PROJECT RURES

A.T1.3 Minimum template for feasibility studies for implementing EE and RES measures

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1. Summary in English

The West-Transdanubian Regional Energy Strategy was developed in 2012 within the framework of the ESPAN project of the Cross-Border Cooperation Programme Austria – Hungary 2007-2013. The strategy explores the energy endowments of Zala, Vas and Győr-Moson Counties and makes proposals for increasing the energy efficiency of the region, assessing the savings potential of specific energy subsectors as well as achieving a larger-scale utilization of renewable resources. Based on an extensive and comprehensive professional cooperation, the main observations of the strategy are the following:

- As a result of **the growing number of home and small power plans** focusing on local energy production and self-sufficiency, **the electricity distribution networks are forced to become bi-directional** on the part of the network licencees;
- **The significance of natural gas distribution networks** – due to the spreading of biomass-based combustion plants – **is expected to decrease,** however, **this process can be counterbalanced by the production of purified methane biogas and synthetic gas** with a calorific value of almost the same as the natural gas **fed into the natural gas network**;
- **The utilization of renewable energy sources are to be increased by taking explicit steps.** The aim is to achieve an almost 100% sustainable, self-sufficient energy production;
- **The production of energy crops should be encouraged** in agricultural areas unsuitable for food production and **the energy recovery of food crop residues** (e.g. biogas, pellet);
- **Electricity should be generated** by mainly wind power plants in the northern part of the region and **by the utilization of solar heat and geothermal energy in the south** – taking the local conditions into consideration;
- The biogas plants should rely on livestock farms in the region which require the plant-based feedstocks of fermentation to be produced on site;
- **In case of buildings, reducing heating and cooling demands should mainly be focused on**, which can be achieved by excellent thermal insulation (wall, doors and windows) as well as the (even subsequent) installation of ventilation systems supplied with heat exchangers.

In order to facilitate putting the above-mentioned development directions into practice, the **West-Transdanubian Regional Energy Strategy** involves energy concepts at small regional level as well

developed for a small region in each county concerned. In Zala County, an energy concept has been developed for the region of Lenti, which includes 5 specific action plans besides the description of its regional endowments and the declaration of its energy development objectives. One of the action plans is the so-called ”House of Renewable Energies”, whose implementation involves the establishment of an Energy Garden in Lentiszombathely, on the outskirts of Lenti, as a pilot project within the framework of the present project.

From the action plans identified in the energy concept concerning the small region of Lenti, the **”House of Renewable Energies”** has been chosen to facilitate its implementation as it regards local residents, public institutions as well as businesses its target groups due to its complex nature. **The immediate objective** of the action plan **is to establish a non-profit information centre in Lenti focusing on a sustainable lifestyle giving high priority to the improvement of energy efficiency and the utilization of renewable energies**. The action plan involves the elements of networking, parnership, incubation, education, information and consulting services in addition to infrastructure developments, the lack of which would obviously mean that the building would be unable to fulfil its innovative and stimulating role. The need for such a primarily demonstrative and awareness raising project addressing local residents, public institutions as well as businesses is largely supported by the findings of representative surveys conducted mainly among residents in the last few years measuring their knowledge on climate change and its mitigation. According to these surveys, the residents require to be familiarized with intensely practical, specific options for action concerning climate protection and the reduction of the emission of greenhouse gases.

As part of the West-Transdanubian Regional Energy Strategy, the implementation of the action plan ”House of Renewable Energies” in the energy concept of the small region of Lenti, is the challenge of the next decade. In order to provide the highest possible benefit with the practical implementation of these ideas, it is justified to assess the expectations of local actors belonging to the target group of the development concept – mainly businesses and residents – towards a project involving elements of awareness raising and infrastructural development with the aim of renewable energy utilization and energy efficiency improvement. Consequently, it is **advisable to implement certain parts of the development package separately as pilot projects. For this reason, an ”Energy Garden” is intended to be established in Lentiszombathely, on the outskirts of Lenti.** The practical experience gained via its construction and operation will facilitate the successful implementation of the action plan ”House of Renewable Energies” in Lenti later on.

The Energy Garden in Lenti is expected to funcion basically **as a venue for demonstrating opportunities for the utilization of renewable energies and the improvement of energy efficiency**, which is facilitated by the procurement of three devices for the improvement of energy efficiency: **a vertical-axis wind turbine, a solar panel system and a vegetable oil mini generator**. The present study demonstrates in details the technological features, benefits, costs and calculations on the payback period of the instruments intended to be procured within the framework of the Energy Garden.

This study devotes a separate chapter to the description of the West-Transdanubian Regional Energy Strategy and the financin facilities for the implementation of the Energy Concept of the small region of Lenti as part thereof. **In the course of identifying the financing facilities, it was regarded as a guiding principle –** discontinuing the common practice in the last few years restricted to using almost exclusively EU funds – **to direct the attention of local actors to a wider range of sources with a nature of financial instruments instead of grants.** These financing facilities include commercial loans and the so-called ESCO instrument relying on energy savings besides **the detailed description of the "Zalagreen" microcredit instrument developed by the Zala County Foundation for Enterprise Promotion** for micro- and small enterprises.

This study, on the whole, contributes to the implementation of the West-Transdanubian Energy Strategy as well as the Energy Concept of the small region of Lenti included therein in two ways. On the one hand, it explores the features of the establishment of the pilot project Lenti Energy Garden facilitating the implementation of one of the action plans of this concept called "House of Renewable Energies", on the other hand, it identifies the financing facilities for stimulating energy developments in the small region.

2. Information on the project

1.1. The position of the strategy in the planning environment of Hungary and Zala County

The West-Transdanubian Regional Energy Strategy is broadly in line with every comprehensive sector strategic planning documents in Hungary and Zala County in addition to those concerning energy efficiency improvement, the extension of renewable energy utilization as well as climate change mitigation. Their relationships are described briefly below.

1.1.1. National strategic plans

The following table provides a brief review of the national planning documents whose guidelines have influenced the content of the proposed developments in the West-Transdanubian Regional Energy Strategy.

Name of Strategic planning document	Relevant parts of the strategic planning document concerning the present development
National Energy Strategy (NES)	The National Energy Strategy adopted in 2011 defines the following main pillars: 1. Energy saving and energy efficiency improvement; 2. Increasing the share of renewable energies; 3. Integration of the Central European network system and the development of the necessary cross-border capacities; 4. Maintenance of the capacity of nuclear energy; 5. Environment-friendly utilization of the national coal and lignite assets in electric power generation. Concerning the present development, the energy efficiency improvement and the extension of renewable energy utilization are of relevance.
Hungary's Renewable Energy Utilization Action Plan 2010-2020 (NAP)	Besides taking quantified commitments concerning the shares of renewable energy utilization of the country within the total gross energy consumption by 2020 (14,65%), Hungary's Renewable Energy Utilization Action Plan 2010-2020 assesses the potentials of the utilization of individual renewable energies and their constraints. On these grounds, the NAP regards the following renewable energies the most prospective ones with respect to utilization: solar energy, geothermal energy, heat pumps, biomass and biogas. The conditions are favourable in Zala County for the utilization of the above-mentioned renewable

Name of Strategic planning document	Relevant parts of the strategic planning document concerning the present development
	energies. The House of Renewable Energies to be established in Lenti is intended to stimulate renewable energy utilization of the same origin identified in NAP accordingly.
Energy and Climate Awareness Raising Action Plan	The Energy and Climate Awareness Raising Action Plan also approved in 2015 stimulates the implementation of awareness raising activities in 5 theme fields as follows: • energy savings and efficiency; • renewable energy use; • energy savings and emission reduction in transport; • resource effective and low-carbon economy and society; • adoption to the changes in climatic conditions. The Action Plan puts forward the following proposals concerning the types of awareness raising: • integration of climate protection into the legislative activities of county governments and municipalities; • partnership with the media in the county; • awareness raising in education; • social and public campaigns; • climate protection networking in the county; • facilitation and demonstration of local pilot projects, good pracices. The proposed development can be regarded as a typical local pilot project, so it is an effective instrument to facilitate the implementation of the Energy and Climate Awareness Raising Action Plan
The Second Climate Change Strategy of Hungary (NCCS-2)	The Second Climate Change Strategy of Hungary as a strategic document determining the criteria and framework of national climate policy is indispensable for any climate dvelopments in the country. The proposed development is in harmony with both the emission reduction objectives of NCCS-2 and its chapters emphasizing the importance of awareness raising.
Hungary's National Energy Efficiency Action Plan until 2020 (NEEAP)	Due to its obligations as a Member State of the EU, our country is bound to approve a National Energy Efficiency Action Plan every three years, currently the NEEAP III approved in 2015 is in effect. This document sets out specific, quantified objectives concerning the national efforts on energy efficiency and outlines the measures to be taken to achieve them. The NEEAP III also gives high

Name of Strategic planning document	Relevant parts of the strategic planning document concerning the present development
	priority to the issue of building energy modernization, whose stimulation is regarded as one of the basic tasks of this project.
National Building Energy Strategy (NBES)	The main, overall objectives of the National Building Energy Strategy approved in 2015 are the following: • Harmonization with the energy targets and environment policy objectives of the EU; • Building modernization as an instrument to reduce the overheads of the residents; • Reduction of budgetary expenditure; • Mitigation of energy poverty; • Reduction of greenhouse gas emissions. According to NBES, the maximum possible energy savings and therefore a reduction of greenhouse gas emissions can be achieved within the building sector by the energy refurbishment of the existing building stock. The proposed project is broadly in line with this concept since the House of Renewable Energies will be able to provide widespread, practical information for the implementation of building energy modernization.

1.1.2. Development planning documents of Zala County

Within the framework of the implementation of the sub-programme called ”Energy Concept of the Small Region of Lenti” as part of the West-Transdanubian Regional Energy Strategy, a pilot project is supposed to be conducted in the town of Lenti in the course of this project. Due to its location, developments of the town of Lenti are predestinated by development planning documents of Zala County. The brief summary of these documents are given below in order to confirm the embeddedness into a regional development environment of the ”House of Renewable Energies” described in details in chapters 4 and 5 as well as its pilot project, the Energy Garden in Lenti.

The Concept of Regional Development of Zala County

The concept of regional development of Zala County developed in 2013 is a conceptual vision for the future until 2030 identifying three overall objectives until 2020 and seven sector strategic objectives for the same period. In the target system of the concept, however, instead of the above-mentioned objectives, it is primarily the horizontal objectives that set the strategic directions which Zala County

intends to implement in order to improve its energy and climate protection position. It is important to point out that according to the Concept, the implementation of horizontal objectives should be facilitated by every strategic objective i.e. each measure facilitating a strategic objective is supposed to serve the horizontal objectives as well without any adverse effects.[1] **Three of the horizontal objectives are specifically consistent with the proposed developments**, these are the following:

- Adoption to climate change, risk management, steps towards energy independence, drinking water protection, providing appropriate quality and quantity of food production;
- Promoting a shift in all sectors to low water footprint and carbon emission options;
- Environmental protection, facilitating effective resource utilization.

Regional Development Programme of Zala County

The Regional Development Programme of Zala County[2] developed in 2014 predominantly relies on the ideas of the Concept of Regional Development. The priority of ”Integrated environmental protection programmes in the interest of maintaining the life chances of the next generations and environmentally sustainable development” and its measures are the most closely connected to the proposed development since they are directed – among others – towards increasing the utilization rate of renewable resources and the effective exploitation of renewable resources and regional capacities. The priority of ”Sustainable development of urban landscape and built environment” indicates the promotion of urban energy savings among the integrated territorial actions.

The regional development programme of the county specifies several sub-programmes, among which the proposed development is coherent with is the ”Regional development sub-document related to the sectoral operational programmes of Zala County”.[3] The county programme of energy efficiency proposes an increased utilization of renewable resources, better utilization of the renewable energy potential and the implementation of energy efficient investments involving residents, public institutions and businesses. To the interest of the publicity of energy developments and the dissemination of results and good practices, ”Launching awareness raising programmes related to energy efficieny” as a separate sub-programme has been indicated, which the present project broadly comply with.

[1] Városfejlesztés Zrt. (2013).: Regional Development Concept of Zala County, Attachment No.4. Proposal Phase, Regional impact assessment. p. 8.
[2] forProjekt Kft., Városfejlesztés Zrt. (2014): Regional Development Programme of Zala County - strategic programme. pp. 71.
[3] ”Cseszt Regélő Nkft., Hétfa Elemző Központ Kft. (2014): Regional development sub-document related to the sectoral operational programmes of Zala County – sectoral sub-programme of establishing a strong competitive Zala pp72.

Climate Strategy of Zala County 2018-2030, with an outlook until 2050

The climate strategy of Zala County approved in 2017 regards the reduction of greenhouse gas emissions, adoption to the expected climate changes and awareness raising related thereto as challenges of the same priority. The climate strategy concludes that by far the largest amount of greenhouse gas emissions (62%) in Zala County results from energy consumption by burning fossil fuels, about half of which (42%) is used for heating, cooling and lighting residential buildings as well as running household appliances. These data firmly support the objectives of the climate strategy of Zala County, according to which the total emission of greenhouse gases is supposed to be decreased by 42% between 2015 and 2050. As for emissions from the operation of buildings, there is a reduction target of 40%. In order to achieve these objectives, several measures have been identified in the strategy, among which the development in progress in Lenti contributes above all to the practical implementation of the following:

- Energy efficiency modernization of business premises and technological processes by creating the conditions and the extension of renewable energy utilization as far as possible;
- Stimulating the extension of renewable electricity generation;
- Stimulating the reduction of greenhouse gas emissions from the operation of residential buildings;
- Complex building energy modernization in public institutions covering renewable energy utilization.

1.2. Content and main observations of the West-Transdanubian Regional Energy Strategy

The West-Transdanubian Regional Energy Strategy was developed in 2012 within the framework of the ESPAN project of the Cross-Border Cooperation Programme Austria – Hungary 2007-2013. **The strategy explores the energy endowments of Zala, Vas and Győr-Moson Counties and makes proposals for increasing the energy efficiency of the region, assessing the savings potential of specific energy subsectors as well as achieving a larger-scale utilization of renewable resources.**

1.2.1. Situation analysis

The chapter of situation analysis of the West-Transdanubian Regional Energy Strategy describes the energy trends and tendencies in progress in the West-Transdanubian region, Hungary, Europe as well as

on the Earth from the beginning of the 1980s until the end of 2010s. It includes statistic datasets separately concerning fossil fuels (oil, natural gas, coal) and renewable energy sources (solar, wind, biomass energy and biofuels) as well as supplies/potentials available, the intensity of extraction, the rate of resource utilization and emission. In terms of production/consumption, the chapter covers the issue of total energy, electricity, energy intensity and energy consumption.

Analysing the processes at global level, it has been concluded that following the second oil crisis at the beginning of the 1980s, the total energy production and consumption of the world surged with an increase of 70% between 1983 and 2007 from 83 thousand billion kW to 141,7 thousand billion kW. According to the study of the U.S. Energy Information Administration published on 27 July, 2010, the energy consumption of the world – certainly without the expected regulatory policies in the future – will have exceeded data from 2007 by 49% by 2035. At the same time the carbon-dioxide emission increased from 18,488 million to 30,377 million tonnes between 1980 and 2008. **Burning fossil fuels is obviously responsible for the more than 64% increase.**

Analysing the energy management processes of the EU, the strategy points out that the EU is unable to supply itself with enough energy although the per capita energy consumption of EU citizens is highly above the world average. It is also an importan factor that **Europe has only a considerable amount of renewable energy but no fossil fuel reserves.**

In case of Hungary, the strategy highlights that in the period from the transition to democracy to the 2010s a drastic decline in energy production by more than 36-38% on the average took place in Hungary. Analysing the consumption factor in Hungary, the data were similar to that of the production: there was a slight decline after 1990 followed by a long-term stagnation. **Studying the energy balance of Hungary, it can be ascertained that up until 2003 the energy supply of the country relied on conventional i.e. hydrocarbon-based power plants and the nuclear plant in Paks**. The expansion of the renewable energy sources started afterwards.

It can be concluded that concerning the total energy consumption – not taking the energy demand of transport into account – **the West-Transdanubian region consumes the least amount of energy resources available following the South-Transdanubian region among the regions of the country.** According to the strategy, another important factor is that despite the economic growth, the industrial and agricultural energy consumption was steadily decreasing between 2003 and 2007. Consquently, in spite of the increase in communal and residential consumption, the energy demand of the region declined. In the first decades of the 2000s, an increase in industrial energy demand was accompanied by

a smaller decrease in the energy consumption of all sectors in Zala County. The strategy emphasises that among the seven regions of the country, **the residential electricity consumption reached the lowest level in the West-Transdanubian region** in 2007. Surprisingly, the population increase of almost 14% of the region generated only an 8% increase in residential energy demand.

1.2.2. Global, national and local climate protection and energy policy concepts

The West-Transdanubian Regional Enegy Strategy devotes a separate chapter to the non-exhaustive description of global, national and local climate protection and energy policy concepts. Firstly, it lists the most important international climate protection and energy consumption agreements followed by a review of the long-term energy policy and directives of the EU envisaged to the member countries. After that, it describes the relevant long- term energy policy concepts of Hungary via several strategic documents and objectives. Finally, the chapter gives a detailed outlook of the energy plans of the West-Transdanubian Region and the counties involved.

In respect of **Zala County**, the strategy points out that concerning the plans on the **utilization of renewable energies**, the county lags slightly behind the rest of the counties in the region since **its first more significant observations and proposals were drawn up in its Spatial Development Plan amended in June, 2010**. Its chapter of energy management and supply claims that the largest amount of unconditional renewable resource in the county is water power, whose performance of 50 MW marked as its theoretical utilization potential can be exploited by the extension of already existing systems and the installation of small and mini water works. Due to the significant forest cover of the county, the spatial development plan currently being amended gives high priority to biomass as a prospective alternative energy source. This statement is based on the assumption that the utilization of residues from forestry, woodworking and furniture industry as well as agriculture, forest plantations established with the aim of energy utilization and appropriate cogeneration technologies could replace the district heating base in Keszthely, the conventional thermal energy in the bigger community educational, medical and other institutions and the heat and electricity conversion base of industrial parks and other businesses in the long run. In addition, the plan also mentioned the opportunity of solar, wind and geothermal energy utilization.

1.2.3. Description of the region from an energy perspective

The West-Transdanubian Regional Energy Strategy devotes a separate chapter to the description of the general geographical, demographic, economic and infrastructural features of the region paying special

attention to the exploration of its energy aspects. Its results are summarized in a SWOT analysis. It is identified, on the whole, a strength of the region from an energy perspective that **the primary renewable energy endowments** (solar, water and geothermal, solid and herbaceous biomass) **are altogether the most favourable in the country**. Furthermore, the biomass-based energy endowments gained in secondary and tertiary conversion (biogas, biodiesel, bio-ethanol) are also favourable. In addition, it concludes that the innovation centres of the region and the planned R&D institutions are suitable for the development and pilot application of further energy technologies (fuel cells, hydrogen decomposition). On the other hand, **the strategy regards** the considerable energy dependence as well as **the low utilization rate of renewable resources in the region as a weakness**, and it is regarded as a threat that the installation and construction of renewable energy production and conversion technologies as well as the rate of job creation and improvement of living standards are expected to be slower than planned due to the financial and legislative shortcomings.

1.2.4. Future vision

The West-Transdanubian Regional Energy Strategy does not determine a single vision for the future but **outlines several possible development paths concerning the energy consumption and greenhouse gas emissions of the region**, which can primarily be attributed to the fact that a simultaneous but reverse double effect occurs in the region. On the one hand, a higher ability-to-pay due to the development of the region within the country and a higher than average commitment of residents to the issues of environmental protection are prevailing, on the other hand, this relative development and its further rate result in an increase in the fossil fuel consumption above the national average. It applies to residential, institutional as well as industrial users. Consequently, the strategy determines three different types of vision for the future, a realistic, an optimistic and a pessimistic one.

The **realistic scenario** is based on the assumption that fossil fuel energy consumption might remain significant in the course of strategic industrial developments in the region therefore there might be a nominal increase in gas and electricity demand although investments will be connected in all cases to the establishment of renewable capacities reflecting the rate of national commitments. In analysing the trends of natural gas consumption, opportunities for natural gas consumption of residential, industrial

and public users as well as the aspects of their willingness to a shift to renewable energy sources and modernization are examined separately. As for residential users, in case of urban constructions, the rate of getting connected to the natural gas supply is around 80% whilst in case of rural constructions this rate is only 60%. Consequently, a higer number of rural residents use alternative fuels already now. Mainly as a result of building energy modernization, a rate of 20% decline in natural gas consumption can be predicted in the period until 2020 according to the above-mentioned data. **In respect of the utilization of renewable resources, the realistic scenario concludes the following:**

- the biomass-based combined heat and electric power plants constructed near the big towns of the region might provide the basic heat supply for the heat bases;
- the capacity of 6-7 MW of the already existing hydroelectric power plant in the region could be doubled at the most with the implementation of projects whose ecological footprint is not significant (cause negligible landscape destruction);
- On the grounds of biogas-based power plants and the performance of bio-methane fed into the natural gas network, a capacity of hundreds of MW could be generated;
- the heat potential of geothermal energy is significant, by drilling new production wells nearby, a heat demand of 400-500 MW could be covered with 150-200 thermal wells in operation;
- solar energy utilization is also of significant potential, the partial supply of electricity demands of detached houses, institutions and industrial establishments could be provided with solar panels.

A **pessimistic scenario** will take place in case the rate and availability of grants facilitating structural changes fall behind expectations or natural gas as a basic energy source maintains those elements of its price structure which limit the competitiveness of alternative technologies. The building energy modernizations wil not be implemented to the extent necessary therefore household fuel consumption will not decrease according to the targets set before in urban areas, neither will the rate of renewables in rural constructions increase.

An **optimistic scenario** will take place in case the rate and availability of grants facilitating structural changes exceed considerably the rate described in the realistic scenario and the price structure of natural gas as a basic energy source is changing in a way that it does not restrict the competitiveness of alternative technologies any more. The upper bounds of the potential of the economically utilizable renewable energy sources will set the limits to the optimistic vision. The majority of planned biomass

utilization projects will be realized and the economic environment changing in a positive direction will generate further projects.

1.2.5. Steps to achieve a realistic vision for the future

Among the possible scenarios concerning the energy production and consumption of the West-Transdanubian Region, **obviously the implementation of the realistic vision is regarded as the most likely one by the West-Transdanubian Regional Energy Strategy**. However, considerable efforts are required to achieve it.

The overall objective of the strategy is – based on the renewable energy capacities and endowments of the region – to provide guidance primarily to the development of energy production. This long-term development involves the development of transport networks and also requires the improvement of the efficiency of the consumer side. It is a relevant aspect that the energy distribution networks are to be shifted from one directional (from producers to consumers) to bi-directional (from producers to consumers but consumers can also be producers). In case of electricity networks, it requires the installation and construction of more sophisticated equipment and in some places strengthened networks, so-called ”smart grids”.

The overwhelming majority of energy generation from electricity and gas networks come from non-renewable energy sources currently. It can be changed by implementing multiple and various investments. The new energy demands could be met by slightly decreasing or the same level of production if existing energy consumers improve their efficiency and decrease their consumption by changing their mindset and consumer habits.

The widespread dissemination of the utilization of renewable resources could primarily be achieved by a predictable, favourable regulatory environment (pricing) in the long run and, secondly, by calls for proposals that could function as incentives. Obviously, not only production but the improvement of energy efficiency and savings of the consumer side should also be stimulated at the same time. As a result, besides improving the regional energy balance, a few thousand new jobs could also be created. According to the observations of the strategy, there is more perspective to utilize a different type of renewable energy in each county of the region, **in Zala County, conditions are the most favourable in particular for the utilization of solar energy and biomass**.

The primary biomass possesses significant energy potentials although it is partly utilized in the neighbouring Austria. It is a source of energy which can be stored easily and for relatively long without

further energy investments as well as it can take various forms such as bio-ethanol, biodiesel, fuel wood, straw bale, woodchips, pellet etc. Energy crops such as poplar, willow, mischanthus can be grown and are worth growing on poor quality soil, there is more than 28,000 ha in the region available for it with favourable returns. Futhermore, the number of medium-sized and large livestock farms is also significant in the region. It is worth building a biogas power plant on them only if the utilization of the heat generated is solved (e.g. district heating, greenhouse, crop-drying machine). The current natural gas demand could also be decreased by the production of biogas (bio-methane) and following appropriate treatment by feeding it into the natural gas network as the above-mentioned bio-ethanol and biodiesel could decrease the petrol demand of vehicles.

The geothermal gradient is higher in the region and the country compared to the neighbouring European countries therefore it is worth benefitting from it in many ways. The construction of a geothermal power plant should be considered when the temperature of water is above 120-130°C and there is sufficiently large water flow to establish a powe plant of 2-5 MW which is economical to run. Thermal water at a temperature of 70-80°C could also be used for district heating in the current systems, besides heat energy can be extracted from the same water in several application areas with gradual heat removal.

Adjusted to watercourses, mini- or micro-hydroelectric power plants could be constructed in some places in the region (~500W-20kW). Already existing dams that have not been utilized for that purpose so far are the most appropriate ones in addition to the sites of the former water mills along the river Zala where power plants could also be built.

1.2.6. Steps to improve energy efficiency

The West-Transdanubian Regional Energy Strategy gives high priority to energy-conscious consumption, whose ultimate goal is the improvement of energy saving and energy efficiency. By achieving it, the amount of fossil fuels consumed can be decreased directly thus resulting in the mitigation of greenhouse gas emissions without investments in the utilization of renewable energies. The strategy draws the attention to the following steps in order to improve energy efficiency:

- **Stimulation of keeping records of and monitoring energy consumption data**. Primary target group: educational, medical and other local government institutions. Secondary target group: residents (via non-governmental organizations);
- **Energy supervisions in public institutions**. In order to facilitate it, pilot audits are conducted in the largest medical and educational institutions as well as the biggest and most prominent– consequently with the highest demonstrative potential – health spas and then widespread dissemination of results. Implementation of cost effective interventions of efficiency improvements revealed by the investigations.
- **Larger consumers and local governments running several institutions: empploying** or using the services of **energy experts**, operation of energy management systems;
- **Training for professionals, especially construction architects, architectural engineers and contractors on the application of energy effective technologies**.
- **Awareness raising campaigns, information and consulting service for residents** (in cooperation with non-governmental organizations and service providers);
- **Stimulation of conscious shopping** (preference of low energy products), accompanied by information service.

1.2.7. Innovative technologies

As in the course of the implementation of Austria – Hungary Cross-border Cooperation Programme, the main objective from an energy perspective is to increase the rate of renewable fuels to the highest extent among the primary energy sources consumed, **the West-Transdanubian Regional Energy Strategy devotes a separate chapter to the innovative, pilot-phase technologies whose implementation, adoption and dissemination can greatly facilitate the wider range of utilization of renewable resources.**

The strategy discusses the Stirling engine and pyrolysis systems in detail, which can assist to utilize the gaseous and solid biomass feedstocks decentralizedly besides the direct utilization of solar energy. In addition, the strategy outlines the storage opportunities – basically in the form of hydrogen – for electricity generated by renewable energy sources, as the first steps to the development of a hydrogen economy. Concerning the utilization of geothermal energy, it discusses those innovative opportunities for power plant utilization which might be taken into account in the implementation of projects in

Hungary. Finally, it is followed by the presentation of opportunities for implementation with thin film solar panels in the near future.

1.2.8. Institutional framework for strategy implementation

The West-Transdanubian Regional Energy Strategy gives a brief desciption of the EU support system, the national and regional programmes facilitating the development of renewable energy systems, in particular the Environment and Energy Operational Programme, which provided funding for energy investments between 2007 and 2013 as well as the Green Investment and Green Economic Development Systems, which primarily support residential investments and utilize funds generated by international and EU quota trading.

The strategy also makes proposals for the organizations to be involved in the implementation, indicating particular higher education and training institutions separately. The document considers the cooperation of professional organizations and experts involved indispensable even in terms of awareness raising. **It proposes the promotion of renewable energy utilization among residents and SMEs with regional radio commercials and the establishment of specially-equipped showrooms in bigger settlements and towns or deployed information trucks and buses. At the information points and in the vehicles, the demonstration of solar panels, solar collectors, wind turbines and heat pumps should be solved**. That way those constructing or planning to refurbish a building can get first-hand information about the necessary devices with the help of demonstration tools in operation.

Finally, the strategy describes some successfully implemented, exemplary programmes stimulating the utilization of renewable resources such as the projects ”Establishment of centres demonstrating the utilization opportunities of renewable resources along the Tőkés arm and in the small region of Tét” and ”Renewable Energy Route”. Their main objectives and content are identical to the project to be implemented in Lenti as they intend to disseminate renewable energies via direct experiments.

1.2.9. Conclusions, proposals

The main development directions indicated in the West-Transdanubian Regional Energy Strategy are summarized in a separate chapter, whose content is the following.

Among the existent energy systems, the role of the electricity network in the region is expected to remain of paramount importance in the coming decades but it will undergo a considerable transformation. Focusing on local energy production and self-sufficiency, **the growing number of home and small power plants will force the networks to become bi-directional** on the part of the network

licencees. The electricity networks will become smart grids. The transition can take place gradually. As a result, a network section at low or medium voltage can be a gross producer or consumer depending on the time of day. The aim is to facilitate self-sufficient energy production.

The significance of natural gas distribution networks is expected to decrease gradually (mainly in rural areas) if biomass combustion plants become widespread and there is enough biomass to be utilized for energy purposes. The significance of gas networks might somehow be conserved by the production of purified methane biogas and synthetic gas with a calorific value of almost the same as of natural gas from different types of renewable resources and by feeding it into the natural gas network. The maintenance of the functionality of distribution-network infrastructure would by all means be favourable in the long run (2030).

The exploitation of renewable resources are to be increased by explicit steps. It will be an important result to achieve the EU goal of 20%, (national 14,65%) but the dynamic shift to the development of an almost 100% sustainable self-sufficient energy production will be even more important.

Biomass might have a prominent role in it. The production of energy crops in agricultural areas unsuitable for food production and the energy recovery of food crop residues (e.g. biogas, pellet) should be encouraged.

Electricity should be generated by mainly wind power plants in the northern part and **by the exploitation of solar and geothermal energy sources in the southern part of the region** – taking the local conditions into consideration. In case of electricity generation by solar energy, the application of two optimum instruments are recommended: the first one is a device of photovoltaic solar panels equipped with a dual-axis solar tracker, the second one has a stirling engine unit in the focal point of the parabolic mirror. The first device generates 30-40% more electricity than the static variety and the second one converts solar heat into electricity without solar panels but with the help of the Stirling engine with quite high efficiency.

The potentials of the utilization of water power are of minor importance at regional level although existent dams and places of bigger currents are worth utilizing for electricity generation. Hydroelectric power plants can generate electricity for decades with relatively steady performane at low costs.

T**he biogas plants should rely on large livestock farms in the region** which require the plant-based feedstocks of fermentation to be produced on site.

In case of buildings, reducing heating and cooling demands should mainly be focused on, which can be achieved by excellent insulation (wall, doors and windows) as well as the (even subsequent) installation of ventilation systems supplied with heat exchangers. Architectural engineering improvements are recommended mainly in case of already insulated buildings because engineering investments and running costs later on can be optimized at individual and regional levels.

1.2.10. Lenti, the renewable small region – The energy concept of the small region of Lenti

The West-Transdanubian Regional Energy Strategy includes energy concepts developed for separate small regions of each county of the region to stimulate the practical implementation of its content. The strategy describes the energy concept of Lenti in Zala County, whose main observations are the following.

In the small region of Lenti, compared to the projects and investments implemented in energy utilization so far, there are more opportunities available for the execution of developments concerning the improvement of energy efficiency and production of renewable energies. The biomass potential of the region, the extractable geothermal energy, the available development areas all require the economy, settlements, buildings and institutions of the small region to be renewed and, as a result, to create an attractive investment environment and a new supply in tourism based on ”the green”, almost unspoilt environment.

At the interviews conducted during programme development, most of the local stakeholders explained with the lack of cooperation and scarcity of funds that in spite of the local endowments, the utilization of renewable energies is not widespread in the region. It is well-known, however, that in the immediate surroundings of the small region (in Slovenia and Austria), there are several good practices which are worth adopting and adjusting to local conditions contributing by that means to economic development and job creation. Consequently, **the main objective of the energy concept of the small region of Lenti is to encourage cooperation between local actors, primarily by facilitating the flow of information**. The concept determines the following three directions in order to achieve this:

- Development needs, ideas of extension connected to existent energy networks (electricity, gas etc.);
- The improvement of energy efficiency at the level of households, institutions and the economy;
- Dissemination of renewable energy utilization (at the level of households, institutions and the economy).

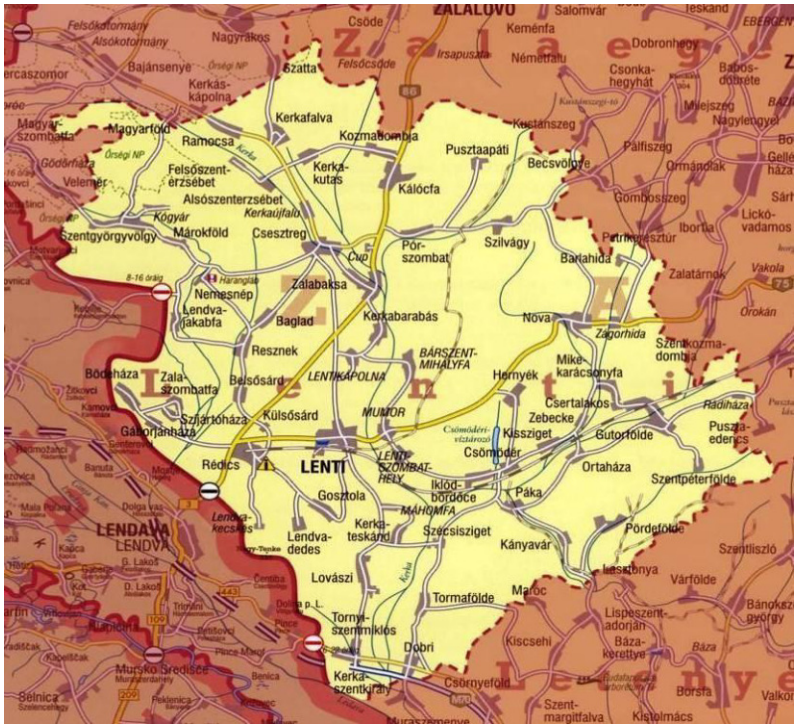
Based on the situation analysis, **endowments are primarily favourable for the utilization of biomass among renewable energy sources** (areas of low Golden Crown (GC) worth, considerable amount of rainfall, labour). Within the framework of biomass utilization, all phases of the technological process from the production of feedstocks (e.g. sprouting energy willow plantation) to processing can be executed in the region creating jobs and resulting in considerable energy savings for consumers. **Besides biomass, the utilization of solar and geothermal energy also have perspectives in the small region of Lenti.** It is recommended to install heat pump systems based on geothermal heat. In case of residents and institutions or factory floors consuming a considerable amount of hot water, the installation of solar collectors will be possible.

It is important to create opportunities for residents – representing a significant proportion of energy consumers – **to become familiar with and as possible apply the technologies utilizing renewable energies in their construction and refurbishment projects**. The action plan ”House of Renewable Energies” is partly intended for this objective, but it is also planned to become an information point for local entrepreneurs besides residents.

3. Technical and technological analysis

3.1 General descripton of the small region of Lenti with special emphasis on its energy, climatic and environmental endowments

The small region of Lenti is located in Zala County, in the West-Transdanubian Region, its area is 663km². Its permanent population was 19,900 at the end of 2016, among its settlements one has a town status. The particularly rural area is characterized by population decline, the rate of which has exceeded 61% in the last ten years according to data supplied by the Central Statistical Office. Due to the settlement structure of small villages, public services are provided in the form of partnerships (administrative, medical, social services), the institutions are located in Lenti and the micro-regional centres.



Map of the small region of Lenti[4]

The district of Lenti is located in Zala County in the West-Transdanubian Region in southwest Hungary **near the Slovenian border**. At the time of the Cold War, it was regarded as a strictly-protected border area, where strategic industries were not settled, but **the environmental conditions are excellent**. Among conventional energy sources, trees can be found in the highest proportion, the ratio of forest area is about 38%. The natural vegetation is is dominated by hornbeam, oak and beech, but its pine forests are also significant.

[4] Source: Information society strategy of the small region of Lenti, June,2007

Along the river Kerka, clay and loamy as well as raw meadow alluvial **soil** is common, which is dense, airless and **suitable for the establishment of energy plantations rather than crop production**. The areas of poor quality are not utilized by agriculture, they have become forested.

The surface of the small region of Lenti is mainly covered with plains surrounded by hilly areas, the altitude is between 165-201m. Among the surface watercourses, the River Kerka and Cupi stream are the most significant but neither of them and no other watercourses are suitable for energy production e.g. the establishment of a mini hydroelectric power plant. Below the surface there are high-temperature thermal fields at a depth of 1000-3000m. The opportunities offered by the thermal spring are utilized only in the thermal spa of Lenti for the present.

The transport-geographical location of the area is favourable directly bordering Slovenia, in Rédics – not far from Lenti – there is a high traffic international bording crossing point, but Croatia (border crossing in Letenye – 33km) and Austria (border crossing in Szentgotthárd-Rábafüzes – 51km) are also in short distances. The southern areas are intersected by the M70 highway. Road 86 connects the area with other counties of the region and the Slovenian border (the Slovenian motorway starts at the border crossing point). Major road 75 connects the area with the Balaton region and Zalaegerszeg. Main railway route 23 connects Zalaegerszeg and Rédics, which is expected to be extended in the direction of Slovenia.

The electric power system functioning as a transit system as well intersects the area and supply is provided by two 120kV entry points at present. The natural gas network, piped-water network, the sewerage syste in bigger settlements are available in the whole region but there is no district heating system. The internet access is also provided everywhere (by optical networks or mobilenet).

The town and bigger villages are characterized by the appearance of orderly settlements, well-kept streets and extended institutional network, however, the building stock of the slowly depopulated small settlements is deteriorating. Few of the residential buildings, rows of houses and public institutions of the small region are rated into the energy efficiency classes A, B or C. As a result of the lifestyle changes accompanied by the increase in energy consumption as well as the increasing energy costs, there are more and more investments of energy efficiency improvement in the residential and communal sectors. These improvements are restricted by the economic situation, in the public sector there are developments only by the utilization of calls for funding (replacement of doors and windows, thermal insulation, heating modernization etc.). Besides firewood, the utilization of renewable energies is not widespread among residents.

The key industries of the small region are agriculture, forestry and timber processing. The traditional woodwork and furniture industry, machine manufacture, textile industry and tile manufacture are significant, but a considerable number of workers are employed in the service sector (trade, tourism, public services). Among industries, machinery, wood and light industry (textile industry) provide the majority of jobs. Some of the woodwork businesses process industrial waste wood (e.g. Németh-Fa Kft. – pellet production) or it is used for heating premises. In order to develop existent industrial plants and establish new ones, the extension of industrial areas would be required (in the area of Zajdai barracks, in the south-eastern part of Lenti). Agriculture is dominated by plant production but there are some livestock farming (beef cattle, turkey, chicken, mangalica) businesses providing jobs for the residents. The non-cultivated as well as the cultivated areas with low Golden Crown (GC) worth are highly suitable for the establishment of biomass plantations due to the heavy rainfall (above 800mm annually). Several farmers established energy plantations but green energy is scarcely utilized in the area (power plants from Austria and Slovenia purchase the feedstocks). From the almost 15,000 population of working age of the small region, 700-1,500 are registered job seekers at the Job Centre (hectic job market). Based on divisions of age groups and qualifications, the number of job seekers with low-level qualifications (vocational qualification at the most) is outstanding among both men and women (81% of men, 66% of women), for whom the prospective biomass utilization might create jobs.[5]

The electricity supplier of the region is E-ON Észak-dunántúli Áramhálózati Zrt. The electricity consumption of households in the small region is as follows: on the grounds of data provided by the Central Statistical Office, the number of household electricity consumers was 11,564 in 2000 and 12,704 in 2010. The increasing number of connections (1,140 new connections in 10 years) in inverse proportion to population decline can be explained by the increase in energy prices and condominiums switching over to individual electricity meters from public accounting. **In spite of the increasing number of consumers, the amount of electricity supplied to households decreased in the region: from 22,096kWh measured in 2000 to 20, 187kWh in 2010.**[6]

The piped natural gas supplier/operator is E-ON Zrt. Gas supply is available in every settlement of the small region. According to data provided by the Central Statistical Office, the natural gas consumption of households is as follows: the number of household gas consumers was 4,859 in 2000 and 7,168 in 2010, the amount of gas supplied was 4,137 thousand m^3 in 2000 and 5,603 thousand m^3 in 2010, the

[5] Source: Kovács, I. (ed.) (2010): Regional economy, situation analysis of employment and training, "Csesz Regélő Nonprofit Kft., Promen Tanácsadó Kft., Csesztreg

[6] Forrás: ESPAN West-Transdanubian Regional Energy Strategy

proportion of consumers with piped gas supply was 49% in 2000 and 71% in 2010. The amount of total piped gas supplied was 9,830 thousand m³ (5,693 thousand m³ of corporate consumption) and 15,805 thousand m³ in 2010 (10,201.9 thousand m³ of corporate consumption). **According to these data, there was a considerable increase in the number of household consumers, however, there was a decrease in the amount of gas calculated per connection**, probably as a result of conscious energy consumption due to the increase in energy prices and the residential and public energy rationalization investments and projects. **There was a significant increase in the amount of corporate consumption** by 4,508 thousand m³ in 10 years, **which can be attributed to the developments of CREATON tile factory.**

3.2 Strategic background of the action plan

The energy concept of the small region of Lenti involved in the West-Transdanubian Regional Energy Strategy concludes that opportunities are granted in the region for a more efficient energy utilization, a decrease in fossil fuel consumption and the replacement of conventional primary and secondary energy sources with the application of renewable energies.

The concept specifies five action plans for the practical implementation of the three development directions determined, which are the folowing:

- Development of Lenti ”House of Renewable Energies” (consulting-information centre), – investment and networking programme;
- Development of Lenti Green Economy Innovation Park;
- Establishment and utilization of biomass plantations;
- Regional pilot project for institutional and corporate energy modernization;
- Residential energy modernization pilot project.

3.3 The main elements of the action plan

3.3.1 Target groups

On the grounds of research conducted in the region (surveys of CEEBEE, ESPAN, FATE projects), awareness raising, consulting, development of cooperation networks, joining interests of the residential sector, local governments and businesses in the small region are of paramount importance to the better utilization of the energy and economic endowments of the small region. The action plan ”House of Renewable Energies” planned in Lenti serves to achieve that aim.

The investment and networking project implemented as a result of the action plan intends to contribute to the cooperation of stakeholders so that a wider range of society can become aware of sustainability as a value, the methods and effects of the utilization of renewable energies can become

well-known and the application of different energy-effective alternatives to construction can become widespread.

The immediate objective of the action plan is to establish a non-profit information centre related to a sustainable lifestyle.

The information centre intends to meet the information demands of several target groups simultaneously as follows:

- *Residents*: financial and construction consulting is provided for households concerning building refurbishments and the forms of renewable energy utilization;
- *Local governments, institutions of the region*: consulting, training and project development services are provided for the energy rationalization of the buildings (offices, surgeries etc.) of public institutions;
- *Enterprises*: the enterprises planning the utilization of renewable energies could play a key role in the long-term economic development of the region, they can join the training, consulting and development services of the centre;
- *Architects, contractors, craftsmen:* the centre organizes training courses and info days for the architects, contractors and craftsmen related to the investments of energy efficiency improvement or renewable energy utilization with the aim of introducing the best available technologies and techniques. In order to facilitate relationship building and networking, the centre intends to get involved in matching the stakeholders of investments, primarily by the development of a regional rating system.

The action plan Lenti ”House of Renewable Energies” comprises several elements, the most significant ones are as follows.

3.3.2 The element of infrastructural development

The name Lenti ”House of Renewable Energies” refers to the community centre to be established. This building will function as the venue for the consulting, training and networking centre stimulating the utilization of renewable energies and energy efficiency improvements in the small region of Lenti.

Having regard to the fact that **the building will serve demonstrative purposes at the same time, the considerations of energy and water savings should be reflected in its design**. As a result, solar collector systems will provide the production of service water and partly the heating of the building. In case of solar collectors, the installation and demonstration of several types is planned as the most well-known systems bear different stress. Rainwater will be collected and used for toilet flushing later on.

A theme park will be established in the yard of the House of Renewable Energies, which will demonstrate the opportunities for the utilization of renewable energies. One of the main objectives is to demonstrate electricity generation with an on-site photovoltaic system and a wind turbine in operation,

which will assist the electricity supply of the building. As the wind speed is relatively low in the region, the construction of a wind mill of max. 1000 W rated power is possible for demonstrative purposes, which is able to produce energy even below 3m/s wind speed.

Besides the utilization of renewable energies, **the building will function as a good example of effective thermal insulation** in case of both boundary surfaces and doors and windows. Furthermore, with the built-in blinds and green shading planted at the right places, **it conveys the message that because of the changing climate, the aspects of shading should be given higher priority than before.**

In the course of building design, its functions should obviously be taken into account, so it **should include more communal space and offices besides being handicap accessible**. An outdoor activity space will be established in the theme park and information boards will also be displayed.

The ideal venue for the Lenti ”House of Renewable Energies” is the town centre of Lenti, but it is possible that some functions will be relocated in separate buildings in the fututre e.g. the building for the ”forest school” programmes aiming at schoolchildren will be separated from the venue for consulting service for the residents or entrepreneurial workshops.

3.3.3 The element of networking, partnerships

Networking and building partnerships are tasks of outstanding importance in the action plan of ”House of Renewable Energies”. Among the prospective partners, the municipalities of the region as well as the leading enterprises in the area, the Zala County Foundation for Enterprise Promotion, the different regional clusters (e.g. Pannon Wood and Furniture Cluster, Pannon Renewable Energy Cluster), the Zala County Chamber of Commerce and Industry, vocational training institutions, forestries, companies distributing equipment for the utilization of renewable energies etc. all play a key role. In order to encourage the domestic adoption of good practices implemented in the neighbouring countries, Slovenian and Austrian partners should also be involved in the networking process.

3.3.4 The element of incubation, training, information and consulting services

One of the main objectives of the concept ”House of Renewable Energies” is launching incubation services related to the subjectmatter (pre-incubation, incubation services). **In order to involve enterprises, focused communication programmes should be launched and the following incubation programmes should be implemented:**

- *Organization of open days*, introduction of the companies dealing with the utilization of renewable energies;

- *Organization of short presentations, training courses* related to green economy and energy efficient architecture, *launching investor programmes*;
- 60 hour training course for enterprises based on the training programme ”Enterprise academy”;
- *Encouraging the preparation of business plans* for credit programmes and calls for proposals, promotion of obtaining national and EU funding.
- risk management and due-diligence of start-ups, transforming enterprises as well as of businesses submitting proposals for aid schemes.
- Information provided to social and economic organizations in the subjectmatter of renewable energies (whether contents should be involved in labour market activities).

In the action plan ”House of Renewable Energies” training courses have a key role. It is justified to commence the following training courses and types of training:

- *Forest school programmes* (a 6-day training block) for primary and secondary school students in the topic of sustainable development and renewable energies, with accomodation;
- *Information programmes, knowledge dissemination programmes for local governments, institutions* (1 or 2-day training courses) in the topic of energy rationalization;
- *Training courses in networking, organizational development* for local governments, the civil society and the entrepreneurial sector;
- *Marketing training for traders, contractors* (traditional and online);
- *Accredited adult education programmes* in renewable energies and energy efficient architecture;
- *OKJ (National Register of Vocational Qualifications) part-qualifications,* organization of OKJ training courses for professionals, candidates for retraining (according to Austrian requirements).

3.4 Justification of development concerning the attitude of residents to climate change

In the last few years there have been representative surveys conducted from several aspects on the energy, environmental and climate consciousness of the Hungarian society (e.g. Hungarian Academy of Sciences, Centre for Economic and Regional Studies – 2015; National Society of Conservationists, Hungary – 2016). On the grounds of these results, it can be concluded that almost all of the respondents (nearly 98%) have heard about climate change and 92% of them know roughly or exactly what this term means. **Almost 90% of respondents regard human environmental pollution as the cause of climate change**. It is an interesting phenomenon that an explicitly smaller proportion of young people (aged 15-24) belive that human activities play a predominant role in bringing about climate change than the older generations. **The majority of respondents, however, misjudge the role of particular industries in bringing about climate change**. They regard waste generation incorrectly as the main contributor followed far behind by industries which actually play a crucial role in climate change: road traffic, energy production, air traffic and large-scale agriculture, which draws the attention to the importance of awareness raising with a focus on energy aspects.

A pleasing result of the surveys is that almost 75% of people totally or quite agree with the fact that they themselves also have to do something againsts climate change. In this context, attitude surveys also covered questions about recent lifestyle changes and residential investments related to climate change. **According to the survey conducted by the Hungarian Academy of Sciences, Centre for Economic and Regional Studies, respondents from Zala County took appropriate steps in accordance with the national average (55,94%) to mitigate climate change, listing mainly those actions which required less financial investment but attention basically** (the use of energy saving bulbs, selective collection of rubbish, decreasing energy consumption by switching off appliances, purchasing energy saving household appliances) although there were some which required more financial investment e.g. the use of solar panels or solar collectors.

The results of the survey suggest on the whole that awareness raising programmes related to climate change and especially energy saving and the utilization of renewable resources are required in the future as well mainly in less populated settlements. It is also justified by the respondents, 90% of whom agreed that this type of programmes would be necessary in their settlement. It is also important to emphasize that according to the above-mentioned respondents, the organization of awareness raising programmes is reasonable only if they address well-defined target groups (e.g. children, farmers,

pensioners) and convey concrete feasible ideas. **The Energy Garden implemented in Lenti within the framework of the RURES project will fully meet these requirements**.

3.4.1 Background of the development

As part of the West-Transdanubian Regional Energy Strategy, the implementation of the action plan ”House of Renewable Energies” in the energy concept of the small region of Lenti, is the challenge of the next decade. In order to provide the highest possible benefit with the practical implementation of these ideas, it is justified to assess the expectations of local actors belonging to the target group of the development concept – mainly businesses and residents – towards a project involving elements of awareness raising and infrastructural development with the aim of renewable energy utilization and energy efficiency improvement. Consequently, it is advisable to implement certain parts of the development package separately as pilot projects. For this reason, an ”Energy Garden” is intended to be established in Lentiszombathely, on the outskirts of Lenti. The practical experience gained via its construction and operation will facilitate the successful implementation of the action plan ”House of Renewable Energies” in Lenti later on.

3.4.2 Main elements of the Energy Garden in Lenti

Within the framework of the project *”Promote the Sustainable Use of Renewable Resources and Energy Efficiency in Rural Regions, RURES*” CE No. 933 promoted by Interreg CENTRAL EUROPE programme, an energy garden will be established in the area of the old primary school in Lenti, more precisely in Lentiszombathely.

The Energy Garden in Lenti is expected to funcion basically as a venue for demonstrating opportunities for the utilization of renewable energies and the improvement of energy efficiency, **which is facilitated by the procurement of three devices for the improvement of energy efficiency: a vertical-axis wind turbine, a solar panel system and a vegetable oil mini generator.**

The primary target groups of the project are enterprises in the small region and residents although it can increase the knowledge of opportunities for and devices of renewable energy utilization on a broader social level by welcoming children, the youth and groups from public institutions as well. We also have great expectations regarding the devices placed in the energy garden to arouse the interest of architects and craftsmen contractors in the area, that way contributing to the extension of renewable energy utilization.

It is expected to be the main target activity guided by the Zala County Government within the framework of the above-mentioned project thus this study also describes the economic value added (EVA) of these devices. The devices to be placed in the energy garden are discussed individually below.

3.4.3 Solar panel system

It is important to point out that the installation of s solar panel system should not only be examined from the aspects of energy efficiency and environmental protection but also as an investment. The construction of the system is essentially an investment with stable calculations in the long run and a return on it. Furthermore, it is tax-exempt and can generate a high yield.

The study hereinafter examines on-grid/grid-tied (grid backfeeding) home solar panel systems in terms of return on investment, which are the most widespread type of solar panel systems in general.

As a result of the unlimited holding and storing capacity of the electricity grid and the application of the annual balance accounting system with the supplier, the implementation of solar panel systems can be highly economical.

Payback period

The simpliest way to calculate the payback period is to take the costs of implementation and the average energy prices as a basis and then examine how much energy and what value can be saved with the implementation of the system.

Installation costs

In case of a 1 kW solar panel system, the installation costs are approx. between HUF 500-700 thousand, which includes the material, labour, licencing and other additional costs (land clearance etc.). The smaller systems are relatively more expensive, the bigger ones are cheaper.

Savings

In case of south-facing ideal orientation and a 35°° angle, a 1kW solar panel system can generate approx. 1100kWh electricity annually.

Savings in terms of economic value added

The calculations are based on the assumption that the solar panel system works with feeding back power into the grid. (grid-tied). The above-mentioned investment costs and annual energy yield are relevant only in that case. Consequently, if the annual electricity generation does not exceed the consumption, utility companies buy electricity at the same price as they sell it themselves.

According to the A1 residential tariff, gross HUF 37,56/kWh of electricity price can be calculated with.

Calculation of simplified payback period:

The simplified payback period can be calculated by dividing the investment costs of the solar panel system with a unit performance by the price of the electricity generated in a year i.e.

Payback period [year] = Investment costs [HUF] / (Energy savings [kWh/year] x Energy price [HUF/kWh])

In case of a 1kW solar panel system with an average HUF 550,000 investment costs and 1100kWh annual electricity savings:

550,000 [HUF] / (1100 [kWh/year] x 37.56 [HUF/kWh]) = 13.31 years

According to this approach, the payback period of a grid-tied solar panel system is approx. 13 years with the current electricity price (after a numerous utility cost reductions).

However, in the course of simplified calculation, several relevant factors were not taken into account. It is very important to consider the changes in energy prices, the costs of maintenance and a certain degree of performance decline. It is also worth considering whether a solar panel system is more

lucrative than putting the amount of investment costs into a deposit account. It is essential whether the investment relied on state subsidy. These factors can be taken into account with the so-called annuity method.

Using the above values, this unspecified calculation results in a slightly shorter, 12-year payback period.

3.4.4 Vertical axis wind turbine

The vertical axis wind turbine can be installed in places where the normal wind turbine cannot be used. As a result, its main advantage is that it can be installed into the roof structure of detached houses, warehouses or even production plants without disturbing the neighbourhood with its operation.

Source: http://www.geo-line.hu/?p=1879

The major axis of the vertical axis wind turbine is perpendicular to the ground whilst in case of normal wind turbines, the axis is horizontal. This vertical design makes its utilization in both rural and urban areas possible. The vertical axis wind turbine does not depend on the wind direction, winds of any direction rotate the wind turbine, the crosswind gust does not twist the turbine from the wind direction. Due to the special blades and the low rotational speed, its operation is quieter. The vertical axis wind

turbine is recommended to be installed in places where there is strong turbulence, in addition, this type of wind turbine can be mounted on rooftops.

Advantages of a vertical axis wind turbine mounted on a rooftop:

- The height of a taller building is up to 12m, so the material costs of a 12m tall column can be saved, which is gross HUF 500,000.
- The roof inclination can accelerate the wind speed thus 30% higher performance can be achieved.
- Easy installation and maintenance
- Quiet operation
- No licence is required
- Attractive appearance

In the RURES project of the Zala County Government a 1000W wind turbine is taken as a basis because its technical specifications meet the requirements set by the establishment of the energy garden (size of the school and its demonstrative nature).

Product description:

The 1000W vertical axis wind turbine to be installed in the energy garden in Lenti is among the most advanced ones available in the world, which operates at a low rotational speed. Due to the well-designed blades, they are omni-directional without performance decline. Beside its attractive appearance, it can be regarded as a noiseless device. The wind turbine mounted on rooftops is able to be grid-tied, which makes its operation even more economical.

Technical features of the wind turbine*:*

- Dimensions: W 1,8m x H 2,7m
- Swept area: 4,62 m²
- Gross weight: 175 kg
- Blades material: carbon fibre
- Generator: Permanent magnet
- Island mode: 24/48V
- Grid connection: 600V
- Temperature range: -40°C/115°C
- Max rotational speed: 180/min

- Wind speed for electricity generation: 3m/s
- Max wind speed for electricity generation: 30m/s
- Optimum wind speed: 12m/s
- Survival wind speed: 55m/s
- Noise level at 12m/s wind speed: 38dB
- Lifetime: 20years
- Warranty: 3years

Payback period

The initial information for the calculation of the payback period is the investment cost. The installation cost of the vertical axis wind turbine in island mode is gross HUF 3,800,000.[7]

In that case, the payback period can be calculated by using the formula demonstrated with the solar panel system.

Payback period [year] = Investment cost [HUF] / (Energy savings [kWh/year] x Energy price [HUF/kWh])

The expected payback period and the economic added value are as follows:

3,800,000 [HUF] / (9200 [kWh/year] x 37.56 [HUF/kWh]) = 11.65 years

In case of the energy garden in Lenti with an investment cost of HUF 3,800,000, a payback period of 11-12 years can be counted on. Obviously, in order to achieve this, the most appropriate place for installation should be found; on the grounds of the above-mentioned technical parameters, the wind turbine is reasonable to be mounted on the rooftop of the school building.

The result calculated complies with the expected payback period in Hungary, which is between 8-11 years.

3.4.5 Vegetable oil ”mini generator”

The ”mini generator” running on vegetable oil is a newfangled tecnology, so the data available is scarce. It means a considerable uncertainty factor during calculations on economic efficiency and payback period, but as a pilot project, its function is to test this type of novel technologies therefore final calculations on payback period should be carried out within the framework of the energy garden.

[7] Source: www.megujuloenergiak.eu

A good practice

In spite of being a novel technology, there is a vegetable oil ”mini generator” in operation in Hungary. It is run by ”Cropell Kft, a family business with modest financial background but existent infrastructure, relationships and sources of purchasing. During the refurbisment of the farm – located on the outskirts of Derekegyház and functioning as a home and business premises – the electricity supply had to be solved. The owner of the farm strived to implement the most cost-effective solution in the long run, so he decided on the generator running on pressed plant oils. The implementation of the project is based on plant oils, which can be provided by growing oilseeds (sunflower, rape) on a field of 1-2 hectare and then by pressing oil from these seeds for the mini generator to generate electricity and hot water. In the course of pressing oil seeds, pellet and cake is produced from the seed residues, which can be combusted. That way the full energy demand of the farm can be covered at low costs. By the establishment of the vegetable oil mini generator, the enterprise has been able to provide the full power supply of the family home and the premises since 2007. Today (in 2013) this solution is used in more than 30 places in the country. Because of the lack of funds, (prospective) farm owners usually purchase the Crofter mini generator from funding from calls for development projects instead of their own sources. The mini generator is currently involved in the BÜKK-MAKK LEADER programme (Sajópetri), where this system is intended to be applied in several projects under impementation and also planned ones, in most cases in a combination with other renewable resources (solar, wind and geothermal energy). ”[8]

Product benefits

In Hungary, the electricity supply of farms and mountain cellars cannot be regarded as fully solved since public utility infrastructures do not serve the whole of these areas. A solution to this problem is offered by owners generating electricity from renewable energy sources, which could not only be a stable source of electricity but also a more cost-effective solution.

The technology to be used in the Energy Garden in Lenti will generate electricity with the help of oilseed-based biofuel, which will be able to meet the lighting, electricity and sanitary hot water demands of the farm. The ”mini generator” is basically a mobile energy source with small space requirements which can be run in an energy-effective way.

[8]Source: https://www.nth.gov.hu/hu/tevekenysegek/gazdasagfejlesztes/helyi-gazdasagfejlesztes/otletado-megoldasok-es-jo-gyakorlatok/onellato-energetika-olajos-magvu-novenyekre-alapozva

The vegetable oil ”mini generator” also has a sustainability-themed awareness raising nature since it highlights the fact that the seeds grown are not only useful in terms of sales but by pressing them, they can be regarded as energy sources thus they are suitable for electricity and thermal energy generation.

The technology described above makes an economical, reliable and decentralized electricity and thermal energy generation possible from widely obtainable feedstocks, consequently, a device has been developed which may prove useful for farms on the outskirts as it contributes to their becoming enegy self-sufficient and economical.

Payback period

Based on the good practices and developments already implemented, we gave an overall picture above of the expected benefits from and results of operating the device. As there are no publicly accessible data on the running costs of the ”mini generator” in the size range to be implemented in the Energy Garden in Lenti, the pilot activity will involve the assessment of the return on investment and economical operation as well as its quantification. The results of the measurements conducted under controlled conditions will be made publicly accessible, the experince learnt from and the conclusions drawn on them could be regarded as the outstanding results of the pilot project.

Concerning the payback period of the vegetable oil ”mini” generator, this study defines how the economic value added can be measured. The payback period can be calculated on the basis of the same formula applied with the solar panel system and the vertical axis wind turbine: **Payback period [year] = Investment costs [HUF] /Energy savings [kWh/year] x Energy price [HUF/kWh]).**

The investment costs refer to the purchase, installation and maintenance costs of the device, the energy savings are given, but in case of the energy price, it is important to insert the market value of oilseeds as a kind of opportunity cost in the formula.

4. Financial analysis

General financing facilities

In case of energy efficiency investments, besides the available financing facilities, it is particularly important for project promoters such as residents, municipalities or businesses to be fully aware of the availability and conditions of financing instruments. One of the services of the Lenti ”House of Renewable Energies” will be financing consultancy offered to private individuals and organizations with the aim of implementing energy efficiency projects. The interested parties will be informed not only about the available EU funding opportunities but also other financial instruments within the framework of consultancy. A short description is given below of the characteristics of financing instruments which support the implementation of energy efficiency investments.

In case of construction investments and refurbishments, the complexity of energy efficiency modernization requires considerable preparations and the technical requirements are fulfilled only if the customers or end-users are well-prepared. The assessment of the necessary funds for the investment is part of the preparation process. By means of the contractor quotations, architectural and expert documents, the end user has accurate knowledge of the amount to calculate with and the necessary scheduling. The most obvious solution is when customers have their own funds.

Savings can be combined with accredited financial products with savings incentive, by which the the interest rate on deposits of own savings are subsidized by the Hungarian government under the current regulatory framework.

Building societies (Hungarian term: lakás-takarékpénztár – LTP) are specialized credit institutions dealing with exclusively housing deposits and loans. The savings plan for housing is an opportunity for housing financing subsidized by the government. The government provides a subsidy related to the savings. When the saving period expires, building societies offer favourable credit facilities. Every Hungarian citizen are entitled to them irrespective of their family status and earnings. Building societies can offer housing loans only to residential customers, housing cooperatives and condominiums.

Commercial credits

The banking system offers diversified financial products to both residential and administrative customers for financing energy efficiency refurbishments. The common feature of these credit products

is that they regard the purpose of the credit i.e. the energy efficient reconstruction of the building as an investment element instead of a source of repayment financed by credit and resulted in energy savings. Consequently, their customers are offered classic, medium term (2-15 years) general purpose loans charged with an interest rate or due to the interest subsidy, a credit with more favourable interest rate but by no means a credit based on the amount saved by energy efficiency.

A credit programme was launched last year (04/2017) for the residential sector overlapping between credits and aid schemes, it is described here briefly because of its methodological nature:

Within the framework of the ” Credit programme for increasing energy efficiency of residential housing and utilization of renewable energies”, HUF 115 billion has been allocated for the building energy investments of the residential sector.

The Economic Development and Innovation Operational Programme (GINOP) and the Competitive Central Hungary Operational Programme (CCHOP) provide funding for increasing energy efficiency of residential housing and the utilization of renewable resources related to them.

Private individuals, condominiums and housing cooperatives can apply for the loan at MFB (Hungarian Development Bank) Points since 24 April, 2017.

The zero interest loan can be used among others for the modernization of heating systems, insulation, replacement of doors and windows as well as the installation of renewable energy sources such as solar panels, solar collectors, heat pumps or up-to-date wood gasification units.

The amount of the loan in case of a natural person ranges from HUF 500 thousand to HUF 10 million, in case of condominiums and housing cooperatives it is between HUF 500 thousand and HUF 7 million per flat. The expected amount of own contribution is at least 10% of the eligible costs of the project.

(ESCO) financing model based on energy savings

Its widespred definition in the EU is the following: According to the Directive 2006/32/EC, ”ESCO (Energy Service Company) is defined as a natural or legal person that delivers energy services and/or other energy efficiency improvements in a user’s facility or premises, and accepts some degree of financial risk in so doing.

Payment of provided services (in total or partially) is based on the reached energy efficiency improvements and the fulfilment of criteria agreed upon in advance in Energy Performance Contracting (EPC)."[9]

In Hungary, the so-called third party ESCO financing practice is widespread among municipalities and fiscal institutions when an outside company delivers technical and financial services for the utilization of energy savings assessed with the end-user. In the last 15 years, similar models have appeared behind the modernization of heating systems and renewable energy improvements of residential communities in case of particular technical warranties.

ESCO financial instruments

A wide range of ESCO financial instruments have developed in Hungary, whose basic varieties are the following, distinguished by not only factors of energy efficiency but also accounting:

In case of **third party financing**, ESCO provides outside financing for the investment as a third party, but does not deliver operation and maintenance services thus the financial instrument is not charged with their costs.

The **operative leasing** involves the implementation of the modernization project and renting of the modernized system.

ESCO – technical and financial services related to full-range modernization, in which ESCO undertakes (i) project identification, (ii) technical planning and licensing, (iii) turnkey construction, (iv) operation and maintenance, (v) invoice management and (vi) organizing the financing of these activities.

Forfeiting / factoring – Long-term receivables of the exporter are purchased by a bank at a discounted present value, the discounter bank assuming financial risks concerning the receivables.

Zalagreen microcredit

The microcredit will be available for micro- and small enterprises in cooperation with the Zala County Foundation for Enterprise Promotion (ZMVA), which developed and launched the financial instrument. The following table describes the main parameters of the credit product.

[9] Source: www.sense-esco.eu/en/what-is-esco

Range of credit applicants	Resident micro- and small enterprises with business premises in the Republic of Hungary and/or in the European Economic Area or with branch establishments in the Republic of Hungary
Credit amount	**HUF 1,000,000.- - -5,000,000**
Own contribution	The minimum contribution required (i.e. provision of outside sources) is **10%** of the total net implementation costs of the project, whose pre- or future appropriation is to be certified when the credit disbursment takes place at the latest. Invoices and corrsponding accounting documents prepared six months at most prior to the submission of loan application can be certified as own contribution.
Credit purpose	Eligible projects: financing costs of energy efficiency investments. establishment of wind power generation systems, installation of solar panel systems, insulation of buildings, implementation of geothermal energy investments. They include: - procurement of machines, equipment, other tangible and intangible assets; - financing costs of construction and refurbishment The proportion of the costs of energy savings within the planned development shall exceed 50% of the total amount of credit disbursment.

Duration	12 – 60 months
Grace period for principal payment	Max 12 months
Interest rate	The interest rate is 3,9% per year, which is available to existing customers. The interest rate rises to 6,5% per year if current repayment obligations are past due by 15 days. An interest subsidy programme might also be available to the interest rate.
Default interest	In case of late payment, a default interest shall be charged, whose rate is 6% per year on the overdue capital besides the interest rate, and also 6% on the unpaid interest.
Credit disbursment	Credit disbursment shall take place with the fulfilment of the special requirements set by ZMVA.
Deadline of credit appropriation	The loan agreement shall be concluded in three months following credit authorization. Credit appropriation shall be started within 60 days following the conclusion of the agreement. Project implementation shall be started within 60 days following credit disbursment and finished 12 months following the conclusion of the agreement, this deadline can be extended for another 6 months with justified reasons. When investment is completed, project implementation shall also be justified credibly with documents (e.g. contracts, invoices etc.). In the course of acounting, invoices prepared 6 months prior to submission can be accepted.

General credit conditions

Enterprises excluded from credit financing	**No credit may be offered to enterprises** - under bankruptcy or liquidation proceedings and/or with overdue public debt (except for deferral payment or payment in instalments granted by the tax authorities); - which do not possess valid offical licences for businesslike operation at the time of concluding the Loan agreement; - which received or would receive de minimis aid in the given or previous two fiscal years above the ceiling determined by the Commission Regulation (EC) No. 1998/2006.
Non-eligible credit appropriations	**Funding is granted with the exception of:** - reclaimable VAT - outstanding loans; - acquisition of business shares, stocks and shares or any other corporate shares; and - purchase of fixed or tangible assets from the direct or indirect owners, executive officers, senior managers of the applicant enterprise or (if managable) the relatives of these persons or within the group of companies, and investments implemented with the pecuniary assistance of all these persons. - enterprises active in the primary production of agricultural products as listed in Annex I to the Treaty establishing the EC; - enterprises active in the processing and marketing of agricultural products as listed in Annex I to the Treaty establishing the EC, when the amount of aid is fixed on the basis of the price or quality of such products purchased or disributed on the market or when the aid depends on being partly or entirely

	passed on to primary producers; - enterprises whose more than 50% of net turnover of the last full business year (in case of private entrepreneurs the tax base of entrepreneurial income) is generated from agricultural activity (According to NACE/TEÁOR '08: 01.11 – 03.22); - aid to export-related activities, namely aid directly linked to the quantities exported, the establishment and operation of a distribution network or to other current expenditure linked to the export activity; - aid contingent upon the use of domestic over imported goods; - enterprises active in the coal sector; - acquisition of road freight transport vehicles in case of enterprises performing road freight transport; - enterprises in difficulty {Government Decree 8/2007. (III. 19.) MeHVM. 12.§ (1) paragraph j)}
Collateral	**According to the Collateral Valuation Regulation of ZMVA, collateral is required in all cases.**
Costs and fees	**<u>Transaction fees</u>** Creditworthiness assessment fee is the charge paid for the procedure of assessing the creditworthiness of the Customer, HUF 15,000 shall be paid with the submission of the loan application.
Submission of loan applications	**Submission of applications is continuous from opening until the credit line is exhausted.** **Loan applications can be submitted via the online** www.credinfo.hu **system.**

The backgound of **Zala Green Credit programme**

Programme objective	ZalaGreen Microcredit Programme aims the dissemination of energy efficient thinking between SMEs located in Zala County. In the framework of the program, the local SMEs can take a special type of loan, which helps SMEs to get energy efficient/renewable energy tools and helps to run their enterprises in a green way. This program will be a pilot action in Hungary which in the case of success can be disseminated in the whole country with the help of the Hungarian Business Promotion Network (ZMVA is a part of this network).
Total credit line available	HUF 30, 000, 000 (EUR 96, 774.2)
Max amount / transaction	HUF 5, 000, 000 (EUR 16, 129)
Number of applications to be granted	6-10
Duration of the programme	2018-2023(24), Lending is expected to be closed in 2018.
Financial intermediary	Zala County Foundation for Enterprise Promotion (ZMVA)
Owner of the fund	Zala County Foundation for Enterprise Promotion (ZMVA)
Evaluation criteria	Business plan Last closed business year Order of arrival Projects are evaluated by the microcredit committee of the Foundation

	complemented by an energy expert delegated by the domestic representatives of the project.
Management of loan applications and transactions	ZMVA will process loan applications and keep record of transactions via Credinfo. Tha system makes the fast evaluation of loan applications and appropriate tracking possible.

5. Summary and recommendations

This is a first step of a really important development which will be continued on several ways (universities, ZalaGreen, accommodations, new projects etc). All in all, in Hungary the part of the EE/RES energy production is only 7%, but the local population requires the EE technologies that is the aim why is this exhibition, energy park is so useful and important in the life of the area.

PROJECT RURES

A.T1.3 Minimum template for feasibility studies for implementing EE and RES measures

May, 2018

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1. Summary in English

The West-Transdanubian Regional Energy Strategy was developed in 2012 within the framework of the ESPAN project of the Cross-Border Cooperation Programme Austria – Hungary 2007-2013. The strategy explores the energy endowments of Zala, Vas and Győr-Moson Counties and makes proposals for increasing the energy efficiency of the region, assessing the savings potential of specific energy subsectors as well as achieving a larger-scale utilization of renewable resources. Based on an extensive and comprehensive professional cooperation, the main observations of the strategy are the following:

- As a result of **the growing number of home and small power plans** focusing on local energy production and self-sufficiency, **the electricity distribution networks are forced to become bi-directional** on the part of the network licencees;
- **The significance of natural gas distribution networks** – due to the spreading of biomass-based combustion plants – **is expected to decrease,** however, **this process can be counterbalanced by the production of purified methane biogas and synthetic gas** with a calorific value of almost the same as the natural gas **fed into the natural gas network**;
- **The utilization of renewable energy sources are to be increased by taking explicit steps.** The aim is to achieve an almost 100% sustainable, self-sufficient energy production;
- **The production of energy crops should be encouraged** in agricultural areas unsuitable for food production and **the energy recovery of food crop residues** (e.g. biogas, pellet);
- **Electricity should be generated** by mainly wind power plants in the northern part of the region and **by the utilization of solar heat and geothermal energy in the south** – taking the local conditions into consideration;
- The biogas plants should rely on livestock farms in the region which require the plant-based feedstocks of fermentation to be produced on site;
- **In case of buildings, reducing heating and cooling demands should mainly be focused on**, which can be achieved by excellent thermal insulation (wall, doors and windows) as well as the (even subsequent) installation of ventilation systems supplied with heat exchangers.

In order to facilitate putting the above-mentioned development directions into practice, the **West-Transdanubian Regional Energy Strategy** involves energy concepts at small regional level as well

developed for a small region in each county concerned. In Zala County, an energy concept has been developed for the region of Lenti, which includes 5 specific action plans besides the description of its regional endowments and the declaration of its energy development objectives. One of the action plans is the so-called ”House of Renewable Energies”, whose implementation involves the establishment of an Energy Garden in Lentiszombathely, on the outskirts of Lenti, as a pilot project within the framework of the present project.

From the action plans identified in the energy concept concerning the small region of Lenti, the **”House of Renewable Energies”** has been chosen to facilitate its implementation as it regards local residents, public institutions as well as businesses its target groups due to its complex nature. **The immediate objective** of the action plan **is to establish a non-profit information centre in Lenti focusing on a sustainable lifestyle giving high priority to the improvement of energy efficiency and the utilization of renewable energies**. The action plan involves the elements of networking, parnership, incubation, education, information and consulting services in addition to infrastructure developments, the lack of which would obviously mean that the building would be unable to fulfil its innovative and stimulating role. The need for such a primarily demonstrative and awareness raising project addressing local residents, public institutions as well as businesses is largely supported by the findings of representative surveys conducted mainly among residents in the last few years measuring their knowledge on climate change and its mitigation. According to these surveys, the residents require to be familiarized with intensely practical, specific options for action concerning climate protection and the reduction of the emission of greenhouse gases.

As part of the West-Transdanubian Regional Energy Strategy, the implementation of the action plan ”House of Renewable Energies” in the energy concept of the small region of Lenti, is the challenge of the next decade. In order to provide the highest possible benefit with the practical implementation of these ideas, it is justified to assess the expectations of local actors belonging to the target group of the development concept – mainly businesses and residents – towards a project involving elements of awareness raising and infrastructural development with the aim of renewable energy utilization and energy efficiency improvement. Consequently, it is **advisable to implement certain parts of the development package separately as pilot projects. For this reason, an ”Energy Garden” is intended to be established in Lentiszombathely, on the outskirts of Lenti.** The practical experience gained via its construction and operation will facilitate the successful implementation of the action plan ”House of Renewable Energies” in Lenti later on.

The Energy Garden in Lenti is expected to funcion basically **as a venue for demonstrating opportunities for the utilization of renewable energies and the improvement of energy efficiency**, which is facilitated by the procurement of three devices for the improvement of energy efficiency: **a vertical-axis wind turbine, a solar panel system and a vegetable oil mini generator**. The present study demonstrates in details the technological features, benefits, costs and calculations on the payback period of the instruments intended to be procured within the framework of the Energy Garden.

This study devotes a separate chapter to the description of the West-Transdanubian Regional Energy Strategy and the financin facilities for the implementation of the Energy Concept of the small region of Lenti as part thereof. **In the course of identifying the financing facilities, it was regarded as a guiding principle –** discontinuing the common practice in the last few years restricted to using almost exclusively EU funds – **to direct the attention of local actors to a wider range of sources with a nature of financial instruments instead of grants.** These financing facilities include commercial loans and the so-called ESCO instrument relying on energy savings besides **the detailed description of the "Zalagreen" microcredit instrument developed by the Zala County Foundation for Enterprise Promotion** for micro- and small enterprises.

This study, on the whole, contributes to the implementation of the West-Transdanubian Energy Strategy as well as the Energy Concept of the small region of Lenti included therein in two ways. On the one hand, it explores the features of the establishment of the pilot project Lenti Energy Garden facilitating the implementation of one of the action plans of this concept called "House of Renewable Energies", on the other hand, it identifies the financing facilities for stimulating energy developments in the small region.

2. Information on the project

1.1. The position of the strategy in the planning environment of Hungary and Zala County

The West-Transdanubian Regional Energy Strategy is broadly in line with every comprehensive sector strategic planning documents in Hungary and Zala County in addition to those concerning energy efficiency improvement, the extension of renewable energy utilization as well as climate change mitigation. Their relationships are described briefly below.

1.1.1. National strategic plans

The following table provides a brief review of the national planning documents whose guidelines have influenced the content of the proposed developments in the West-Transdanubian Regional Energy Strategy.

Name of Strategic planning document	Relevant parts of the strategic planning document concerning the present development
National Energy Strategy (NES)	The National Energy Strategy adopted in 2011 defines the following main pillars: 1. Energy saving and energy efficiency improvement; 2. Increasing the share of renewable energies; 3. Integration of the Central European network system and the development of the necessary cross-border capacities; 4. Maintenance of the capacity of nuclear energy; 5. Environment-friendly utilization of the national coal and lignite assets in electric power generation. Concerning the present development, the energy efficiency improvement and the extension of renewable energy utilization are of relevance.
Hungary's Renewable Energy Utilization Action Plan 2010-2020 (NAP)	Besides taking quantified commitments concerning the shares of renewable energy utilization of the country within the total gross energy consumption by 2020 (14,65%), Hungary's Renewable Energy Utilization Action Plan 2010-2020 assesses the potentials of the utilization of individual renewable energies and their constraints. On these grounds, the NAP regards the following renewable energies the most prospective ones with respect to utilization: solar energy, geothermal energy, heat pumps, biomass and biogas. The conditions are favourable in Zala County for the utilization of the above-mentioned renewable

Name of Strategic planning document	Relevant parts of the strategic planning document concerning the present development
	energies. The House of Renewable Energies to be established in Lenti is intended to stimulate renewable energy utilization of the same origin identified in NAP accordingly.
Energy and Climate Awareness Raising Action Plan	The Energy and Climate Awareness Raising Action Plan also approved in 2015 stimulates the implementation of awareness raising activities in 5 theme fields as follows: • energy savings and efficiency; • renewable energy use; • energy savings and emission reduction in transport; • resource effective and low-carbon economy and society; • adoption to the changes in climatic conditions. The Action Plan puts forward the following proposals concerning the types of awareness raising: • integration of climate protection into the legislative activities of county governments and municipalities; • partnership with the media in the county; • awareness raising in education; • social and public campaigns; • climate protection networking in the county; • facilitation and demonstration of local pilot projects, good pracices. The proposed development can be regarded as a typical local pilot project, so it is an effective instrument to facilitate the implementation of the Energy and Climate Awareness Raising Action Plan
The Second Climate Change Strategy of Hungary (NCCS-2)	The Second Climate Change Strategy of Hungary as a strategic document determining the criteria and framework of national climate policy is indispensable for any climate dvelopments in the country. The proposed development is in harmony with both the emission reduction objectives of NCCS-2 and its chapters emphasizing the importance of awareness raising.
Hungary's National Energy Efficiency Action Plan until 2020 (NEEAP)	Due to its obligations as a Member State of the EU, our country is bound to approve a National Energy Efficiency Action Plan every three years, currently the NEEAP III approved in 2015 is in effect. This document sets out specific, quantified objectives concerning the national efforts on energy efficiency and outlines the measures to be taken to achieve them. The NEEAP III also gives high

Name of Strategic planning document	Relevant parts of the strategic planning document concerning the present development
	priority to the issue of building energy modernization, whose stimulation is regarded as one of the basic tasks of this project.
National Building Energy Strategy (NBES)	The main, overall objectives of the National Building Energy Strategy approved in 2015 are the following: • Harmonization with the energy targets and environment policy objectives of the EU; • Building modernization as an instrument to reduce the overheads of the residents; • Reduction of budgetary expenditure; • Mitigation of energy poverty; • Reduction of greenhouse gas emissions. According to NBES, the maximum possible energy savings and therefore a reduction of greenhouse gas emissions can be achieved within the building sector by the energy refurbishment of the existing building stock. The proposed project is broadly in line with this concept since the House of Renewable Energies will be able to provide widespread, practical information for the implementation of building energy modernization.

1.1.2. Development planning documents of Zala County

Within the framework of the implementation of the sub-programme called ”Energy Concept of the Small Region of Lenti” as part of the West-Transdanubian Regional Energy Strategy, a pilot project is supposed to be conducted in the town of Lenti in the course of this project. Due to its location, developments of the town of Lenti are predestinated by development planning documents of Zala County. The brief summary of these documents are given below in order to confirm the embeddedness into a regional development environment of the ”House of Renewable Energies” described in details in chapters 4 and 5 as well as its pilot project, the Energy Garden in Lenti.

The Concept of Regional Development of Zala County

The concept of regional development of Zala County developed in 2013 is a conceptual vision for the future until 2030 identifying three overall objectives until 2020 and seven sector strategic objectives for the same period. In the target system of the concept, however, instead of the above-mentioned objectives, it is primarily the horizontal objectives that set the strategic directions which Zala County

intends to implement in order to improve its energy and climate protection position. It is important to point out that according to the Concept, the implementation of horizontal objectives should be facilitated by every strategic objective i.e. each measure facilitating a strategic objective is supposed to serve the horizontal objectives as well without any adverse effects.[1] **Three of the horizontal objectives are specifically consistent with the proposed developments**, these are the following:

- Adoption to climate change, risk management, steps towards energy independence, drinking water protection, providing appropriate quality and quantity of food production;
- Promoting a shift in all sectors to low water footprint and carbon emission options;
- Environmental protection, facilitating effective resource utilization.

Regional Development Programme of Zala County

The Regional Development Programme of Zala County[2] developed in 2014 predominantly relies on the ideas of the Concept of Regional Development. The priority of ”Integrated environmental protection programmes in the interest of maintaining the life chances of the next generations and environmentally sustainable development” and its measures are the most closely connected to the proposed development since they are directed – among others – towards increasing the utilization rate of renewable resources and the effective exploitation of renewable resources and regional capacities. The priority of ”Sustainable development of urban landscape and built environment” indicates the promotion of urban energy savings among the integrated territorial actions.

The regional development programme of the county specifies several sub-programmes, among which the proposed development is coherent with is the ”Regional development sub-document related to the sectoral operational programmes of Zala County”.[3] The county programme of energy efficiency proposes an increased utilization of renewable resources, better utilization of the renewable energy potential and the implementation of energy efficient investments involving residents, public institutions and businesses. To the interest of the publicity of energy developments and the dissemination of results and good practices, ”Launching awareness raising programmes related to energy efficieny” as a separate sub-programme has been indicated, which the present project broadly comply with.

[1] Városfejlesztés Zrt. (2013).: Regional Development Concept of Zala County, Attachment No.4. Proposal Phase, Regional impact assessment. p. 8.
[2] forProjekt Kft., Városfejlesztés Zrt. (2014): Regional Development Programme of Zala County - strategic programme. pp. 71.
[3] ”Cseszt Regélő Nkft., Hétfa Elemző Központ Kft. (2014): Regional development sub-document related to the sectoral operational programmes of Zala County – sectoral sub-programme of establishing a strong competitive Zala pp72.

Climate Strategy of Zala County 2018-2030, with an outlook until 2050

The climate strategy of Zala County approved in 2017 regards the reduction of greenhouse gas emissions, adoption to the expected climate changes and awareness raising related thereto as challenges of the same priority. The climate strategy concludes that by far the largest amount of greenhouse gas emissions (62%) in Zala County results from energy consumption by burning fossil fuels, about half of which (42%) is used for heating, cooling and lighting residential buildings as well as running household appliances. These data firmly support the objectives of the climate strategy of Zala County, according to which the total emission of greenhouse gases is supposed to be decreased by 42% between 2015 and 2050. As for emissions from the operation of buildings, there is a reduction target of 40%. In order to achieve these objectives, several measures have been identified in the strategy, among which the development in progress in Lenti contributes above all to the practical implementation of the following:

- Energy efficiency modernization of business premises and technological processes by creating the conditions and the extension of renewable energy utilization as far as possible;
- Stimulating the extension of renewable electricity generation;
- Stimulating the reduction of greenhouse gas emissions from the operation of residential buildings;
- Complex building energy modernization in public institutions covering renewable energy utilization.

1.2. Content and main observations of the West-Transdanubian Regional Energy Strategy

The West-Transdanubian Regional Energy Strategy was developed in 2012 within the framework of the ESPAN project of the Cross-Border Cooperation Programme Austria – Hungary 2007-2013. **The strategy explores the energy endowments of Zala, Vas and Győr-Moson Counties and makes proposals for increasing the energy efficiency of the region, assessing the savings potential of specific energy subsectors as well as achieving a larger-scale utilization of renewable resources.**

1.2.1. Situation analysis

The chapter of situation analysis of the West-Transdanubian Regional Energy Strategy describes the energy trends and tendencies in progress in the West-Transdanubian region, Hungary, Europe as well as

on the Earth from the beginning of the 1980s until the end of 2010s. It includes statistic datasets separately concerning fossil fuels (oil, natural gas, coal) and renewable energy sources (solar, wind, biomass energy and biofuels) as well as supplies/potentials available, the intensity of extraction, the rate of resource utilization and emission. In terms of production/consumption, the chapter covers the issue of total energy, electricity, energy intensity and energy consumption.

Analysing the processes at global level, it has been concluded that following the second oil crisis at the beginning of the 1980s, the total energy production and consumption of the world surged with an increase of 70% between 1983 and 2007 from 83 thousand billion kW to 141,7 thousand billion kW. According to the study of the U.S. Energy Information Administration published on 27 July, 2010, the energy consumption of the world – certainly without the expected regulatory policies in the future – will have exceeded data from 2007 by 49% by 2035. At the same time the carbon-dioxide emission increased from 18,488 million to 30,377 million tonnes between 1980 and 2008. **Burning fossil fuels is obviously responsible for the more than 64% increase.**

Analysing the energy management processes of the EU, the strategy points out that the EU is unable to supply itself with enough energy although the per capita energy consumption of EU citizens is highly above the world average. It is also an importan factor that **Europe has only a considerable amount of renewable energy but no fossil fuel reserves.**

In case of Hungary, the strategy highlights that in the period from the transition to democracy to the 2010s a drastic decline in energy production by more than 36-38% on the average took place in Hungary. Analysing the consumption factor in Hungary, the data were similar to that of the production: there was a slight decline after 1990 followed by a long-term stagnation. **Studying the energy balance of Hungary, it can be ascertained that up until 2003 the energy supply of the country relied on conventional i.e. hydrocarbon-based power plants and the nuclear plant in Paks**. The expansion of the renewable energy sources started afterwards.

It can be concluded that concerning the total energy consumption – not taking the energy demand of transport into account – **the West-Transdanubian region consumes the least amount of energy resources available following the South-Transdanubian region among the regions of the country.** According to the strategy, another important factor is that despite the economic growth, the industrial and agricultural energy consumption was steadily decreasing between 2003 and 2007. Consquently, in spite of the increase in communal and residential consumption, the energy demand of the region declined. In the first decades of the 2000s, an increase in industrial energy demand was accompanied by

a smaller decrease in the energy consumption of all sectors in Zala County. The strategy emphasises that among the seven regions of the country, **the residential electricity consumption reached the lowest level in the West-Transdanubian region** in 2007. Surprisingly, the population increase of almost 14% of the region generated only an 8% increase in residential energy demand.

1.2.2. Global, national and local climate protection and energy policy concepts

The West-Transdanubian Regional Enegy Strategy devotes a separate chapter to the non-exhaustive description of global, national and local climate protection and energy policy concepts. Firstly, it lists the most important international climate protection and energy consumption agreements followed by a review of the long-term energy policy and directives of the EU envisaged to the member countries. After that, it describes the relevant long- term energy policy concepts of Hungary via several strategic documents and objectives. Finally, the chapter gives a detailed outlook of the energy plans of the West-Transdanubian Region and the counties involved.

In respect of **Zala County**, the strategy points out that concerning the plans on the **utilization of renewable energies**, the county lags slightly behind the rest of the counties in the region since **its first more significant observations and proposals were drawn up in its Spatial Development Plan amended in June, 2010**. Its chapter of energy management and supply claims that the largest amount of unconditional renewable resource in the county is water power, whose performance of 50 MW marked as its theoretical utilization potential can be exploited by the extension of already existing systems and the installation of small and mini water works. Due to the significant forest cover of the county, the spatial development plan currently being amended gives high priority to biomass as a prospective alternative energy source. This statement is based on the assumption that the utilization of residues from forestry, woodworking and furniture industry as well as agriculture, forest plantations established with the aim of energy utilization and appropriate cogeneration technologies could replace the district heating base in Keszthely, the conventional thermal energy in the bigger community educational, medical and other institutions and the heat and electricity conversion base of industrial parks and other businesses in the long run. In addition, the plan also mentioned the opportunity of solar, wind and geothermal energy utilization.

1.2.3. Description of the region from an energy perspective

The West-Transdanubian Regional Energy Strategy devotes a separate chapter to the description of the general geographical, demographic, economic and infrastructural features of the region paying special

attention to the exploration of its energy aspects. Its results are summarized in a SWOT analysis. It is identified, on the whole, a strength of the region from an energy perspective that **the primary renewable energy endowments** (solar, water and geothermal, solid and herbaceous biomass) **are altogether the most favourable in the country**. Furthermore, the biomass-based energy endowments gained in secondary and tertiary conversion (biogas, biodiesel, bio-ethanol) are also favourable. In addition, it concludes that the innovation centres of the region and the planned R&D institutions are suitable for the development and pilot application of further energy technologies (fuel cells, hydrogen decomposition). On the other hand, **the strategy regards** the considerable energy dependence as well as **the low utilization rate of renewable resources in the region as a weakness**, and it is regarded as a threat that the installation and construction of renewable energy production and conversion technologies as well as the rate of job creation and improvement of living standards are expected to be slower than planned due to the financial and legislative shortcomings.

1.2.4. Future vision

The West-Transdanubian Regional Energy Strategy does not determine a single vision for the future but **outlines several possible development paths concerning the energy consumption and greenhouse gas emissions of the region**, which can primarily be attributed to the fact that a simultaneous but reverse double effect occurs in the region. On the one hand, a higher ability-to-pay due to the development of the region within the country and a higher than average commitment of residents to the issues of environmental protection are prevailing, on the other hand, this relative development and its further rate result in an increase in the fossil fuel consumption above the national average. It applies to residential, institutional as well as industrial users. Consequently, the strategy determines three different types of vision for the future, a realistic, an optimistic and a pessimistic one.

The **realistic scenario** is based on the assumption that fossil fuel energy consumption might remain significant in the course of strategic industrial developments in the region therefore there might be a nominal increase in gas and electricity demand although investments will be connected in all cases to the establishment of renewable capacities reflecting the rate of national commitments. In analysing the trends of natural gas consumption, opportunities for natural gas consumption of residential, industrial

and public users as well as the aspects of their willingness to a shift to renewable energy sources and modernization are examined separately. As for residential users, in case of urban constructions, the rate of getting connected to the natural gas supply is around 80% whilst in case of rural constructions this rate is only 60%. Consequently, a higer number of rural residents use alternative fuels already now. Mainly as a result of building energy modernization, a rate of 20% decline in natural gas consumption can be predicted in the period until 2020 according to the above-mentioned data. **In respect of the utilization of renewable resources, the realistic scenario concludes the following:**

- the biomass-based combined heat and electric power plants constructed near the big towns of the region might provide the basic heat supply for the heat bases;
- the capacity of 6-7 MW of the already existing hydroelectric power plant in the region could be doubled at the most with the implementation of projects whose ecological footprint is not significant (cause negligible landscape destruction);
- On the grounds of biogas-based power plants and the performance of bio-methane fed into the natural gas network, a capacity of hundreds of MW could be generated;
- the heat potential of geothermal energy is significant, by drilling new production wells nearby, a heat demand of 400-500 MW could be covered with 150-200 thermal wells in operation;
- solar energy utilization is also of significant potential, the partial supply of electricity demands of detached houses, institutions and industrial establishments could be provided with solar panels.

A **pessimistic scenario** will take place in case the rate and availability of grants facilitating structural changes fall behind expectations or natural gas as a basic energy source maintains those elements of its price structure which limit the competitiveness of alternative technologies. The building energy modernizations wil not be implemented to the extent necessary therefore household fuel consumption will not decrease according to the targets set before in urban areas, neither will the rate of renewables in rural constructions increase.

An **optimistic scenario** will take place in case the rate and availability of grants facilitating structural changes exceed considerably the rate described in the realistic scenario and the price structure of natural gas as a basic energy source is changing in a way that it does not restrict the competitiveness of alternative technologies any more. The upper bounds of the potential of the economically utilizable renewable energy sources will set the limits to the optimistic vision. The majority of planned biomass

utilization projects will be realized and the economic environment changing in a positive direction will generate further projects.

1.2.5. Steps to achieve a realistic vision for the future

Among the possible scenarios concerning the energy production and consumption of the West-Transdanubian Region, **obviously the implementation of the realistic vision is regarded as the most likely one by the West-Transdanubian Regional Energy Strategy**. However, considerable efforts are required to achieve it.

The overall objective of the strategy is – based on the renewable energy capacities and endowments of the region – to provide guidance primarily to the development of energy production. This long-term development involves the development of transport networks and also requires the improvement of the efficiency of the consumer side. It is a relevant aspect that the energy distribution networks are to be shifted from one directional (from producers to consumers) to bi-directional (from producers to consumers but consumers can also be producers). In case of electricity networks, it requires the installation and construction of more sophisticated equipment and in some places strengthened networks, so-called ”smart grids”.

The overwhelming majority of energy generation from electricity and gas networks come from non-renewable energy sources currently. It can be changed by implementing multiple and various investments. The new energy demands could be met by slightly decreasing or the same level of production if existing energy consumers improve their efficiency and decrease their consumption by changing their mindset and consumer habits.

The widespread dissemination of the utilization of renewable resources could primarily be achieved by a predictable, favourable regulatory environment (pricing) in the long run and, secondly, by calls for proposals that could function as incentives. Obviously, not only production but the improvement of energy efficiency and savings of the consumer side should also be stimulated at the same time. As a result, besides improving the regional energy balance, a few thousand new jobs could also be created. According to the observations of the strategy, there is more perspective to utilize a different type of renewable energy in each county of the region, **in Zala County, conditions are the most favourable in particular for the utilization of solar energy and biomass**.

The primary biomass possesses significant energy potentials although it is partly utilized in the neighbouring Austria. It is a source of energy which can be stored easily and for relatively long without

further energy investments as well as it can take various forms such as bio-ethanol, biodiesel, fuel wood, straw bale, woodchips, pellet etc. Energy crops such as poplar, willow, mischanthus can be grown and are worth growing on poor quality soil, there is more than 28,000 ha in the region available for it with favourable returns. Futhermore, the number of medium-sized and large livestock farms is also significant in the region. It is worth building a biogas power plant on them only if the utilization of the heat generated is solved (e.g. district heating, greenhouse, crop-drying machine). The current natural gas demand could also be decreased by the production of biogas (bio-methane) and following appropriate treatment by feeding it into the natural gas network as the above-mentioned bio-ethanol and biodiesel could decrease the petrol demand of vehicles.

The geothermal gradient is higher in the region and the country compared to the neighbouring European countries therefore it is worth benefitting from it in many ways. The construction of a geothermal power plant should be considered when the temperature of water is above 120-130°C and there is sufficiently large water flow to establish a powe plant of 2-5 MW which is economical to run. Thermal water at a temperature of 70-80°C could also be used for district heating in the current systems, besides heat energy can be extracted from the same water in several application areas with gradual heat removal.

Adjusted to watercourses, mini- or micro-hydroelectric power plants could be constructed in some places in the region (~500W-20kW). Already existing dams that have not been utilized for that purpose so far are the most appropriate ones in addition to the sites of the former water mills along the river Zala where power plants could also be built.

1.2.6. Steps to improve energy efficiency

The West-Transdanubian Regional Energy Strategy gives high priority to energy-conscious consumption, whose ultimate goal is the improvement of energy saving and energy efficiency. By achieving it, the amount of fossil fuels consumed can be decreased directly thus resulting in the mitigation of greenhouse gas emissions without investments in the utilization of renewable energies. The strategy draws the attention to the following steps in order to improve energy efficiency:

- **Stimulation of keeping records of and monitoring energy consumption data**. Primary target group: educational, medical and other local government institutions. Secondary target group: residents (via non-governmental organizations);
- **Energy supervisions in public institutions**. In order to facilitate it, pilot audits are conducted in the largest medical and educational institutions as well as the biggest and most prominent– consequently with the highest demonstrative potential – health spas and then widespread dissemination of results. Implementation of cost effective interventions of efficiency improvements revealed by the investigations.
- **Larger consumers and local governments running several institutions: empploying** or using the services of **energy experts**, operation of energy management systems;
- **Training for professionals, especially construction architects, architectural engineers and contractors on the application of energy effective technologies**.
- **Awareness raising campaigns, information and consulting service for residents** (in cooperation with non-governmental organizations and service providers);
- **Stimulation of conscious shopping** (preference of low energy products), accompanied by information service.

1.2.7. Innovative technologies

As in the course of the implementation of Austria – Hungary Cross-border Cooperation Programme, the main objective from an energy perspective is to increase the rate of renewable fuels to the highest extent among the primary energy sources consumed, **the West-Transdanubian Regional Energy Strategy devotes a separate chapter to the innovative, pilot-phase technologies whose implementation, adoption and dissemination can greatly facilitate the wider range of utilization of renewable resources.**

The strategy discusses the Stirling engine and pyrolysis systems in detail, which can assist to utilize the gaseous and solid biomass feedstocks decentralizedly besides the direct utilization of solar energy. In addition, the strategy outlines the storage opportunities – basically in the form of hydrogen – for electricity generated by renewable energy sources, as the first steps to the development of a hydrogen economy. Concerning the utilization of geothermal energy, it discusses those innovative opportunities for power plant utilization which might be taken into account in the implementation of projects in

Hungary. Finally, it is followed by the presentation of opportunities for implementation with thin film solar panels in the near future.

1.2.8. Institutional framework for strategy implementation

The West-Transdanubian Regional Energy Strategy gives a brief desciption of the EU support system, the national and regional programmes facilitating the development of renewable energy systems, in particular the Environment and Energy Operational Programme, which provided funding for energy investments between 2007 and 2013 as well as the Green Investment and Green Economic Development Systems, which primarily support residential investments and utilize funds generated by international and EU quota trading.

The strategy also makes proposals for the organizations to be involved in the implementation, indicating particular higher education and training institutions separately. The document considers the cooperation of professional organizations and experts involved indispensable even in terms of awareness raising. **It proposes the promotion of renewable energy utilization among residents and SMEs with regional radio commercials and the establishment of specially-equipped showrooms in bigger settlements and towns or deployed information trucks and buses. At the information points and in the vehicles, the demonstration of solar panels, solar collectors, wind turbines and heat pumps should be solved**. That way those constructing or planning to refurbish a building can get first-hand information about the necessary devices with the help of demonstration tools in operation.

Finally, the strategy describes some successfully implemented, exemplary programmes stimulating the utilization of renewable resources such as the projects ”Establishment of centres demonstrating the utilization opportunities of renewable resources along the Tőkés arm and in the small region of Tét” and ”Renewable Energy Route”. Their main objectives and content are identical to the project to be implemented in Lenti as they intend to disseminate renewable energies via direct experiments.

1.2.9. Conclusions, proposals

The main development directions indicated in the West-Transdanubian Regional Energy Strategy are summarized in a separate chapter, whose content is the following.

Among the existent energy systems, the role of the electricity network in the region is expected to remain of paramount importance in the coming decades but it will undergo a considerable transformation. Focusing on local energy production and self-sufficiency, **the growing number of home and small power plants will force the networks to become bi-directional** on the part of the network

licencees. The electricity networks will become smart grids. The transition can take place gradually. As a result, a network section at low or medium voltage can be a gross producer or consumer depending on the time of day. The aim is to facilitate self-sufficient energy production.

The significance of natural gas distribution networks is expected to decrease gradually (mainly in rural areas) if biomass combustion plants become widespread and there is enough biomass to be utilized for energy purposes. The significance of gas networks might somehow be conserved by the production of purified methane biogas and synthetic gas with a calorific value of almost the same as of natural gas from different types of renewable resources and by feeding it into the natural gas network. The maintenance of the functionality of distribution-network infrastructure would by all means be favourable in the long run (2030).

The exploitation of renewable resources are to be increased by explicit steps. It will be an important result to achieve the EU goal of 20%, (national 14,65%) but the dynamic shift to the development of an almost 100% sustainable self-sufficient energy production will be even more important.

Biomass might have a prominent role in it. The production of energy crops in agricultural areas unsuitable for food production and the energy recovery of food crop residues (e.g. biogas, pellet) should be encouraged.

Electricity should be generated by mainly wind power plants in the northern part and **by the exploitation of solar and geothermal energy sources in the southern part of the region** – taking the local conditions into consideration. In case of electricity generation by solar energy, the application of two optimum instruments are recommended: the first one is a device of photovoltaic solar panels equipped with a dual-axis solar tracker, the second one has a stirling engine unit in the focal point of the parabolic mirror. The first device generates 30-40% more electricity than the static variety and the second one converts solar heat into electricity without solar panels but with the help of the Stirling engine with quite high efficiency.

The potentials of the utilization of water power are of minor importance at regional level although existent dams and places of bigger currents are worth utilizing for electricity generation. Hydroelectric power plants can generate electricity for decades with relatively steady performane at low costs.

T**he biogas plants should rely on large livestock farms in the region** which require the plant-based feedstocks of fermentation to be produced on site.

In case of buildings, reducing heating and cooling demands should mainly be focused on, which can be achieved by excellent insulation (wall, doors and windows) as well as the (even subsequent) installation of ventilation systems supplied with heat exchangers. Architectural engineering improvements are recommended mainly in case of already insulated buildings because engineering investments and running costs later on can be optimized at individual and regional levels.

1.2.10. Lenti, the renewable small region – The energy concept of the small region of Lenti

The West-Transdanubian Regional Energy Strategy includes energy concepts developed for separate small regions of each county of the region to stimulate the practical implementation of its content. The strategy describes the energy concept of Lenti in Zala County, whose main observations are the following.

In the small region of Lenti, compared to the projects and investments implemented in energy utilization so far, there are more opportunities available for the execution of developments concerning the improvement of energy efficiency and production of renewable energies. The biomass potential of the region, the extractable geothermal energy, the available development areas all require the economy, settlements, buildings and institutions of the small region to be renewed and, as a result, to create an attractive investment environment and a new supply in tourism based on ”the green”, almost unspoilt environment.

At the interviews conducted during programme development, most of the local stakeholders explained with the lack of cooperation and scarcity of funds that in spite of the local endowments, the utilization of renewable energies is not widespread in the region. It is well-known, however, that in the immediate surroundings of the small region (in Slovenia and Austria), there are several good practices which are worth adopting and adjusting to local conditions contributing by that means to economic development and job creation. Consequently, **the main objective of the energy concept of the small region of Lenti is to encourage cooperation between local actors, primarily by facilitating the flow of information**. The concept determines the following three directions in order to achieve this:

- Development needs, ideas of extension connected to existent energy networks (electricity, gas etc.);
- The improvement of energy efficiency at the level of households, institutions and the economy;
- Dissemination of renewable energy utilization (at the level of households, institutions and the economy).

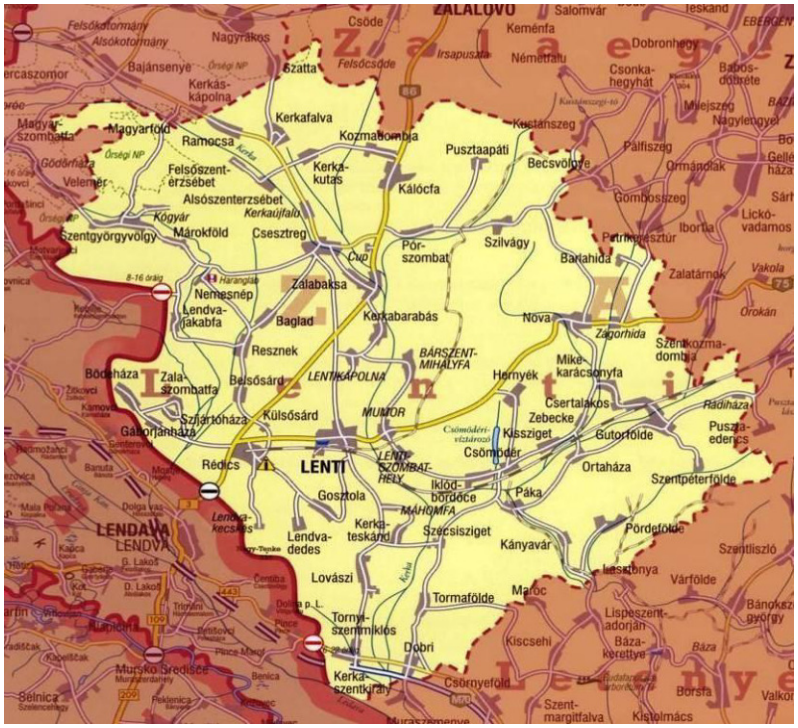
Based on the situation analysis, **endowments are primarily favourable for the utilization of biomass among renewable energy sources** (areas of low Golden Crown (GC) worth, considerable amount of rainfall, labour). Within the framework of biomass utilization, all phases of the technological process from the production of feedstocks (e.g. sprouting energy willow plantation) to processing can be executed in the region creating jobs and resulting in considerable energy savings for consumers. **Besides biomass, the utilization of solar and geothermal energy also have perspectives in the small region of Lenti.** It is recommended to install heat pump systems based on geothermal heat. In case of residents and institutions or factory floors consuming a considerable amount of hot water, the installation of solar collectors will be possible.

It is important to create opportunities for residents – representing a significant proportion of energy consumers – **to become familiar with and as possible apply the technologies utilizing renewable energies in their construction and refurbishment projects**. The action plan ”House of Renewable Energies” is partly intended for this objective, but it is also planned to become an information point for local entrepreneurs besides residents.

3. Technical and technological analysis

3.1 General descripton of the small region of Lenti with special emphasis on its energy, climatic and environmental endowments

The small region of Lenti is located in Zala County, in the West-Transdanubian Region, its area is 663km². Its permanent population was 19,900 at the end of 2016, among its settlements one has a town status. The particularly rural area is characterized by population decline, the rate of which has exceeded 61% in the last ten years according to data supplied by the Central Statistical Office. Due to the settlement structure of small villages, public services are provided in the form of partnerships (administrative, medical, social services), the institutions are located in Lenti and the micro-regional centres.



Map of the small region of Lenti[4]

The district of Lenti is located in Zala County in the West-Transdanubian Region in southwest Hungary **near the Slovenian border**. At the time of the Cold War, it was regarded as a strictly-protected border area, where strategic industries were not settled, but **the environmental conditions are excellent**. Among conventional energy sources, trees can be found in the highest proportion, the ratio of forest area is about 38%. The natural vegetation is is dominated by hornbeam, oak and beech, but its pine forests are also significant.

[4] Source: Information society strategy of the small region of Lenti, June,2007

Along the river Kerka, clay and loamy as well as raw meadow alluvial **soil** is common, which is dense, airless and **suitable for the establishment of energy plantations rather than crop production**. The areas of poor quality are not utilized by agriculture, they have become forested.

The surface of the small region of Lenti is mainly covered with plains surrounded by hilly areas, the altitude is between 165-201m. Among the surface watercourses, the River Kerka and Cupi stream are the most significant but neither of them and no other watercourses are suitable for energy production e.g. the establishment of a mini hydroelectric power plant. Below the surface there are high-temperature thermal fields at a depth of 1000-3000m. The opportunities offered by the thermal spring are utilized only in the thermal spa of Lenti for the present.

The transport-geographical location of the area is favourable directly bordering Slovenia, in Rédics – not far from Lenti – there is a high traffic international bording crossing point, but Croatia (border crossing in Letenye – 33km) and Austria (border crossing in Szentgotthárd-Rábafüzes – 51km) are also in short distances. The southern areas are intersected by the M70 highway. Road 86 connects the area with other counties of the region and the Slovenian border (the Slovenian motorway starts at the border crossing point). Major road 75 connects the area with the Balaton region and Zalaegerszeg. Main railway route 23 connects Zalaegerszeg and Rédics, which is expected to be extended in the direction of Slovenia.

The electric power system functioning as a transit system as well intersects the area and supply is provided by two 120kV entry points at present. The natural gas network, piped-water network, the sewerage syste in bigger settlements are available in the whole region but there is no district heating system. The internet access is also provided everywhere (by optical networks or mobilenet).

The town and bigger villages are characterized by the appearance of orderly settlements, well-kept streets and extended institutional network, however, the building stock of the slowly depopulated small settlements is deteriorating. Few of the residential buildings, rows of houses and public institutions of the small region are rated into the energy efficiency classes A, B or C. As a result of the lifestyle changes accompanied by the increase in energy consumption as well as the increasing energy costs, there are more and more investments of energy efficiency improvement in the residential and communal sectors. These improvements are restricted by the economic situation, in the public sector there are developments only by the utilization of calls for funding (replacement of doors and windows, thermal insulation, heating modernization etc.). Besides firewood, the utilization of renewable energies is not widespread among residents.

The key industries of the small region are agriculture, forestry and timber processing. The traditional woodwork and furniture industry, machine manufacture, textile industry and tile manufacture are significant, but a considerable number of workers are employed in the service sector (trade, tourism, public services). Among industries, machinery, wood and light industry (textile industry) provide the majority of jobs. Some of the woodwork businesses process industrial waste wood (e.g. Németh-Fa Kft. – pellet production) or it is used for heating premises. In order to develop existent industrial plants and establish new ones, the extension of industrial areas would be required (in the area of Zajdai barracks, in the south-eastern part of Lenti). Agriculture is dominated by plant production but there are some livestock farming (beef cattle, turkey, chicken, mangalica) businesses providing jobs for the residents. The non-cultivated as well as the cultivated areas with low Golden Crown (GC) worth are highly suitable for the establishment of biomass plantations due to the heavy rainfall (above 800mm annually). Several farmers established energy plantations but green energy is scarcely utilized in the area (power plants from Austria and Slovenia purchase the feedstocks). From the almost 15,000 population of working age of the small region, 700-1,500 are registered job seekers at the Job Centre (hectic job market). Based on divisions of age groups and qualifications, the number of job seekers with low-level qualifications (vocational qualification at the most) is outstanding among both men and women (81% of men, 66% of women), for whom the prospective biomass utilization might create jobs.[5]

The electricity supplier of the region is E-ON Észak-dunántúli Áramhálózati Zrt. The electricity consumption of households in the small region is as follows: on the grounds of data provided by the Central Statistical Office, the number of household electricity consumers was 11,564 in 2000 and 12,704 in 2010. The increasing number of connections (1,140 new connections in 10 years) in inverse proportion to population decline can be explained by the increase in energy prices and condominiums switching over to individual electricity meters from public accounting. **In spite of the increasing number of consumers, the amount of electricity supplied to households decreased in the region: from 22,096kWh measured in 2000 to 20, 187kWh in 2010.**[6]

The piped natural gas supplier/operator is E-ON Zrt. Gas supply is available in every settlement of the small region. According to data provided by the Central Statistical Office, the natural gas consumption of households is as follows: the number of household gas consumers was 4,859 in 2000 and 7,168 in 2010, the amount of gas supplied was 4,137 thousand m^3 in 2000 and 5,603 thousand m^3 in 2010, the

[5] Source: Kovács, I. (ed.) (2010): Regional economy, situation analysis of employment and training, "Csesz Regélő Nonprofit Kft., Promen Tanácsadó Kft., Csesztreg

[6] Forrás: ESPAN West-Transdanubian Regional Energy Strategy

proportion of consumers with piped gas supply was 49% in 2000 and 71% in 2010. The amount of total piped gas supplied was 9,830 thousand m³ (5,693 thousand m³ of corporate consumption) and 15,805 thousand m³ in 2010 (10,201.9 thousand m³ of corporate consumption). **According to these data, there was a considerable increase in the number of household consumers, however, there was a decrease in the amount of gas calculated per connection**, probably as a result of conscious energy consumption due to the increase in energy prices and the residential and public energy rationalization investments and projects. **There was a significant increase in the amount of corporate consumption** by 4,508 thousand m³ in 10 years, **which can be attributed to the developments of CREATON tile factory.**

3.2 Strategic background of the action plan

The energy concept of the small region of Lenti involved in the West-Transdanubian Regional Energy Strategy concludes that opportunities are granted in the region for a more efficient energy utilization, a decrease in fossil fuel consumption and the replacement of conventional primary and secondary energy sources with the application of renewable energies.

The concept specifies five action plans for the practical implementation of the three development directions determined, which are the folowing:

- Development of Lenti ”House of Renewable Energies” (consulting-information centre), – investment and networking programme;
- Development of Lenti Green Economy Innovation Park;
- Establishment and utilization of biomass plantations;
- Regional pilot project for institutional and corporate energy modernization;
- Residential energy modernization pilot project.

3.3 The main elements of the action plan

3.3.1 Target groups

On the grounds of research conducted in the region (surveys of CEEBEE, ESPAN, FATE projects), awareness raising, consulting, development of cooperation networks, joining interests of the residential sector, local governments and businesses in the small region are of paramount importance to the better utilization of the energy and economic endowments of the small region. The action plan ”House of Renewable Energies” planned in Lenti serves to achieve that aim.

The investment and networking project implemented as a result of the action plan intends to contribute to the cooperation of stakeholders so that a wider range of society can become aware of sustainability as a value, the methods and effects of the utilization of renewable energies can become

well-known and the application of different energy-effective alternatives to construction can become widespread.

The immediate objective of the action plan is to establish a non-profit information centre related to a sustainable lifestyle.

The information centre intends to meet the information demands of several target groups simultaneously as follows:

- *Residents*: financial and construction consulting is provided for households concerning building refurbishments and the forms of renewable energy utilization;
- *Local governments, institutions of the region*: consulting, training and project development services are provided for the energy rationalization of the buildings (offices, surgeries etc.) of public institutions;
- *Enterprises*: the enterprises planning the utilization of renewable energies could play a key role in the long-term economic development of the region, they can join the training, consulting and development services of the centre;
- *Architects, contractors, craftsmen:* the centre organizes training courses and info days for the architects, contractors and craftsmen related to the investments of energy efficiency improvement or renewable energy utilization with the aim of introducing the best available technologies and techniques. In order to facilitate relationship building and networking, the centre intends to get involved in matching the stakeholders of investments, primarily by the development of a regional rating system.

The action plan Lenti ”House of Renewable Energies” comprises several elements, the most significant ones are as follows.

3.3.2 The element of infrastructural development

The name Lenti ”House of Renewable Energies” refers to the community centre to be established. This building will function as the venue for the consulting, training and networking centre stimulating the utilization of renewable energies and energy efficiency improvements in the small region of Lenti.

Having regard to the fact that **the building will serve demonstrative purposes at the same time, the considerations of energy and water savings should be reflected in its design**. As a result, solar collector systems will provide the production of service water and partly the heating of the building. In case of solar collectors, the installation and demonstration of several types is planned as the most well-known systems bear different stress. Rainwater will be collected and used for toilet flushing later on.

A theme park will be established in the yard of the House of Renewable Energies, which will demonstrate the opportunities for the utilization of renewable energies. One of the main objectives is to demonstrate electricity generation with an on-site photovoltaic system and a wind turbine in operation,

which will assist the electricity supply of the building. As the wind speed is relatively low in the region, the construction of a wind mill of max. 1000 W rated power is possible for demonstrative purposes, which is able to produce energy even below 3m/s wind speed.

Besides the utilization of renewable energies, **the building will function as a good example of effective thermal insulation** in case of both boundary surfaces and doors and windows. Furthermore, with the built-in blinds and green shading planted at the right places, **it conveys the message that because of the changing climate, the aspects of shading should be given higher priority than before.**

In the course of building design, its functions should obviously be taken into account, so it **should include more communal space and offices besides being handicap accessible**. An outdoor activity space will be established in the theme park and information boards will also be displayed.

The ideal venue for the Lenti ”House of Renewable Energies” is the town centre of Lenti, but it is possible that some functions will be relocated in separate buildings in the fututre e.g. the building for the ”forest school” programmes aiming at schoolchildren will be separated from the venue for consulting service for the residents or entrepreneurial workshops.

3.3.3 The element of networking, partnerships

Networking and building partnerships are tasks of outstanding importance in the action plan of ”House of Renewable Energies”. Among the prospective partners, the municipalities of the region as well as the leading enterprises in the area, the Zala County Foundation for Enterprise Promotion, the different regional clusters (e.g. Pannon Wood and Furniture Cluster, Pannon Renewable Energy Cluster), the Zala County Chamber of Commerce and Industry, vocational training institutions, forestries, companies distributing equipment for the utilization of renewable energies etc. all play a key role. In order to encourage the domestic adoption of good practices implemented in the neighbouring countries, Slovenian and Austrian partners should also be involved in the networking process.

3.3.4 The element of incubation, training, information and consulting services

One of the main objectives of the concept ”House of Renewable Energies” is launching incubation services related to the subjectmatter (pre-incubation, incubation services). **In order to involve enterprises, focused communication programmes should be launched and the following incubation programmes should be implemented:**

- *Organization of open days*, introduction of the companies dealing with the utilization of renewable energies;

- *Organization of short presentations, training courses* related to green economy and energy efficient architecture, *launching investor programmes*;
- 60 hour training course for enterprises based on the training programme ”Enterprise academy”;
- *Encouraging the preparation of business plans* for credit programmes and calls for proposals, promotion of obtaining national and EU funding.
- risk management and due-diligence of start-ups, transforming enterprises as well as of businesses submitting proposals for aid schemes.
- Information provided to social and economic organizations in the subjectmatter of renewable energies (whether contents should be involved in labour market activities).

In the action plan ”House of Renewable Energies” training courses have a key role. It is justified to commence the following training courses and types of training:

- *Forest school programmes* (a 6-day training block) for primary and secondary school students in the topic of sustainable development and renewable energies, with accomodation;
- *Information programmes, knowledge dissemination programmes for local governments, institutions* (1 or 2-day training courses) in the topic of energy rationalization;
- *Training courses in networking, organizational development* for local governments, the civil society and the entrepreneurial sector;
- *Marketing training for traders, contractors* (traditional and online);
- *Accredited adult education programmes* in renewable energies and energy efficient architecture;
- *OKJ (National Register of Vocational Qualifications) part-qualifications,* organization of OKJ training courses for professionals, candidates for retraining (according to Austrian requirements).

3.4 Justification of development concerning the attitude of residents to climate change

In the last few years there have been representative surveys conducted from several aspects on the energy, environmental and climate consciousness of the Hungarian society (e.g. Hungarian Academy of Sciences, Centre for Economic and Regional Studies – 2015; National Society of Conservationists, Hungary – 2016). On the grounds of these results, it can be concluded that almost all of the respondents (nearly 98%) have heard about climate change and 92% of them know roughly or exactly what this term means. **Almost 90% of respondents regard human environmental pollution as the cause of climate change**. It is an interesting phenomenon that an explicitly smaller proportion of young people (aged 15-24) belive that human activities play a predominant role in bringing about climate change than the older generations. **The majority of respondents, however, misjudge the role of particular industries in bringing about climate change**. They regard waste generation incorrectly as the main contributor followed far behind by industries which actually play a crucial role in climate change: road traffic, energy production, air traffic and large-scale agriculture, which draws the attention to the importance of awareness raising with a focus on energy aspects.

A pleasing result of the surveys is that almost 75% of people totally or quite agree with the fact that they themselves also have to do something againsts climate change. In this context, attitude surveys also covered questions about recent lifestyle changes and residential investments related to climate change. **According to the survey conducted by the Hungarian Academy of Sciences, Centre for Economic and Regional Studies, respondents from Zala County took appropriate steps in accordance with the national average (55,94%) to mitigate climate change, listing mainly those actions which required less financial investment but attention basically** (the use of energy saving bulbs, selective collection of rubbish, decreasing energy consumption by switching off appliances, purchasing energy saving household appliances) although there were some which required more financial investment e.g. the use of solar panels or solar collectors.

The results of the survey suggest on the whole that awareness raising programmes related to climate change and especially energy saving and the utilization of renewable resources are required in the future as well mainly in less populated settlements. It is also justified by the respondents, 90% of whom agreed that this type of programmes would be necessary in their settlement. It is also important to emphasize that according to the above-mentioned respondents, the organization of awareness raising programmes is reasonable only if they address well-defined target groups (e.g. children, farmers,

pensioners) and convey concrete feasible ideas. **The Energy Garden implemented in Lenti within the framework of the RURES project will fully meet these requirements**.

3.4.1 Background of the development

As part of the West-Transdanubian Regional Energy Strategy, the implementation of the action plan ”House of Renewable Energies” in the energy concept of the small region of Lenti, is the challenge of the next decade. In order to provide the highest possible benefit with the practical implementation of these ideas, it is justified to assess the expectations of local actors belonging to the target group of the development concept – mainly businesses and residents – towards a project involving elements of awareness raising and infrastructural development with the aim of renewable energy utilization and energy efficiency improvement. Consequently, it is advisable to implement certain parts of the development package separately as pilot projects. For this reason, an ”Energy Garden” is intended to be established in Lentiszombathely, on the outskirts of Lenti. The practical experience gained via its construction and operation will facilitate the successful implementation of the action plan ”House of Renewable Energies” in Lenti later on.

3.4.2 Main elements of the Energy Garden in Lenti

Within the framework of the project *”Promote the Sustainable Use of Renewable Resources and Energy Efficiency in Rural Regions, RURES*” CE No. 933 promoted by Interreg CENTRAL EUROPE programme, an energy garden will be established in the area of the old primary school in Lenti, more precisely in Lentiszombathely.

The Energy Garden in Lenti is expected to funcion basically as a venue for demonstrating opportunities for the utilization of renewable energies and the improvement of energy efficiency, **which is facilitated by the procurement of three devices for the improvement of energy efficiency: a vertical-axis wind turbine, a solar panel system and a vegetable oil mini generator.**

The primary target groups of the project are enterprises in the small region and residents although it can increase the knowledge of opportunities for and devices of renewable energy utilization on a broader social level by welcoming children, the youth and groups from public institutions as well. We also have great expectations regarding the devices placed in the energy garden to arouse the interest of architects and craftsmen contractors in the area, that way contributing to the extension of renewable energy utilization.

It is expected to be the main target activity guided by the Zala County Government within the framework of the above-mentioned project thus this study also describes the economic value added (EVA) of these devices. The devices to be placed in the energy garden are discussed individually below.

3.4.3 Solar panel system

It is important to point out that the installation of s solar panel system should not only be examined from the aspects of energy efficiency and environmental protection but also as an investment. The construction of the system is essentially an investment with stable calculations in the long run and a return on it. Furthermore, it is tax-exempt and can generate a high yield.

The study hereinafter examines on-grid/grid-tied (grid backfeeding) home solar panel systems in terms of return on investment, which are the most widespread type of solar panel systems in general.

As a result of the unlimited holding and storing capacity of the electricity grid and the application of the annual balance accounting system with the supplier, the implementation of solar panel systems can be highly economical.

Payback period

The simpliest way to calculate the payback period is to take the costs of implementation and the average energy prices as a basis and then examine how much energy and what value can be saved with the implementation of the system.

Installation costs

In case of a 1 kW solar panel system, the installation costs are approx. between HUF 500-700 thousand, which includes the material, labour, licencing and other additional costs (land clearance etc.). The smaller systems are relatively more expensive, the bigger ones are cheaper.

Savings

In case of south-facing ideal orientation and a 35°° angle, a 1kW solar panel system can generate approx. 1100kWh electricity annually.

Savings in terms of economic value added

The calculations are based on the assumption that the solar panel system works with feeding back power into the grid. (grid-tied). The above-mentioned investment costs and annual energy yield are relevant only in that case. Consequently, if the annual electricity generation does not exceed the consumption, utility companies buy electricity at the same price as they sell it themselves.

According to the A1 residential tariff, gross HUF 37,56/kWh of electricity price can be calculated with.

Calculation of simplified payback period:

The simplified payback period can be calculated by dividing the investment costs of the solar panel system with a unit performance by the price of the electricity generated in a year i.e.

Payback period [year] = Investment costs [HUF] / (Energy savings [kWh/year] x Energy price [HUF/kWh])

In case of a 1kW solar panel system with an average HUF 550,000 investment costs and 1100kWh annual electricity savings:

550,000 [HUF] / (1100 [kWh/year] x 37.56 [HUF/kWh]) = 13.31 years

According to this approach, the payback period of a grid-tied solar panel system is approx. 13 years with the current electricity price (after a numerous utility cost reductions).

However, in the course of simplified calculation, several relevant factors were not taken into account. It is very important to consider the changes in energy prices, the costs of maintenance and a certain degree of performance decline. It is also worth considering whether a solar panel system is more

lucrative than putting the amount of investment costs into a deposit account. It is essential whether the investment relied on state subsidy. These factors can be taken into account with the so-called annuity method.

Using the above values, this unspecified calculation results in a slightly shorter, 12-year payback period.

3.4.4 Vertical axis wind turbine

The vertical axis wind turbine can be installed in places where the normal wind turbine cannot be used. As a result, its main advantage is that it can be installed into the roof structure of detached houses, warehouses or even production plants without disturbing the neighbourhood with its operation.

Source: http://www.geo-line.hu/?p=1879

The major axis of the vertical axis wind turbine is perpendicular to the ground whilst in case of normal wind turbines, the axis is horizontal. This vertical design makes its utilization in both rural and urban areas possible. The vertical axis wind turbine does not depend on the wind direction, winds of any direction rotate the wind turbine, the crosswind gust does not twist the turbine from the wind direction. Due to the special blades and the low rotational speed, its operation is quieter. The vertical axis wind

turbine is recommended to be installed in places where there is strong turbulence, in addition, this type of wind turbine can be mounted on rooftops.

Advantages of a vertical axis wind turbine mounted on a rooftop:

- The height of a taller building is up to 12m, so the material costs of a 12m tall column can be saved, which is gross HUF 500,000.
- The roof inclination can accelerate the wind speed thus 30% higher performance can be achieved.
- Easy installation and maintenance
- Quiet operation
- No licence is required
- Attractive appearance

In the RURES project of the Zala County Government a 1000W wind turbine is taken as a basis because its technical specifications meet the requirements set by the establishment of the energy garden (size of the school and its demonstrative nature).

Product description:

The 1000W vertical axis wind turbine to be installed in the energy garden in Lenti is among the most advanced ones available in the world, which operates at a low rotational speed. Due to the well-designed blades, they are omni-directional without performance decline. Beside its attractive appearance, it can be regarded as a noiseless device. The wind turbine mounted on rooftops is able to be grid-tied, which makes its operation even more economical.

Technical features of the wind turbine*:*

- Dimensions: W 1,8m x H 2,7m
- Swept area: 4,62 m²
- Gross weight: 175 kg
- Blades material: carbon fibre
- Generator: Permanent magnet
- Island mode: 24/48V
- Grid connection: 600V
- Temperature range: -40°C/115°C
- Max rotational speed: 180/min

- Wind speed for electricity generation: 3m/s
- Max wind speed for electricity generation: 30m/s
- Optimum wind speed: 12m/s
- Survival wind speed: 55m/s
- Noise level at 12m/s wind speed: 38dB
- Lifetime: 20years
- Warranty: 3years

Payback period

The initial information for the calculation of the payback period is the investment cost. The installation cost of the vertical axis wind turbine in island mode is gross HUF 3,800,000.[7]

In that case, the payback period can be calculated by using the formula demonstrated with the solar panel system.

Payback period [year] = Investment cost [HUF] / (Energy savings [kWh/year] x Energy price [HUF/kWh])

The expected payback period and the economic added value are as follows:

3,800,000 [HUF] / (9200 [kWh/year] x 37.56 [HUF/kWh]) = 11.65 years

In case of the energy garden in Lenti with an investment cost of HUF 3,800,000, a payback period of 11-12 years can be counted on. Obviously, in order to achieve this, the most appropriate place for installation should be found; on the grounds of the above-mentioned technical parameters, the wind turbine is reasonable to be mounted on the rooftop of the school building.

The result calculated complies with the expected payback period in Hungary, which is between 8-11 years.

3.4.5 Vegetable oil ”mini generator”

The ”mini generator” running on vegetable oil is a newfangled tecnology, so the data available is scarce. It means a considerable uncertainty factor during calculations on economic efficiency and payback period, but as a pilot project, its function is to test this type of novel technologies therefore final calculations on payback period should be carried out within the framework of the energy garden.

[7] Source: www.megujuloenergiak.eu

A good practice

In spite of being a novel technology, there is a vegetable oil ”mini generator” in operation in Hungary. It is run by ”Cropell Kft, a family business with modest financial background but existent infrastructure, relationships and sources of purchasing. During the refurbisment of the farm – located on the outskirts of Derekegyház and functioning as a home and business premises – the electricity supply had to be solved. The owner of the farm strived to implement the most cost-effective solution in the long run, so he decided on the generator running on pressed plant oils. The implementation of the project is based on plant oils, which can be provided by growing oilseeds (sunflower, rape) on a field of 1-2 hectare and then by pressing oil from these seeds for the mini generator to generate electricity and hot water. In the course of pressing oil seeds, pellet and cake is produced from the seed residues, which can be combusted. That way the full energy demand of the farm can be covered at low costs. By the establishment of the vegetable oil mini generator, the enterprise has been able to provide the full power supply of the family home and the premises since 2007. Today (in 2013) this solution is used in more than 30 places in the country. Because of the lack of funds, (prospective) farm owners usually purchase the Crofter mini generator from funding from calls for development projects instead of their own sources. The mini generator is currently involved in the BÜKK-MAKK LEADER programme (Sajópetri), where this system is intended to be applied in several projects under impementation and also planned ones, in most cases in a combination with other renewable resources (solar, wind and geothermal energy). ”[8]

Product benefits

In Hungary, the electricity supply of farms and mountain cellars cannot be regarded as fully solved since public utility infrastructures do not serve the whole of these areas. A solution to this problem is offered by owners generating electricity from renewable energy sources, which could not only be a stable source of electricity but also a more cost-effective solution.

The technology to be used in the Energy Garden in Lenti will generate electricity with the help of oilseed-based biofuel, which will be able to meet the lighting, electricity and sanitary hot water demands of the farm. The ”mini generator” is basically a mobile energy source with small space requirements which can be run in an energy-effective way.

[8]Source: https://www.nth.gov.hu/hu/tevekenysegek/gazdasagfejlesztes/helyi-gazdasagfejlesztes/otletado-megoldasok-es-jo-gyakorlatok/onellato-energetika-olajos-magvu-novenyekre-alapozva

The vegetable oil ”mini generator” also has a sustainability-themed awareness raising nature since it highlights the fact that the seeds grown are not only useful in terms of sales but by pressing them, they can be regarded as energy sources thus they are suitable for electricity and thermal energy generation.

The technology described above makes an economical, reliable and decentralized electricity and thermal energy generation possible from widely obtainable feedstocks, consequently, a device has been developed which may prove useful for farms on the outskirts as it contributes to their becoming enegy self-sufficient and economical.

Payback period

Based on the good practices and developments already implemented, we gave an overall picture above of the expected benefits from and results of operating the device. As there are no publicly accessible data on the running costs of the ”mini generator” in the size range to be implemented in the Energy Garden in Lenti, the pilot activity will involve the assessment of the return on investment and economical operation as well as its quantification. The results of the measurements conducted under controlled conditions will be made publicly accessible, the experince learnt from and the conclusions drawn on them could be regarded as the outstanding results of the pilot project.

Concerning the payback period of the vegetable oil ”mini” generator, this study defines how the economic value added can be measured. The payback period can be calculated on the basis of the same formula applied with the solar panel system and the vertical axis wind turbine: **Payback period [year] = Investment costs [HUF] /Energy savings [kWh/year] x Energy price [HUF/kWh]).**

The investment costs refer to the purchase, installation and maintenance costs of the device, the energy savings are given, but in case of the energy price, it is important to insert the market value of oilseeds as a kind of opportunity cost in the formula.

4. Financial analysis

General financing facilities

In case of energy efficiency investments, besides the available financing facilities, it is particularly important for project promoters such as residents, municipalities or businesses to be fully aware of the availability and conditions of financing instruments. One of the services of the Lenti ”House of Renewable Energies” will be financing consultancy offered to private individuals and organizations with the aim of implementing energy efficiency projects. The interested parties will be informed not only about the available EU funding opportunities but also other financial instruments within the framework of consultancy. A short description is given below of the characteristics of financing instruments which support the implementation of energy efficiency investments.

In case of construction investments and refurbishments, the complexity of energy efficiency modernization requires considerable preparations and the technical requirements are fulfilled only if the customers or end-users are well-prepared. The assessment of the necessary funds for the investment is part of the preparation process. By means of the contractor quotations, architectural and expert documents, the end user has accurate knowledge of the amount to calculate with and the necessary scheduling. The most obvious solution is when customers have their own funds.

Savings can be combined with accredited financial products with savings incentive, by which the the interest rate on deposits of own savings are subsidized by the Hungarian government under the current regulatory framework.

Building societies (Hungarian term: lakás-takarékpénztár – LTP) are specialized credit institutions dealing with exclusively housing deposits and loans. The savings plan for housing is an opportunity for housing financing subsidized by the government. The government provides a subsidy related to the savings. When the saving period expires, building societies offer favourable credit facilities. Every Hungarian citizen are entitled to them irrespective of their family status and earnings. Building societies can offer housing loans only to residential customers, housing cooperatives and condominiums.

Commercial credits

The banking system offers diversified financial products to both residential and administrative customers for financing energy efficiency refurbishments. The common feature of these credit products

is that they regard the purpose of the credit i.e. the energy efficient reconstruction of the building as an investment element instead of a source of repayment financed by credit and resulted in energy savings. Consequently, their customers are offered classic, medium term (2-15 years) general purpose loans charged with an interest rate or due to the interest subsidy, a credit with more favourable interest rate but by no means a credit based on the amount saved by energy efficiency.

A credit programme was launched last year (04/2017) for the residential sector overlapping between credits and aid schemes, it is described here briefly because of its methodological nature:

Within the framework of the ” Credit programme for increasing energy efficiency of residential housing and utilization of renewable energies”, HUF 115 billion has been allocated for the building energy investments of the residential sector.

The Economic Development and Innovation Operational Programme (GINOP) and the Competitive Central Hungary Operational Programme (CCHOP) provide funding for increasing energy efficiency of residential housing and the utilization of renewable resources related to them.

Private individuals, condominiums and housing cooperatives can apply for the loan at MFB (Hungarian Development Bank) Points since 24 April, 2017.

The zero interest loan can be used among others for the modernization of heating systems, insulation, replacement of doors and windows as well as the installation of renewable energy sources such as solar panels, solar collectors, heat pumps or up-to-date wood gasification units.

The amount of the loan in case of a natural person ranges from HUF 500 thousand to HUF 10 million, in case of condominiums and housing cooperatives it is between HUF 500 thousand and HUF 7 million per flat. The expected amount of own contribution is at least 10% of the eligible costs of the project.

(ESCO) financing model based on energy savings

Its widespred definition in the EU is the following: According to the Directive 2006/32/EC, ”ESCO (Energy Service Company) is defined as a natural or legal person that delivers energy services and/or other energy efficiency improvements in a user’s facility or premises, and accepts some degree of financial risk in so doing.

Payment of provided services (in total or partially) is based on the reached energy efficiency improvements and the fulfilment of criteria agreed upon in advance in Energy Performance Contracting (EPC)."[9]

In Hungary, the so-called third party ESCO financing practice is widespread among municipalities and fiscal institutions when an outside company delivers technical and financial services for the utilization of energy savings assessed with the end-user. In the last 15 years, similar models have appeared behind the modernization of heating systems and renewable energy improvements of residential communities in case of particular technical warranties.

ESCO financial instruments

A wide range of ESCO financial instruments have developed in Hungary, whose basic varieties are the following, distinguished by not only factors of energy efficiency but also accounting:

In case of **third party financing**, ESCO provides outside financing for the investment as a third party, but does not deliver operation and maintenance services thus the financial instrument is not charged with their costs.

The **operative leasing** involves the implementation of the modernization project and renting of the modernized system.

ESCO – technical and financial services related to full-range modernization, in which ESCO undertakes (i) project identification, (ii) technical planning and licensing, (iii) turnkey construction, (iv) operation and maintenance, (v) invoice management and (vi) organizing the financing of these activities.

Forfeiting / factoring – Long-term receivables of the exporter are purchased by a bank at a discounted present value, the discounter bank assuming financial risks concerning the receivables.

Zalagreen microcredit

The microcredit will be available for micro- and small enterprises in cooperation with the Zala County Foundation for Enterprise Promotion (ZMVA), which developed and launched the financial instrument. The following table describes the main parameters of the credit product.

[9] Source: www.sense-esco.eu/en/what-is-esco

Range of credit applicants	Resident micro- and small enterprises with business premises in the Republic of Hungary and/or in the European Economic Area or with branch establishments in the Republic of Hungary
Credit amount	**HUF 1,000,000.- - -5,000,000**
Own contribution	The minimum contribution required (i.e. provision of outside sources) is **10%** of the total net implementation costs of the project, whose pre- or future appropriation is to be certified when the credit disbursment takes place at the latest. Invoices and corrsponding accounting documents prepared six months at most prior to the submission of loan application can be certified as own contribution.
Credit purpose	Eligible projects: financing costs of energy efficiency investments. establishment of wind power generation systems, installation of solar panel systems, insulation of buildings, implementation of geothermal energy investments. They include: - procurement of machines, equipment, other tangible and intangible assets; - financing costs of construction and refurbishment The proportion of the costs of energy savings within the planned development shall exceed 50% of the total amount of credit disbursment.

Duration	12 – 60 months
Grace period for principal payment	Max 12 months
Interest rate	The interest rate is 3,9% per year, which is available to existing customers. The interest rate rises to 6,5% per year if current repayment obligations are past due by 15 days. An interest subsidy programme might also be available to the interest rate.
Default interest	In case of late payment, a default interest shall be charged, whose rate is 6% per year on the overdue capital besides the interest rate, and also 6% on the unpaid interest.
Credit disbursment	Credit disbursment shall take place with the fulfilment of the special requirements set by ZMVA.
Deadline of credit appropriation	The loan agreement shall be concluded in three months following credit authorization. Credit appropriation shall be started within 60 days following the conclusion of the agreement. Project implementation shall be started within 60 days following credit disbursment and finished 12 months following the conclusion of the agreement, this deadline can be extended for another 6 months with justified reasons. When investment is completed, project implementation shall also be justified credibly with documents (e.g. contracts, invoices etc.). In the course of acounting, invoices prepared 6 months prior to submission can be accepted.

General credit conditions

Enterprises excluded from credit financing	**No credit may be offered to enterprises** - under bankruptcy or liquidation proceedings and/or with overdue public debt (except for deferral payment or payment in instalments granted by the tax authorities); - which do not possess valid offical licences for businesslike operation at the time of concluding the Loan agreement; - which received or would receive de minimis aid in the given or previous two fiscal years above the ceiling determined by the Commission Regulation (EC) No. 1998/2006.
Non-eligible credit appropriations	**Funding is granted with the exception of:** - reclaimable VAT - outstanding loans; - acquisition of business shares, stocks and shares or any other corporate shares; and - purchase of fixed or tangible assets from the direct or indirect owners, executive officers, senior managers of the applicant enterprise or (if managable) the relatives of these persons or within the group of companies, and investments implemented with the pecuniary assistance of all these persons. - enterprises active in the primary production of agricultural products as listed in Annex I to the Treaty establishing the EC; - enterprises active in the processing and marketing of agricultural products as listed in Annex I to the Treaty establishing the EC, when the amount of aid is fixed on the basis of the price or quality of such products purchased or disributed on the market or when the aid depends on being partly or entirely

	passed on to primary producers; - enterprises whose more than 50% of net turnover of the last full business year (in case of private entrepreneurs the tax base of entrepreneurial income) is generated from agricultural activity (According to NACE/TEÁOR '08: 01.11 – 03.22); - aid to export-related activities, namely aid directly linked to the quantities exported, the establishment and operation of a distribution network or to other current expenditure linked to the export activity; - aid contingent upon the use of domestic over imported goods; - enterprises active in the coal sector; - acquisition of road freight transport vehicles in case of enterprises performing road freight transport; - enterprises in difficulty {Government Decree 8/2007. (III. 19.) MeHVM. 12.§ (1) paragraph j)}
Collateral	**According to the Collateral Valuation Regulation of ZMVA, collateral is required in all cases.**
Costs and fees	**<u>Transaction fees</u>** Creditworthiness assessment fee is the charge paid for the procedure of assessing the creditworthiness of the Customer, HUF 15,000 shall be paid with the submission of the loan application.
Submission of loan applications	**Submission of applications is continuous from opening until the credit line is exhausted.** **Loan applications can be submitted via the online** www.credinfo.hu **system.**

The backgound of **Zala Green Credit programme**

Programme objective	ZalaGreen Microcredit Programme aims the dissemination of energy efficient thinking between SMEs located in Zala County. In the framework of the program, the local SMEs can take a special type of loan, which helps SMEs to get energy efficient/renewable energy tools and helps to run their enterprises in a green way. This program will be a pilot action in Hungary which in the case of success can be disseminated in the whole country with the help of the Hungarian Business Promotion Network (ZMVA is a part of this network).
Total credit line available	HUF 30, 000, 000 (EUR 96, 774.2)
Max amount / transaction	HUF 5, 000, 000 (EUR 16, 129)
Number of applications to be granted	6-10
Duration of the programme	2018-2023(24), Lending is expected to be closed in 2018.
Financial intermediary	Zala County Foundation for Enterprise Promotion (ZMVA)
Owner of the fund	Zala County Foundation for Enterprise Promotion (ZMVA)
Evaluation criteria	Business plan Last closed business year Order of arrival Projects are evaluated by the microcredit committee of the Foundation

	complemented by an energy expert delegated by the domestic representatives of the project.
Management of loan applications and transactions	ZMVA will process loan applications and keep record of transactions via Credinfo. Tha system makes the fast evaluation of loan applications and appropriate tracking possible.

5. Summary and recommendations

This is a first step of a really important development which will be continued on several ways (universities, ZalaGreen, accommodations, new projects etc). All in all, in Hungary the part of the EE/RES energy production is only 7%, but the local population requires the EE technologies that is the aim why is this exhibition, energy park is so useful and important in the life of the area.