PROJECT RURES

D.T2.3.2 Action plan for a transfer of pilot actions May, 2020

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1. About project RURES

Project RURES - Promote the Sustainable Use of Renewable Resources and Energy Efficiency in Rural Regions, is being implemented and co-financed through Interreg Central Europe programme and has been approved for financing in the second call for project proposals. The project implementation begun on July 2017 and lasts for 3 years, i.e. until June 2020. 11 institutions from 6 Central European countries (Germany, Poland, Slovenia, Hungary, Czech Republic and Croatia) participate in the project as project partners.

The main objective of RURES is the exploitation of the potential from energy being produced from renewable energy sources (RES) and increased energy efficiency (EE) in rural regions. The capacity of the public sector in rural regions regarding to strategies for the implementation of EE and RES measures and policies will be built up by integrating the political decision makers, so that they can directly and successfully develop and implement EE and RES in their regions. Experiences between the regions are exchanged and especially the less developed benefit from further ones. Also, the gap between exploitation of RES is reduced and greater RES potential is utilized.

Through the experiences from RURES activities, the partner regions increase their capacity regarding to a community oriented sustainable regional development and the respective added value for the region. The rural regions become more attractive for investments in EE and RES. This will strengthen the competitiveness in the future and will lead to a reduced energy dependency, increase of RES usage and reduction of climate gas emissions.

The specific objectives the RURES project is tackling are:

- Exploitation of renewable energy and increase of energy efficiency in rural regions;
- Support of political decision makers in the development and implementation process of energy policies.

There are several identified results the implementation of this project will trigger in the Central Europe region. Implementation of the best practices in integrating RES and EE measures in partners regions will have a show character to initiate further EEP implementation actions. Exchange of experiences between and beyond the project partner regions will lead to new knowledge and especially less developed regions regarding to EE and RES exploitation will benefit due to new path and possibilities e.g. alternative financing seek to further investments in sustainable energies and trigger further activities in these priority (financial capacity).

Also, the knowledge about the economic benefits and added value of RES measures increase. Managerial competences will increase by elaborating and testing new tools and concepts for the participation and involvement of a broad public in the energy policy strategies and their implementation process. Political capacity is set up by the establishment of the Local Support Groups, which aim as regional energy networks with a broad involvement of stakeholder, interest groups and decision makers in the regional strategy and energy policy development and implementation process.

2. Description of pilot investments and review of transferability possibilities

2.1. Pilot investment I1 – Ventilation system with heat recovery in public sport centre

2.1.1. Description of Pilot investment I1

This pilot investment has been implemented in the high school sports hall in the Town of Leisnig in Germany, Saxony region. The sports hall was built in 1986. The construction of the gym consists of an agricultural hall, but the building was used as a gym from the beginning.

Image 1 Interior view of the sports hall

Image 2 Street view of the sports hall

The existing heating and ventilation system of the building was based on technology installed in 1991. The heating system was based on oil and the ventilation system was inefficient compared to the current standards.

Image 3 Old heating system

Image 4 Old ventilation system

An update of these technical devices was therefore overdue. Since a natural gas network is available in the district, it was decided to use a new boiler with gas condensing technology for heating and to combine it with a new ventilation system with efficient heat exchangers.

A ventilation system with heat recovery will be operated for the economic heating of the sports hall. This is a combined supply and return air unit in accordance with ErP Directive 2018 (Ecodesign Directive), which is equipped with a highly efficient cross-flow plate heat exchanger for heat recovery. The ventilation system is equipped with a combined supply and exhaust air unit with a highly efficient cross-flow plate heat exchanger for heat recovery. The location of the ventilation system is the ventilation centre of the old system on the upper floor of the building.

Table 1 Essential technical data for dimensioning the heat exchanger

Outside air preheating (WRG)	
Fresh air temperature	*-14.0 °C*
Exhaust air temperature	*22.0 °C*
Relative humidity of the exhaust air	*30.0%.*
Supply air temperature	*15.0 °C*
Temperature transfer degree dry (EN 308)	*74 %*
Heat recovery efficiency	*81 %*
Heat output	*141.0 kW*
Condensate accumulation	*32.0 kg/h*
Exhaust air temperature	*-2.4 °C*
Relative humidity of the exhaust air	*100.0 %.*
WRG class acc. to EN 13053/2012	*H1*

Parallel to the renewal of the ventilation system, a gas condensing boiler is used to supply the building with heat. The installation site is on the ground floor of the central heating plant. The nominal heating capacity of this boiler plant is 184 kW. Hot water is produced by means of two storage water heaters, also installed in the central heating plant.

The total investment costs amount to 156,068.50 €. This also includes the costs for the heat generator, ancillary works as well as architectural and engineering services.

To implement the pilot installation, a detailed planning is required. To gain an efficient and economical operation, the system planning contains a big variety of important aspects. Therefore, a selection is listed below and some important facts in term of the planning and the maintenance of the system are summed up.

- an airtight building envelope must be achieved and tested;
- the exhaust air zones must be arranged as compactly as possible to keep material expenditures and costs low;
- the electrical consumption of the system must be kept as low as possible by selecting the appropriate fan for the system size;
- fire and smoke protection devices, fire protection and thermal insulation are designed according to the rules of technology. In particular, the guideline on fire protection requirements for ventilation systems must be observed;

- the roof hoods and external grilles are to be classified into roof and façade under consideration of an attractive roof and façade design.

The ventilation system and its components must be designed, constructed and installed in a way that they function always and without any incidents. This includes the planning of enough maintenance openings and the protecting of the ventilation ducts from dust and dirt during the construction phase. The ventilation system must be correctly adjusted, and the necessary ventilation currents must be adapted to the desired characteristics of use. To ensure the correct and energy-saving use of the ventilation system, residents must be instructed on its use. This requires a detailed instruction in the function and operating mode of the system, such as control or the process of changing the filter.

2.1.2. Potential and general benefits of transfer of Pilot investment I1 to other European regions

Since the planned project aims to improve a sports hall in a small rural town, benefits are expected in several areas. For the community, this means creating a new and important location for local development through the social impact and use of modern energy technology.

The closer environment consists of small towns like Leisnig, per example Colditz or Hartha. Leisnig itself has a variety of active sport and cultural associations as well as two schools. A well-functioning gym gives the schools and the associations an opportunity to hold up their sport exercises or to even use them for cultural events. This offers the whole society in the surrounding area a new, reasonable place to meet up and shape the daily life.

Sport facilities are an important component for a well-functioning society and through that for a well-developed environment. With better and new sport offers the attractiveness of a rural area is expected to rise and to get an important economic factor. It can create jobs and have a big impact on the image of the area. For the city council this means to create a new and important location for the local development, through the social impacts and with using a modern energy technology. The current heating system would be updated to a more efficient ventilation system with heat exchangers.

The whole facility would improve its environmental, social and economic impact through the update to a more efficient, environmental-friendly technology.

Table 2 Energy data

Energy data	***Energy consumption***	***Energy demand***	***Reduction of energy***		
	[kWh/a]	*[kWh/m²a]*	*[kWh/a]*	*[%/a]*	*[kWh/30a]*
actual state	*207.995*	*260,2*	*/*	*/*	*/*
Ventilation system with heat recovery	*158.700*	*198,6*	*49.295*	***23,7***	*1.478.846*
Emissions	*SO_2*	*NO_X*	*dust*	*CO_2*	*CO_2-reduction*
	[g/a]	*[g/a]*	*[g/a]*	*[kg/a]*	*[%]*
actual state	*77.605*	*57.284*	*2.274*	*56.929*	*/*
Ventilation system with heat recovery	*59.618*	*44.397*	*1.852*	*44.415*	***22***

Table 3 shows that an energy saving of 23.7 percent can be achieved with the ventilation system with heat recovery. Furthermore, 22 percent of CO_2 emissions can be saved. The calculated savings were related to the actual consumption. With the current heating system, it is not possible to sufficiently heat the hall during the winter months, which is why a higher consumption is possible.

By supporting this kind of infrastructure, the whole region benefits from the energy and structural improvement of the public facilities. The measure is relatively small but can have a significant impact on society and the environment in such a region. Especially in rural areas, the number of old, non-reconstructed buildings is quite high. A comprehensive renovation of this kind of buildings and the integration of modern renewable energy technologies can significantly improve the ecological balance of the rural and semi-rural regions in Central Europe and beyond. Technically speaking, the integration of a new ventilation system into an existing building always requires individual preparation, planning and implementation, but the benefits for society are numerous.

In general, there is a high potential for municipalities to improve the attractiveness of extensive renovations of dilapidated buildings and to counteract urbanisation. With better and new sports facilities, it is expected that the attractiveness of the rural area will increase and become an important economic factor. It can create jobs and have a major impact on the image of the region.

The knowledge gained is not limited to the region. The building type of the Karl Zimmermann sports hall is widespread in the Central and Eastern Europe. In most cases, the buildings are in a similarly poor energy condition as the Karl Zimmermann Gymnasium.

The installed technology corresponds to the state of the art. Their use is reliable and has been tried and tested several times. The technology is available throughout Europe and also in non-European countries. The installation can be carried out on site by any local specialist company. Similar projects in other EU and non-EU regions can make rural areas more attractive living spaces and attract young families but should be combined with other regional development measures.

2.2. Pilot investment I2 – Intelligent water metering

2.2.1. Description of pilot investment I2

The pilot action is located in Pałecznica Municipality, Poland, which covers around 48 km^2. There are 14 villages in the area, where approximately 3.630 people live. Beside commune's residents, the water is transferred to neighbour municipalities. In total around 11.790 inhabitants are supported by Pałecznica's water network.

As part of the RURES project intelligent water metering (IWM) was implemented in Pałecznica Municipality. Thanks to the project efforts, replacement of zone water meters, purchase of software for remote reading and analyzing of data, appropriate devices for storing information and data analysis could be purchased and installed.

Image 5 PV installation near water pumping system

Pilot area is already equipped with PV installation which is strictly used to power water pumps. Total produced electricity is consumed on the point of production. In case of electricity surplus up to 10 kW of power from PV can be inputted in power distribution network where 80 % can be taken back from the grid up to one year after production. The rest of 20 % is delivered to the network (Distribution system operator) to compensate network operational costs. Such a way of delivering and consumption of electricity is also known as net metering approach where the calculation was carried out on the half year basis or yearly.

For extraordinary situations (weather conditions, maintenance…) there is a diesel aggregate in reserve. Whole process, from pumping water and electricity production to distribution of water is covered by local management system which includes PV measurements and water measurements.

Pilot investment requirements:

- adaptation (or replacement) of water meters for transmitting meters,
- GSM/UMTS/GPRS/LTE/other data transmitters and receivers,
- software for administration of the system,
- training of person(-s) which will take care of the system.

The pilot investment helps to start automation of data collection and analysis process: data from meters are remotely collected and transferred to external server, from where they can be analyzed and used directly in real time periods.

During the preparation phase local authorities decided to create 7 zones of data metering. Each zone starts with one zonal meter. If the water network goes further (abroad the zone), the second water meter is placed.

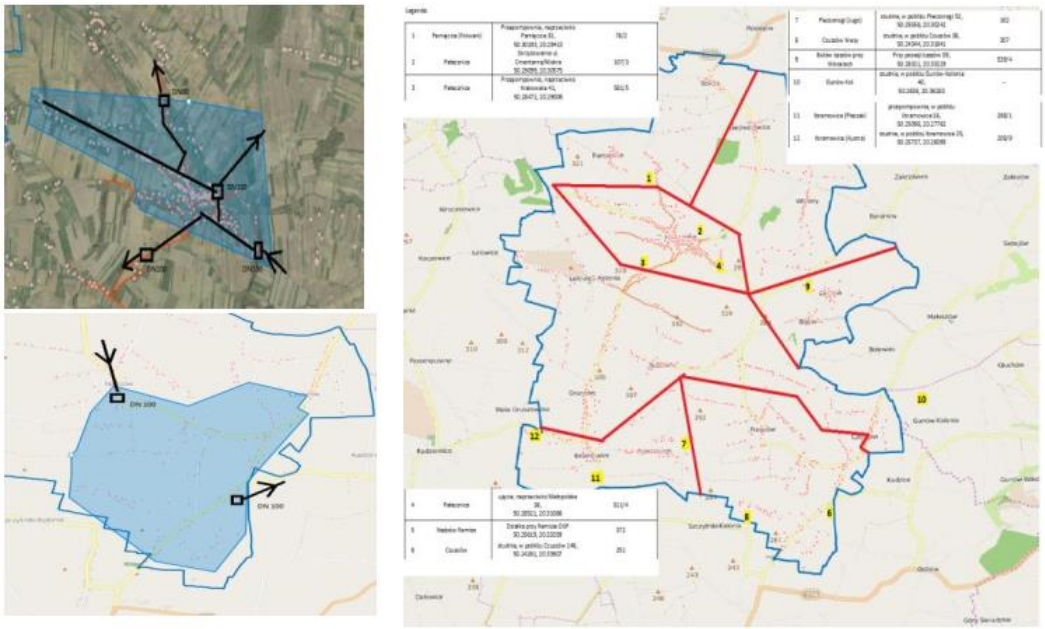


Image 6 Palecznica Municipality – division to zones

Technological development in the water supply industry and in the area of remote monitoring of media consumption caused that the commune authorities consider the possibility of using smart metering and remote reading of water consumption. For this purpose, it was necessary to replace devices (water meters, valves, pressure gauges, etc.) for those that allow remote, automatic reading of data and give the ability to control network parameters from the control panel, through a computer or mobile device (i.e. tablet, smartphone).

Estimated costs of the pilot investment, according to market research from January 2019 were set at 218.171,00 PLN which is around 50.600,00 €. Procurement has been conducted to purchase meters, equipment, system, training in March 2019 and the best bidder gave the total price of 198.338,00 PLN, which is around 46.000,00 €.

Some extra costs, not considered during the application phase, appeared during the implementation of the pilot investment. In the preparation phase it appeared that the best way for data analysis will be creation of 7 zones (dividing the water network on 7 zones), however, this required installation of 3 new

wells, where water meters could be placed. This was unexpected work and costs were fully carried from municipality own budget.

Finally, total cost of the investment rose up to 65 915 €.

The water supply system in Pałecznica Municipality consists of a water intake (2 pumps with a capacity of 94 m3/h each), two storage tanks, a water tower, three pumping stations and a water supply network with a length of approx. 80 km. Pałecznica Municipality has 1076 individual and 16 zonal water meter clocks registered. The commune is responsible for water supply, maintaining the network and settling accounts with recipients.

Previously, one person visited once in three months the location of the meter and personally controlled its condition and indications. The data was then transferred to the unit responsible for the settlement and a settlement document was issued. The annual cost of employing collectors and paying their business trips within the commune to collect data from meters was about PLN 55.000,00 (around 12.800,00 €). The pilot investment helped to start automation of this process: data from meters are collected and transferred to external server, from where they can be analysed and used directly in real time periods.

Image 7 Old water meters

The investment was carried out on two equal levels:

1. Market research, purchase and assembly of water meters. There are several types of water meters on the market with the possibility of remote data reading. The most popular in Poland are "standard" water meters - mechanical, wing type. For the pilot investment ultrasonic water meters were purchased. They use sound waves to measure water flow. Water meters have the function of direct signal transmission or through an overlay mounted on their casing. Producers ensures the longer life of ultrasonic water meters, which has a significant impact on the maintenance costs of these devices.

Solutions for data collection and reading are similar for all types of water meters: reading and data transmission can be carried out by radio/GSM or using digital transmission (e.g. M-bus). The pilot investment mixes both methods – if there is possibility of wire data transfer this method is the first option (better stability). All purchased meters and data concentrators give the possibility to connect them to internet network in the future (when the cables are installed).

2. Analysis of needs and creation of a tailored system for intelligent monitoring of media consumption. The planned system is designed to collect data directly from water meters, and through a set of concentrators and signal repeaters, using Internet access (cable or GSM connection). Data will be stored and processed in the control panel at external server, allowing for generating reports, viewing consumption or alarms and failures monitoring. Access to data (after logging in) through a readable program have employees obliged to maintain the water supply network.

Image 8 New water meter and equipment

2.2.2. Potential and general benefits of transfer of Pilot investment I2 to other European regions

The pilot investment allows to test intelligent water metering in rural region. In Małopolska Region there were no such investments with remote data metering and Pałecznica Municipality is now a show case for other municipalities. To calculate real benefits (water and energy savings) data has to be gathered in a longer period of time, however by implementation of automatic water metering system consumption should decrease for approximately 20 %.

As for now, if the savings reach 10%, that means the investment's return period is 2,1 year. Savings (cca. 29.724 €) can be used for the further development of the water metering system (e.g. connecting individual households).

The commune gains a tool to optimize the use of the water supply system. Remote monitoring enables adapting the network capabilities to the needs of recipients and facilitates supervision of the water supply system at current time. This means water and energy savings (expected 20% reduction), which is in line with sustainable development policies at all levels (from local to international).

Implementation of the pilot investment, as a part of continuous improvement of the water supply network, means socio-economic development (access to information and communication technologies,

internet of things), life quality improvement (a better understanding of the daily water demand; savings can be used for another investments) and leads to environment and resources protection.

Ultimately this investment will lead to the implementation of a larger investment: equipping all inhabitants of the Pałecznica Municipality with intelligent reading of water consumption and combining them into one intelligent system cooperating with water intake and pumping stations and storage tanks.

Main objective of the project is exploitation of renewable energy sources and increasing of energy efficiency in rural regions due to its great potential to achieve energy autonomy. It is always difficult and risky to implement innovative projects among the first due to the many problems and possibility of failure. Implementation of pilot action for Palecznica Municipality will bring a set of possibilities and limitations of intelligent water metering system taking into account existing systems on the pilot area.

It can be easily implemented in any region in case Municipality owns the water system. But in any case, intelligent management system is replicable itself. It is all about principle of smart metering system and intelligent management system due to pilot investment will be the trigger to show that IWM results with energy and financial savings. By that, it is highly expected that such kind of investment can be transferable to other municipalities to reach every single building or system.

It is also important to note that Poland has developed net metering approach in terms of distributed generation of electricity which is not the case with most other countries. Because of that, other countries won't gain so much savings but they need to be led by positive examples.

2.3. Pilot investment I3 – Solar “E-Tree”

2.3.1. Description of pilot investment I3

The Solar E-Tree is installed on the property / land owned by Municipality of Puconci in Pomurje region, Slovenia. With the location around the Puconci elementary school, the Green hall (energy-saving sports gym), the bus station, the outdoor sports grounds, the park and the church, the frequent location of E-Tree has been reached. The location was determined within the framework of the meetings with the Local Support Group (LSG) and the mayor of the municipality of Puconci.

Image 9 Location of the Solar "E-Tree"

Solar E-Tree is constructed from 3 components: Solar Tree, Solar bench and Smart bench with shadow. All together they provide 11 pieces of solar cells, capacity of 1,74 kWp, 16 seats for visitors (benches), LED lightning of 20 W, 16 USB ports for charging different mobile devices, one wireless charger, ready for use charging station installed on the bench for e-bike, e-roller, e-cycle 2 x 220 V (300 W), sensors for temperature, humidity and 100 % solar powered charging independent of grid supply.

Solar tree supports working of portable computers, mobile phones and has LED lights that are working at night, solar panels have a huge capacity, it has resistant steel structure and electrical equipment is installed inside the box. Solar tree has a regulator, battery and converter installed for operation.

Solar bench (smart bench) is made of galvanized steel, which makes the solar bench firmly and resistant to vandalism and natural conditions (salt). On the middle part of the bench are solar panels that supply electricity with USB ports for charging mobile devices. Installation and construction is very quick and easy.

Smart bench with shadow has 6 seats, connected USB cables for users, has LED lightning and sensors for temperature, humidity. Its steel construction is very resistant, while all electrical equipment is installed inside the box. All constructions are well designed and performed with good quality materials. That makes the investment looks good and durable.

When installing Solar E-Tree is estimated that energy produced will be 1.870 kWh annually. In 30 year, the Solar E-Tree will generate 56,1 MWh of pure electricity. At the annual level, with energy production from Solar E-Tree we will save 1.041 kgCO2 (1,04 t CO2 compared to purchasing this energy). During the lifetime of 30 years, the Solar E-Tree will save 31,27 tCO2.

It is anticipated that the period of use of the Solar E-Tree, with regular maintenance, will be at least 15 years. Regular maintenance of the Solar E-Tree means regular (monthly) cleaning, maintenance and regular servicing of all installed equipment and devices according to the manufacturer's instructions. Preventive maintenance involves inspecting the Solar E-Tree and performing works to prevent the loss of properties of the Solar E-Tree, meet the requirements of the project and to comply with the Solar E-Tree regulations according to which the facility is built.

Image 10 Preparation of the foundation

Only the construction and other products that meet the prescribed requirements may be used in the maintenance of the Solar E-Tree. Materials used in the maintenance and other materials used must have properties that correspond to the properties of the originally built materials. The maintenance of the installed equipment is carried out according to the instructions of the manufacturer and the contractor. Maintenance must not change the planned properties of the Solar E-Tree. The essential requirements for the facility and other instructions that apply to the construction and maintenance of this facility must be considered. The municipality also provided insurance for vandalism / destruction of the Solar E-Tree.

Total real cost of this pilot investment was 19.945,83 € which includes the costs of acquiring the Solar E-Tree and the costs of additional works i.e. fixing the tree on the ground with the concrete.

2.3.2. Potential and general benefits of transfer of Pilot investment I3 to other European regions

This pilot investment is an example of good practice to local and regional authorities both in rural and in urban area and is an example to citizens how energy refurbishment results not only in energy and financial savings but also in better quality of space usage. The sun is a huge source of energy which has only recently

been tapped into. It provides immense resources which can generate clean, non-polluting and sustainable electricity, thus resulting in no global warming emissions.

One of the most remarkable reports about solar energy solution (Solar Tree for street lightning, home supply, station for e-cars…) is that it caters to basically all the energy needs. From lighting to heating, this can be utilized by first identifying energy sources and installing the right equipment with solar energy resolutions. The use of equipment made with such solutions, help reduce a good percentage of our energy bill through solar panel installation projects on places like rooftops. Impact on the national level in the sense that more frequent solutions of energy efficiency can reduce the use of imported sources as an energy source and thus keep the money in the country.

The pilot action and the approach is first of its kind in Pomurje region and also in Slovenia. It is an innovative investment, it serves as best-practice for RES production and also have experimental nature and demonstration character. Experimental nature: through the period of use we are interested the actual use by students, children, tourists, citizens how much they will actually use electricity produced from the sun and the users of each target group. Demonstration character: the most exemplary way to see the conversion of solar energy into electricity, using it for lighting and charging devices and independence from the electricity grid of the Solar E-Tree.

Solar E-tree represents an autonomous photovoltaic system. It is equipped with a system of solar panels which, as long as they're illuminated by the sunlight, produce voltage at their respective endings. That voltage can then be used for charging batteries. Accumulated energy from those batteries is then used for various purposes. Although we are witnessing constant advancement of the technologies used in battery construction, the problem of fast battery discharge in mobile phones and portable computers is still present. With implementation of this project we have offered an option for the population of Municipality Puconci for charging their devices, not in a conventional way. The area around Solar E-Tree will became a place where pupils/children from nearby Puconci Elementary School, users of the playground and outdoor fitness park, visitors of organized events in cultural center "Memorial home of Štefan Küzmič" would gather and recharge their devices and, at the same time, socialise.

Image 11 Finalised Solar E-Tree installation

The impacts of this pilot action are seen in an increase of: a) encouragement of the ideas that improve the quality of life of members in the community, b) promotion of the renewable sources of electric energy and c) promotion of the ecological awareness in the community. Solar E-Tree has, besides its main function as an electricity plant, an important social and educational function. The benefits of it is in teaching kids about the need to increase energy efficiency, environmental awareness and environmental protection in the earliest age using renewable sources of free energy. At the same time, we want young generation to transfer their knowledge about new living habits to an older generation.

This pilot action can be easily transferred to any region (rural areas or in cities, universities, companies, etc.) of Europe or all over the world. This is a good idea and its learning potential is high. With usage of solar panels electricity could be available to users in inaccessible areas and remote parts of the country where the cost of building infrastructure would be much higher than the cost of installing solar panels.

It is also good example for private investors, as with this pilot investment they can become better acquainted with the PV technology and decide to use small installations at their households.

Local institutions together with media can support design and implementation of new approaches to the technology through activities as local experiments, festivals, exhibitions and various information events. Constraints that we daily encounter can be solved if community works and acts as a collective, because only with active participation, support of different innovations and will to progress, small improvements can be achieved that will in future represent essential and irreplaceable aspect in the development of society.

Here defined pilot solution can in this context or in a different design be transferred to any public location in rural or urban areas. Implementation of this type of projects that promote the use of renewable energy at the local level is extremely important for the further development of any area.

The similar projects in Pomurje region or country can find possibilities in financing in budget funds from Municipalities, European funds from transnational and cross-border programs, Norwegian mechanism, Horizon 2020, Cohesion funds, Rural development program, Eco Fund funds, Crowdfunding, Public-private partnership, etc

2.4. Pilot investment I4 - Establishing a renewable energy-yard

2.4.1. Description of pilot investment I4

The pilot investment is located in Hungarian Zala County, in town of Lenti. The area of the pilot action is a former school building of Lentiszombathely. The school building was not used for several years which resulted a serious damage in the state of the building.

The main characteristics were the followings before the investment:

- The building had to be comprehensively renewed
- Previously, it was in the lowest EE category
- The electricity system was working, but also had to be renewed
- The gas heating had to be replaced by EE/RES solution

The renewing was implemented in parallel time with the installation of the RURES energy yard EE solutions. The only difference was the source of the works; the renovation was done from local government's own capital while the purchase and the installation of the EE/RES equipment was financed by the RURES project from ERDF (with Hungarian state contribution 10%, and ZCG's own capital 5%).

With this improvement the following aims were achieved;

- The building had a general renovation from outside, (the inside will be renovated from future projects, but already can be used for exhibition purposes)
- The EE category was upgraded
- The electricity system was renewed, now it's able to handle the purchased technologies

The equipment that has been purchased and installed in the framework of the project for this pilot investment is listed in Table 3.

Table 3 List of RES systems in Hungarian pilot investment

RES system	***Photovoltaics***	***Solar collectors***	***Wind generator***	***Vegetable oil power plant***
Technical characteristics	power network feeding solar cell system, able to generate 4.000 kWh/year electric energy	solar collector of 10-16 m2	vertical wind generator of 1000W	small power plant operating with used vegetable oil
	16 pieces of the solar cells of 250W, perform generation of electric energy of 4.000 kWh/year	complete system suitable for producing hot water of use and helping the heating	Size: 1,8m wide x 2,7m high (settled 6 m above the surrounding landmarks)	capacity of 5 kW
	nominal capacity: 4 kWp	capacity: 7 kW (10 m2 collector surface) – 11,2 kW	Maximum rpm: 180/min,	

		(16 m2 collector surface)	production wind speed: 3m/s	
			capacity: 1 kW	
Cost	6.500 €	4.500 €	12.500 €	11.500 €

Image 13 PV system

Image 12 Solar system for hot water

Image 15 Vertical wind generator

Image 14 Vegetable oil power plant

2.4.2. Potential and general benefits of transfer of Pilot investment I4 to other European regions

With the installation of the solar cell system to replace the heating system (a new electrical heating system has to be out-built), the savings will be approximately 4 000 kWh/year. Since, the production of 1 kWh means 0,35 kg CO_2 emission, emission of 1,4 tCO_2/year can be reduced. From wind generator, if the average wind power is 5 m/s annually, 2 000 - 2 500 kWh/year can be produced. This production leads to decrease of the CO_2 emission up to 0,8 t/year at least. In the case of solar collector, if we calculate with 10 m2 surface, the production is 6 800 kWh/year which means average 2,38 tCO_2/year emission reduction. The vegetable oil fed mini power plant will be used for exhibition purposes only, so this tool is not relevant for CO_2 emission reducing. The tool itself will be useful for those farmers and farms which are not connected to the national electricity system and have to find a solution for the electricity demand.

The basic output is absolutely transferrable as a “hard” outcome. The main question from the transferability is not the investment, but rather the later planned “soft” outcomes like the educational

and touristic use. From the transfer view, this networking action would be more interesting, namely how could the partner manage it after the finished investment. All in all, now this is a useful exhibition park and investment, but the next task is to “fill it with content” (e.g. workshops, school days, conferences, exhibitions etc.) and if a strong EE network was formed, that (together with the concrete investment) will be the real value from transfer side.

The pilot program can also be used by other regions where the state financially supports investments that generate significant energy savings, the beneficiaries have their own resources, as well as incentives for energy savings. Particularly suitable for Eastern European countries where discretionary income is lower and the cultural state is quite the same (e.g. from educational side).

An important element of adaptability is that the applicant is motivated in the field of implementation, in contrast to exclusive non-refundable subsidies or even own contribution.

2.5. Pilot investment I5 - Energy efficient administrative building in Čakovec

2.5.1. Description of pilot investment I5

The building in which the pilot investment has been implemented is situated in the ex-military complex in Čakovec, Medjimurje County, Croatia. The building has around 600 m^2 of net floor space area with three floors and according to energy audit is classified as D energy class building. Four public institutions have their offices in the building (Medjimurje Energy Agency Ltd., Public institution for the development of the Medjimurje County REDEA, MIN Ltd. and Family Center of Social Work Center) which all have a large number of users searching for their services.

Image 16 Building where Croatian pilot installations are located

First step in preparing of pilot investment was to hire external experts that made feasibility studies for the planned EE and RES measures. The second stage of the investment preparation was to hire external experts to develop technical documentation needed for smooth implementation of the pilot investment. This developed technical documentation is used to conduct public procurement for the equipment and installation of the same. It is also used to present technical data within this report. With the implementation of all of the mentioned measures, the building will consume less energy and thus become more energy efficient. Since it is a public building accessible to wide range of users (employees, service users from private sector, political decision makers, natural persons…), the results of this pilot investment will have a wide impact on raising awareness and it will also be used as a best practice example of an energy efficient public building that is using renewable energy sources in the rural area of Medjimurje County.

Technical characteristics of the implemented pilot action are listed in Table 4.

Table 4 List of installed technical solutions in Croatian pilot site

Measures	***Solar collector system for hot water and heating support***	***Indoor lighting system***	***Smart metering system for all energy sources***	***A+++ energy class kitchen appliances***
Technical characteristics	Indirectly heated standing water tank with two heat exchangers (boiler + solar)	274x LED luminaire, 10W, 2-pin (G-24), 4500K, 850 lm	One gas consumption metering system	2x Refrigerator, freestanding with built-in freezer
	3 vacuum solar collectors	37x LED luminaire, 6W, 2-pin (G-24), 4500K, 485 lm	One electric energy consumption metering system	2x Dishwasher, built-in
	Solar pump group	14x LED luminaire, 6W, E27, 3000K, 485 lm	Two water consumption metering system	1x Electric hob
	Solar expansion vessel	18x LED tube, 18W, G13, 4500K, L=1200 mm, 1600 lm	Three calorimeters	2x Microwave
	Plate heat exchanger	5x motion sensors, 230V, 500W, range 10m, 360°	All meters linked to online Energy management information system	2x Electric kettle
	High-efficiency circulation pump	2x motion sensors, 230V, 500W, range 10m, 180°	On-the-spot visualisation of energy consumption	2x Refrigerator, freestanding with built-in freezer
Cost (excluding VAT)	12.709,58 €	5.334,05 €	2.602,93 €	3.108,97 €

In addition to the measures described in the Table, a professional supervision has also been procured for the total cost of 297,48 €. Taking everything into account, the final total value of this pilot action was 24.053,02 €.

After the implementation of all of the measures, annual energy savings will be up to 15,278.2 kWh and annual decrease of the CO_2 emission up to 5,74 t.

Image 18 New LED lights

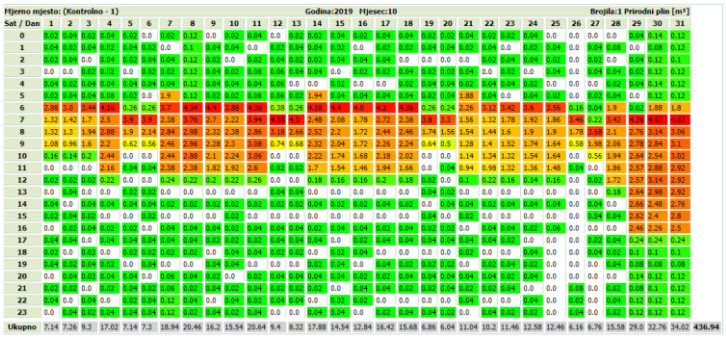
Image 17 Installed movement sensors

Image 20 Solar collectors for hot water and heating support

Image 19 Additional technical equipment for solar water heating

Image 22 New A+++ kitchen appliences

Image 21 One of monitoring devices (left) and an example of energy management system readings (below)



2.5.2. Potential and general benefits of transfer of Pilot investment I5 to other European regions

Refurbishing of public buildings in order for them to become more energy efficient is an activity that is current in most of the European countries. This is especially so in the countries of former Eastern European block (ex-communist countries) where many buildings were built in the 60's and 70's with not much thought on making those buildings energy efficient. A lot of inhabitants were moving from rural to semi-urban and urban area at that time and there was a necessity for building new, both residential and public buildings (kindergartens, schools, courts, etc.). Apart from that, the fuel for heating was also rather cheap and they gave little thought on the future repercussions on such form of buildings.

In Medjimurje region, where this pilot investment is implemented, the climate is classified as continental. This sort of climate is characterized by cold winters with significant precipitation and hot and dry summers. This kind of climate is also present in most parts of the Central Europe region so here defined pilot solution can in this context be transferred to any public building in this area. Furthermore, it is necessary in such climate conditions to construct well insulated buildings that can keep the indoor temperature between 19°C and 25°C so that the comfort of the residents stays the same with the energy consumption kept at minimum level.

Following all of the mentioned above, the investment implemented in this project on a public building in Čakovec, can easily be transferred to any other public building in Eastern European block. Apart from the measures implemented in this pilot, there are often other investments implemented to enhance energy efficiency of public buildings such as renovation of facades, installation of new highly efficient windows and doors, refurbishment of roofs and so on.

3. Step-by-step action plan for transfer of pilot actions

1. Identification of regional/local challenges and needs

As a first step, it is important to identify real challenges and needs of the local or regional community. The identification can be done by any relevant sector of the community – private companies, public bodies, NGOs, wide public. Once the need is identified as crucial for the functioning and further development of the community, next steps have to be taken.

2. Identification of potential solutions

As to identify potential solutions of the determined need, relevant local and regional stakeholders should be consulted and gathered in a work group. The group should be composed of experts in the field relevant for the energy sector, local or regional public authorities' representatives, owners of the properties the solution would be implemented at, representatives of citizens cooperatives, representatives of NGOs dealing with climate and energy. Also, local or regional private companies developing energy solutions should be consulted in this step (should there be any).

3. Market research on the availability of identified technical solution

Once a work group identifies several potential technical solutions, wider market research should be done. This is important as to receive feedback from other regions, how they have resolved similar needs and challenges. Also, it is important to conduct research on the state-of-art technical solutions since the technologies are changing rapidly on the yearly basis.

4. Definition of cost and financing possibilities of the potential solutions

This step can be implemented together with the previous one, but it is important to be a separate point. Costs of the technological solutions is very important issue for the investor. There are various financing possibilities in different regions and countries. The financing can come from local, regional, national or EU level. It is also possible to combine different levels of financing. Beside this, the financing can come from public or private sector which is also very important to elaborate. Public – private partnerships as well as Energy performance contracting is a financing method being used more often all over Europe. There is also a possibility to engage citizen communities as well as to perform crowdfunding or crowdinvesting procedure. The funding possibilities will be further elaborated in the next section.

5. Development of feasibility studies for potential solutions

Points 3 and 4, after being elaborated, will be joined in a common document for each potential technical solution. This document, the feasibility study should then be thoroughly studied by the investor.

6. Selection of the most feasible solution

The investor, with assistance of the experts gathered in the established work group, will, following the studying of the feasibility studies, decide which of the proposed technical solutions will be most acceptable for satisfying the identified regional or local challenges and needs. During this step, investor has to take into account infrastructural and technical current state and upgrade possibilities as well as the cost and current funding possibilities.

7. Development of the technical documentation

Once the selection of the most suitable technical solution has been made, the investor will hire an expert to develop detailed technical documentation for the investment. This documentation has to be in line with the identified needs and challenges, current infrastructural and technical state and the budget of the investor. The investor and the external expert have to be in constant communication and coordination, but the investor should also consult with the established work group to minimise possibilities of mistakes and misunderstandings.

8. Development of procurement documentation

Once the technical documentation is developed and delivered to the investor, the same can start to develop procurement documentation. In different EU countries, there are different public procurement rules and thresholds and the documentation has to be prepared obeying the same. This step depends on the amount of the investment and the chosen financing mechanism. Some of them require more complexed documentation, and other are rather simple to implement.

9. Implementation of public procurement

After the finalisation of both the technical and the procurement documentation, the investor can publish procurement using relevant means. The means of publication of the procurement vary depending on the estimated value of the investment, country and thresholds defined by the national procurement laws.

10. Contracting of service and work providers

This step follows successfully implemented procurement procedure. Once all of the legal deadlines are over, the contracting of the chosen service and/or work providers can begin. It is important to develop well elaborated contract that clearly defines rights and obligations of both contracting parties. Sometimes, if the investment is rather big, it is reasonable to hire a lawyer to develop the contract so that the mistakes and misunderstandings are set to minimum.

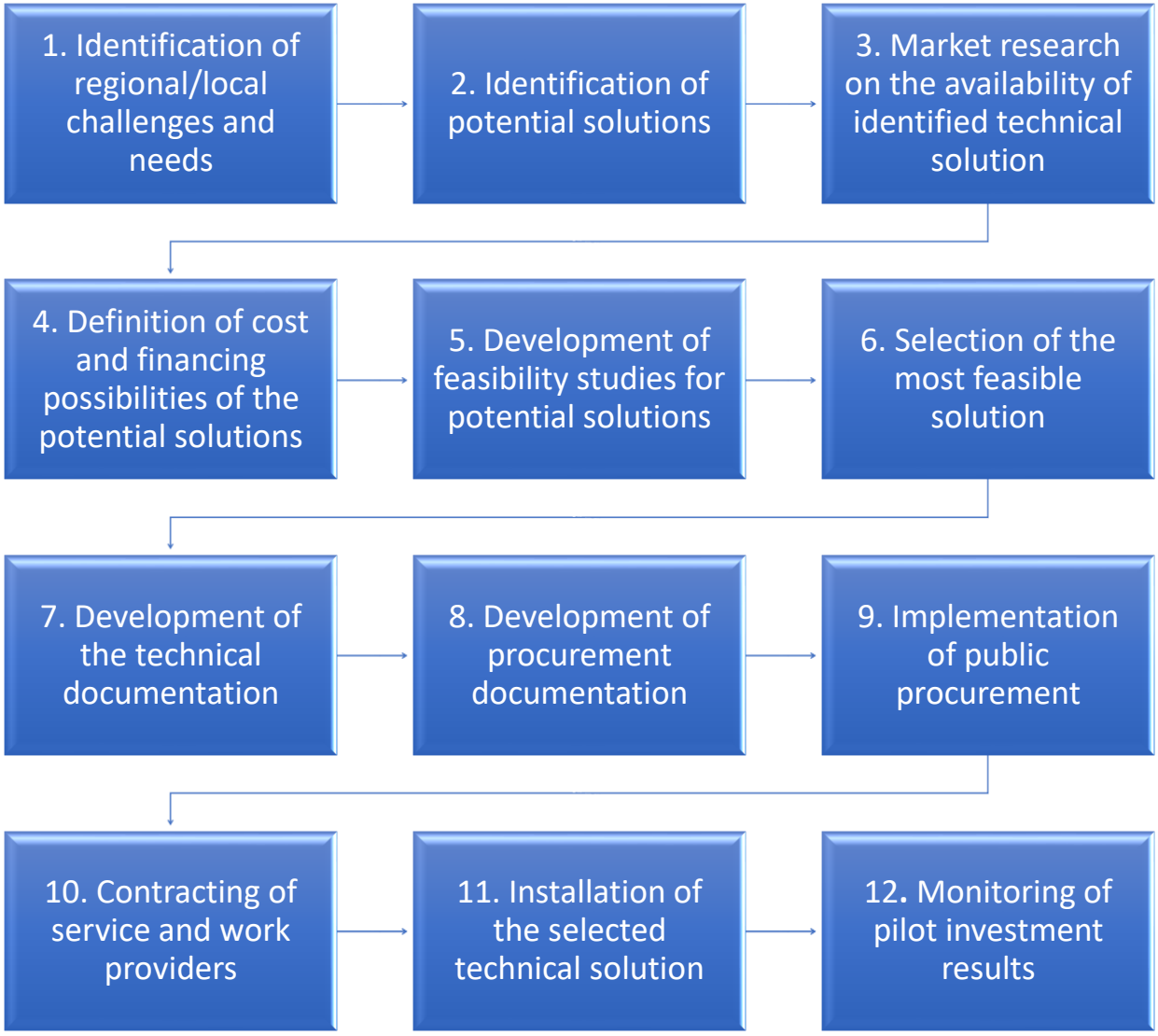
11. Installation of the selected technical solution

The final step in the pilot investment implementation is the installation of the selected technical solution. The implemented technical solution should reflect well organised pervious steps and good cooperation between all relevant regional and local stakeholder, whether they are private companies, public institution or general public. The implemented pilot, through its' functioning, should satisfy the identified needs and be a positive response to the previous challenges.

12. Monitoring of pilot investment results

Following the sole implementation of the innovative technical solution, it is important to monitor its functioning. Through monitoring investor can keep track of and calculate savings in both energy and greenhouse gasses emissions with regards to business as usual and prove the project's sustainability. Also, the financial savings and profit are important to be known, especially if the PPP, EPC, crowdinvesting or similar financing model has been used. The promotion and visibility of such an investment is crucial as to encourage other organisations to become more energy efficient and use renewable energy sources in their regions.

Table 5 Flow chart of action plan for transfer of pilot actions



4. Financing possibilities for implementation of pilot actions

There are several financing options available for investors who are planning to implement energy efficiency or renewable energy projects. They can be roughly divided to following: public budgets, regional funds, national funds, EU funds and private capital.

Funding option that has been most widely used in the last decade was using EU funds. This option provides different types of funding opportunities such as grants, loans, guarantees, subsidies and prizes. The **European regional development fund (ERDF)** is one part of the European Structural and Investment Funds (ESIF) and is available in all EU countries. It is transferred to the regional/national programmes (depending on the country regional statistical division) and the European Territorial Cooperation (ETC). The support intensity of the fund depends on the region category but in general, the ERDF provides up to 85% of the investment cost as a non-refundable grant.

The second part of the ESIF is **Cohesion Fund (CF)** which provides funding to Member States in with the gross national income (GNI) is lower than 90% of the EU average. Funding from CF can cover up to 85% of the eligible costs and possible means of funding are loans, guarantees and equities.

EU member states usually have their own **national funds** where investors may get grants and/or loans (such as The Environmental Protection and Energy Efficiency Fund in Croatia or Polish National Fund for Environmental Protection and Water Management). Those funds issue public calls several times a year or have continuously open calls where investors can apply and get certain percentage of the eligible cost for implementation of their investment.

Investments can also be funded through development and investment banks. **European Investment Bank (EIB) and European bank for Reconstruction and Development (EBRD)** are such institutions that can grant investors funds or part of funds to implement their investments. The EIB is the Bank of the European Union, which represents the interests of the Member States and implements EU policies. In order to achieve EU targets, the EIB borrows, lends multilaterally and provides guidance on questions regarding potential combinations of financing sources, and provides administrative and project management. ERBD is a multilateral International Financial Institution (IFI) that provides financing, policy reform dialogue and advisory services to its clients. Although the Bank focusses more on private sector funding, municipal infrastructure is an important pillar of its portfolio.

Apart from banks on European level, EU member states have their own **national banks for reconstruction and development** which provide investors with loans and guarantees for projects and investments on local and regional level.

Innovative pilot projects and investments of a smaller, local and regional scale, can be funded through various **Interreg programmes**. Interreg programmes can be cross-border, transnational and interregional. The percentage of funding varies depending on the programme and the country investor is located in, but it can come up to 85%.

In the future, and to achieve the set EU targets in decrease of CO_2 emission and increase of energy efficiency, cooperation between public and private sector will be more encouraged. Such cooperation possibilities lay in the public-private partnerships and in energy performance contracting. **Public-Private**

Partnerships (PPPs) are defined as long-term agreements between the government and a private partner whereby the private partner delivers and funds public services using a capital asset, sharing the associated risks. In a PPP agreement, the service delivery objectives of the government are intended to be aligned with the profit objectives of the private partner. **Energy performance contracting (EPC)** is a mechanism that involves an Energy Service Company (ESCO) which provides various services, such as finances and guaranteed energy savings. The remuneration of the ESCO depends on the achievement of the guaranteed savings. The ESCO stays involved in the measurement and verification process for the energy savings in the repayment period. ESCO and energy performance contracting are mostly found in the public sector and to a lesser extent in the industrial and commercial building sectors.

The European Energy Efficiency Fund (eeef) aims to support EU goals to promote a sustainable energy market and climate protection. Its objective is to contribute to the mitigation of climate change while also achieving economic sustainability and attracting additional private and public capital into financing climate initiatives. The eeef provides direct investments to project developers, energy services companies (ESCOs) and small-scale energy service providers for projects that promote energy efficiency and renewable energy. Direct investments can range from EUR 5 to 25 million.

Several alternative funding possibilities are also entering the growing market of energy efficiency and RES project development and implementation. One of those is **crowdfunding (crowdinvesting)**. It is financing provided by a group of individuals and organisations who commit their resources in order to support ideas initiated by others. Various crowdfunding platforms issue online calls to donate, lend or invest money in specific projects. Individual projects may attract a few hundred individuals or organisations leveraging hundreds of thousands of euros. When financing sustainable energy projects, municipalities often face various difficulties stemming from the fact that they are too small-scale or not attractive enough for local banks. Crowdfunding could be of interest as an alternative financing model, because it allows municipalities to maintain assets within local boundaries and raises public awareness of energy efficiency topics.

Energy communities is the other kind of alternative financing mechanisms for EE and RES projects. It can be understood as a way to 'organise' collective energy actions around open, democratic participation and governance and the provision of benefits for the members or the local community. Community energy refers to a wide range of collective energy actions that involve citizens' participation in the energy system. Community energy projects have increased rapidly partly driven by renewable energy support schemes providing incentives and increased awareness on collective actions. Their long-term sustainability will be contingent on the development of viable business models moving towards innovative financing and remuneration schemes, smart technologies, national regulatory support and their wider social acceptance and degree of citizen participation.

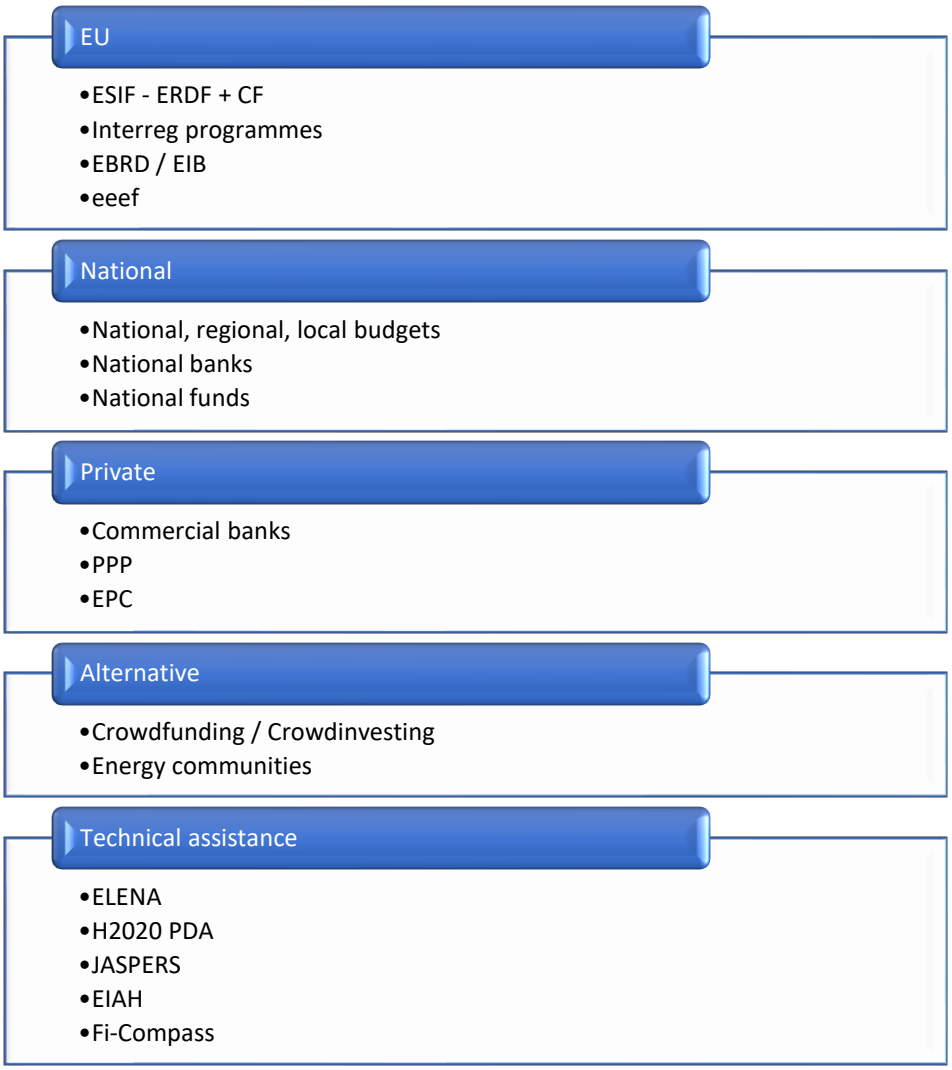
Apart from financial mechanisms that fund the investments itself, there are also several different possibilities that offer financing of preparation of investment documentation. One of these options is the **European Local Energy Assistance (ELENA)**. It was established in 2009 by the European Commission (EC) and the European Investment Bank (EIB) in order to mobilise investments for sustainable energy projects at local level. ELENA enhances the capacity of local authorities to develop investment programmes and implement economically feasible projects by providing the funding to prepare these projects and programmes for financing and implementation. ELENA usually supports projects of at least EUR 30 million for a two- to four-year period and covers up to 90% of technical assistance and/or project development costs. **Other technical assistance schemes** are Project Development Assistance call within Horizon 2020

programme, the Joint Assistance to Support Projects in European Regions (JASPERS), the European Investment Advisory Hub (EIAH) and Financial instruments advisory service (Fi-Compass).

Finally, the investments can also be financed through **national, regional or local budgets** or with combination of the same. This usually depends on the amount of funds available in the relevant budget as well as on the value of the planned investment. Sometimes, investors also seek the stimulation from **commercial banks** for part of the money needed to implement planned investment. Commercial banks offer different kinds of loans with various interest rates.

All of the mentioned financing options can also be combined in various ways, depending on the planned investment and the cost of the same. It is important to make realistic financial study while preparing investment plan, taking into account current state of financial market and possible changes of the same. If the investment is planned to be payed in one currency and the funds will be asked for in other one, it is important to take into account also possible periodical exchange rate fluctuations.

Table 6 List of potential financing models for implementation of pilot investments



5. Conclusion

Europe as well as the whole of the world are facing serious weather and environment problem events linked to climate change. The increase of greenhouse gas emissions has been substantial in the previous century, and it is up to governments and organisations to develop and kickstart actions to mitigate and adapt to inevitable climate changes.

Having this in mind, European Commission has, on 14 January 2020, presented the European Green Deal Investment Plan, which will mobilise at least €1 trillion of sustainable investments over the next decade. The document is considered to be a roadmap for making the EU's economy sustainable and it sets targets at cutting the greenhouse gasses emission in half by 2030. Moreover, it sets a target for Europe to become climate-neutral continent by 2050. To reach those targets, private and public sector have to work together in developing new technologies, implementing new energy efficient solutions and raise knowledge of broader masses.

The pilot investments that have been implemented within RURES project are just a small drop in the sea of possibilities to reduce impact to climate but offer an added value as best practice examples. All of them can be adjusted to local or regional needs and transferred and implemented in any other part of Europe and beyond. Pilots that are linked to enhancing energy efficiency of buildings, have within this project been implemented in public ones (pilots 1, 4 and 5). However, all of these systems can be planned and designed to be used in buildings used by private companies, industry, multi-apartment buildings or private houses.

One of the pilots is linked to the public water distribution system, i.e. to the monitoring and metering of water consumption. This pilot can be transferred to any local or regional water distribution system. It is not technically challenging to implement and the cost of the same can be adjusted to the needs of the local or regional community. The pilot can also be implemented in phases and thus additionally lower the financial burden to the investor.

The pilot that is demonstrating the installation and usage of renewable energy sources in public space (Solar E-Tree) is transferable to any public space in any local or regional community. It is a technology that is available throughout the world, but also the one that can be easily adjusted to needs of the observed public space. Use of the solar energy to get electric energy for charging various devices is increasing in demand since more and more towns and municipalities are obtaining electric vehicles, but also the usage of portable communication devices is increasing among residents.

When planning installation of systems that use renewable energy sources, the investor has to take into account possibilities of forces majeure occurring. This kind of events may have both positive or negative influence on RES technologies and usage of energy produced from RES systems. One of the most recent examples is the Covid-19 outbreak which led to decrease of production of energy from conventional sources (coal, oil) but did not have negative influence on the energy being produced from renewable sources. Some analyses have shown that due to this conventional sources usage decrease, the share of RES in production of electrical energy rose to 43% in EU and UK.

Buildings in Europe were being refurbished at significant pace in the past decade, and there are calculations that it will proceed also in the future. New buildings that are being built have to satisfy energy criteria set in national legislation and taken from EU directives. Both of these examples set a need to

involve renewable energy sources among the buildings' energy systems, but also a need to monitor the consumption of all of the energy sources. Energy monitoring systems (EMS) are already widely spread on the market and there are a lot of IT tools available for building owners to use. However, there is still a need to educate and raise awareness of the benefit of the same, so having EMSs within pilot installations is beneficial for building owners, but also for private sector, schools and higher education institutions and wider public.

Through the projects' activity related to peer review and evaluation of the pilot action (D.T2.3.1), partners gained relevant and useful comments on the pilot investments from external expert stakeholders. Peer reviews have been performed by various expert stakeholders from Germany, Poland, Slovenia, Hungary and Croatia. The comments and observations were very useful when investigating transferability possibilities, but also when developing this document. Also, this was one of the ways project partners disseminated pilot activities and other project deliverables to wider expert community in their countries.