides geothermal energy for heating and technology purposes (office building, production plants) for businesses, from which extra revenue is made. Cheap energy is an attraction for businesses locating in the town.

The idea of the municipality was to use the thermal water found during an ore mining drilling in 1983 for the production of hot water heating the municipal institutions. A feasibility study for this concept was made as soon as in the early 1990s. In 2003, on the basis of a professional study by geologists, a decision was made to drill a thermal well in the centre of the settlement – for this purpose SAPARD resources were used at that time. This was followed by the construction of the pipelines and the heating centre serving the consumers. The servicing of local businesses and institutions was planned by the utilisation of thermal water (heating and hot water). The full cost of this phase was 335,000 EUR with 50% SAPARD contribution.

In 2008 the 2nd phase of the project was also finished (from KIOP[1] resources), resulting in a remote heating system utilising geothermal energy more efficiently than the original solutions, allowing the integration of further institutions. The budget of this section consisted of three components: 302,000 EUR own contribution, 293,000 EUR governmental support and 730,000 EU funds (KIOP resources).
Finally, in 2010 a new development with 257,000 EUR from fully own resources allowed the integration of the floor heating systems of the three halls of the industrial park owned by the municipality, and, before the re-injection of the thermal water, there was still usable thermal power for the fruit processing and vegetable drying facility also owned by the municipality.
As a result of the completed developments (three phases), the yearly saved gas consumption is approximately 860,000 m^3, which means 183,000 EUR cost savings per year [10].

4. Conclusions

In the recent decades, global environmental changes, warming and other, formerly inexperienced natural phenomena have pushed mankind towards more and more environment conscious thinking. Different solutions have been found for the decrease of environmental degradation, which have usually been also fixed by international conventions and agreements [11]. As members of the society, and later also local society itself, consider the objectives of environmental sustainability, in the ideal case the municipalities and their leaders also recognise the demand that sets the respective village or town on the path of becoming a green settlement [12]. The appearance of ecologically conscious settlements was inspired by social movements almost everywhere in the world, but there was one more factor that played a crucial role in the region examined and the case studied demonstrated. This is the dedication and strategic approach of the settlement management of the time. By the demonstration of the examples in the study we wish to show that the opportunities lying in renewable sources of energy are now available even in the settlements and rural areas most backward from socio-economic aspects – in fact, they can be alternatives of economic development.

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