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KNOWLEDGE BASE WITH – REPOSITORY OF BEST PRACTICES COMMUNITY ENERGY AND ANALYSIS OF CITIZENS INVESTMENT

DELIVERABLE 2.3.1.

Report: a common analytical report on best practices and institutional, legal, policy environment to establishment of community energy projects and investments participatory investment mechanisms in CE.

Version 1

01 2021

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1. INTRODUCTION

Involving citizens in renewable energy production projects can increase the social acceptance of these projects, and thus enable a rapid energy transition.

Citizen-owned energy projects in Europe generally refer to projects in which citizens own or participate in sustainable energy production. This is usually achieved in Europe when citizens (private households, communities, etc.) form a legal structure to co-finance and set up such projects. Renewable energy produced by such projects is then sold jointly, and profits are shared among the citizens participating in the project. Citizens who join a community to invest in such projects live usually in a close neighborhood or have the same interest. Consequently, public acceptance of renewable energy production is significantly increasing.

Intra-community energy projects have become common practice in the European Union in recent years. Such projects are an indispensable element in achieving a low-carbon energy transition.

Citizens' energy communities and renewable energy communities are specific as follows:

1. Geographical scope: The development of local energy communities according to the European Directive is encouraged 'in the vicinity' of renewable energy projects owned and developed by that community.
2. Activities: Energy communities cover a wide range of activities related to all forms of renewable energy sources in the electricity and heating sectors.
3. Participants: Any actor may participate in the civil energy community, if the members or shareholders engaged in a large commercial activity, and for whom the energy sector is the primary area of economic activity, do not carry out direct decision-making activity. Participants who can join include individuals, local authorities and micro, small, medium, and large enterprises.
4. Autonomy: The definition of citizens' energy communities does not include autonomy; but decision-making should be limited to members or shareholders who are not engaged in a large commercial activity and for whom the energy sector is not a primary area or economic activity.
5. Effective control: Renewable energy communities can be effectively controlled through micro, small and medium-sized enterprises that are 'located close' to a renewable energy project.

Throughout all the **European** countries there are many possibilities how to establish an energy cooperative. Depending on the legal conditions in the specific country there are different legal entities which can be used. When choosing one legal form it is most important to assure the right to vote for decisions for as many involved citizens as possible. This ensures, that everyone is feeling involved and is able to adjust projects.

For example, in **Germany**, there is an entity that is called “Genossenschaft”. This is often used for energy cooperatives. It is easy to set up and citizens are able invest straightforward. In addition, every member has one vote regardless of the size of his investment. This ensures a high commitment to the projects. In Germany there exist roughly 1,750 of such energy cooperatives (acc. to https://publications.jrc.ec.europa.eu/repository/bitstream/JRC119433/energy_communities_report_final.pdf, p. 8)

For the establishment of an energy cooperative (energy community) according to the applicable laws and regulations in **Croatia**, a minimum initial capital of 1,000 HRK per member of the cooperative and at least 7 cooperative members is required. All members of the cooperative

are expected to work actively in the cooperative with the fact that each member of the cooperative has one vote, regardless of how much initial capital he contributed to the cooperative, which shows the democracy of this type of association. The distribution of profits goes according to the participation of cooperative members in the creation of profits, where 30% of profits must be reinvested in the development of the cooperative. There are currently 8 such cooperatives registered in Croatia. Most active and know cooperative in Croatia is Green Energy Cooperative or „Zelena energetska zajednica“ (ZEZ).

There is a legal framework **in Poland** that allows for the functioning of both energy cooperatives and energy clusters.

The scope of activity of the energy cooperative is related to the production of electricity, biogas or heat in RES installations and balancing the demand for the above-mentioned energy carriers solely for the own needs of the energy cooperative and its members. One of the advantages of an energy cooperative is that given the amount of electricity generated in all installations of renewable energy sources and then consumed by all electricity consumers in an energy cooperative:

- The distribution network is treated as a "virtual energy storage" that allows for the settlement of energy bills based on the discounts – the surplus of energy produced in the cooperative can be taken from the grid with a discount of 60%.
- Self-consumption of energy in an energy cooperative is exempt from charges related to energy distribution.
- The energy cooperative is exempt from fees constituting the total cost of electricity, such as excise duty, RES fee, capacity fee, cogeneration fee, etc.

An energy cooperative in Poland must operate under the conditions specified in the law:

- It can function only in rural or urban-rural communes.
- The number of members is below 1000.
- It is a legal entity.
- It has the capacity to cover at least 70% of its own energy consumption per year.
- The maximum capacity of RES installations is 10 MWe/30 MWt/40 million m^3 of biogas.
- The activity may not be related to electricity trading with external entities.
- Activities may not be carried out in more than three municipalities directly adjacent to each other.

Due to the limitations related to the operation of an energy cooperative, there is currently no formally approved energy cooperative in Poland that meets the criteria specified in the Act on RES. Therefore, these are energy clusters that are currently being established. In 2018, 66 energy clusters received Pilot Energy Cluster Certificates from the Ministry of Energy, including 4 from the Lubelskie Voivodeship.

Energy clusters, are not legal entities, operate based on civil law contracts concluded between various entities in the field of generation, balancing, distribution or trade. The main goal of creating energy clusters is to develop diffuse conventional or renewable energy sources. A cluster may be established and operate in an area of no more than five communes or one poviat, and its members may be natural persons, enterprises, local government units, as well as other entities operating in the area covered by the cluster.

In **Hungary** a national “Pilot project promoting the establishment and operation of energy communities” (2020-3.1.4-ZFR-EKM) was announced in 2020. Seven applicants won the fund to form an energy community. 7 applicants won the support for a pilot project supporting the

establishment and operation of Energy Communities in Hungary. The pilot projects started in November 2020 and the duration is 24 months, so it currently has no demonstrable outputs.

2. BEST PRACTICE PROJECTS

2.1. GERMANY

One very successful cooperative in Germany is the citizen energy cooperative in Pfaffenhofen (BEG, Bürgerenergie im Landkreis Pfaffenhofen a. d. Ilm). It already developed several projects, mainly in photovoltaic and wind power. A brief look on those projects will be made in the following pages.

https://buergerenergie-pfaffenhofen.de/

Image 1: Logo of the BEG (Link to introduction video), Source: Bürgerenergie im Landkreis Pfaffenhofen a. d. Ilm eG

2.1.1. Solar carport

Table 1: Details on the solar carport at the train station Pfaffenhofen

Name of the project:	Solar carport at the train station Pfaffenhofen
Year of commissioning:	30.06.2012
Country:	Germany
Description of the project:	A photovoltaic plant was installed on the already existing park and ride parking space at the train station in Pfaffenhofen. It was planned and installed by the BEG.
Rated power:	283.50 kWp
Estimated yearly yield:	~ 265,000kWh (power for 75 households)
Total investment:	710,000 €
Minimum investment:	1,000 €
Return:	3.00% - 3.25% (depending on the yearly yield)
Type of participation:	Partial loans with qualified subordination
Number of involved citizens:	
Type of citizen involvement:	Investors and decision makers
Financial framework:	Private investments
Institutional / legal structure:	Cooperative (“Genossenschaft”)
Political framework (national):	Refund through the EEG (Erneuerbare Energien Gesetz / Renewable Energy Law)
Resource involved / technology:	Sun / Photovoltaic

Image 2: Solar car port in Pfaffenhofen, Source: Bürgerenergie im Landkreis Pfaffenhofen a. d. Ilm eG

2.1.2. Photovoltaic plant on the roof of the fire brigade Pfaffenhofen

Table 2: Details on the photovoltaic plant on the roof of the firefighters in Pfaffenhofen

Name of the project:	Photovoltaic plant on the roof of the firefighter building
Year of commissioning:	December 2011
Country:	Germany
Description of the project:	A photovoltaic system with a total output of 36.96 kWp is installed on the existing fire station. The plant was commissioned by the town of Pfaffenhofen in 2011 and put into operation in December with the aim of selling it to the newly founded citizens' energy cooperative.
Rated power:	36.96 kWp
Estimated yearly yield:	~ 34,000 kWh (power for 10 households)
Total investment:	78,000 €
Minimum investment:	1,000 €
Return:	4.00% - 4.50% (depending on the yearly yield)
Type of participation:	Partial loans with qualified subordination
Number of involved citizens:	
Type of citizen involvement:	Investors and decision makers
Financial framework:	Private investments
Institutional / legal structure:	Cooperative (“Genossenschaft”)
Political framework (national):	Refund through the EEG (Erneuerbare Energien Gesetz / Renewable Energy Law)
Resource involved / technology:	Sun / Photovoltaic

Image 3: Photovoltaic plant on the firebrigade roof, Source: Bürgerenergie im Landkreis Pfaffenhofen a. d. Ilm eG

2.1.3. Wind farm Gerolsbach

Table 3: Details on wind farm project "Windpark Gerolsbach"

Name of the project:	Wind farm Gerolsbach
Year of commissioning:	Autumn 2015
Country:	Germany
Description of the project:	For this project, an extra company was founded (Windkraft Gerolsbach GmbH & Co. KG), which took care of all operational business. Equity holders of this are the community of Gerolsbach, the BEG and the Bayern Natur GmbH. The new founded GmbH then was able to build a windpark with 3 Nordex N117 turbines in 2015.
Rated power:	7.2 MW (3x Nordex N117)
Estimated yearly yield:	16,095,000 kWh (power for 4.600 households)
Total investment:	~ 14,000,000 €
Minimum investment:	1,000 €
Return:	3.00%
Type of participation:	Loans
Number of involved citizens:	
Type of citizen involvement:	Investment and decision makers
Financial framework:	Equity and invest 61.1%: Community of Gerolsbach 35.7%: BEG 3.2%: Bayernwerk Natur GmbH
Institutional / legal structure:	Cooperation between a community, a cooperative and the Bayernwerk (grid operator)
Political framework (national):	Refund through the EEG (Erneuerbare-Energien-Gesetz / Renewable Energy Law)
Resource involved / technology:	Wind / Wind turbines

Image 4: Example picture of a wind turbine in the forest, Source: https://unsplash.com/photos/eBOqEYcqWzQ

2.1.4. Citizen wind turbine in the “Lustholz”

Table 4: Details on wind turbine project "Lustholz"

Name of the project:	Citizen wind turbine in the “Lustholz”
Year of commissioning:	Spring 2016
Country:	Germany
Description of the project:	With this wind turbine, the first real citizen wind turbine was developed and financed mostly by the BEG. It was built in a forest near Pfaffenhofen in 2016 and since then performs better than calculated.
Rated power:	3.0 MW (1x Enercon E115)
Estimated yearly yield:	6,177,000 kWh (power for 1.500 household)
Total investment:	5,350,000 €
Minimum investment:	1,000 €
Return:	3.00 %
Type of participation:	Loans
Number of involved citizens:	> 230 citizens
Type of citizen involvement:	Investors and decision makers
Financial framework:	
Institutional / legal structure:	Cooperation between the cooperative and the wind turbine manufacturer who took a share of the project.
Political framework (national):	Refund through the EEG (Erneuerbare-Energien-Gesetz / Renewable Energy Law)
Resource involved / technology:	Wind / Wind turbines

Image 5: Promotional video for the citizen wind turbine (Link), Source: Bürgerenergie im Landkreis Pfaffenhofen a. d. Ilm eG

Image 6: Short reminder video for the citizen wind turbine (Link), Source: Bürgerenergie im Landkreis Pfaffenhofen a. d. Ilm eG

Image 7: Another promotional video by the BEG as an example (Link). The wind farm is not built yet., Source: Bürgerenergie im Landkreis Pfaffenhofen a. d. Ilm eG

2.2. CROATIA

2.2.1. Križevci solar roofs

Green Energy Cooperative or originally in Croatian „*Zelena energetska zajednica*“ (ZEZ) is a cooperative that deals with planning and managing projects for the application of renewable energy sources and energy efficiency. The cooperative was established with the aim of operating in the local community with special emphasis on the sustainable development of tourism, agriculture, and commercial and public institutions. In the future, the cooperative plans to start the activity of supplying electricity produced from renewable energy sources. ZEZ especially nurtures the principle of cooperation with individuals, companies, institutions, and all other stakeholders whose primary interest is socially responsible business and sustainable development of local communities.

Most famous best practice project example in Croatia is „*Križevački sunčani krovovi*“ or „*Križevci solar roofs*“. The details are in the table below.

Table 5: Details on Križevci solar roofs

Name of the project:	Križevci solar roofs - Križevački sunčani krovovi[1,2]
Year of commissioning:	2019
Country:	Croatia
Description of the project:	Zelena Energetska Zadruga (ZEZ) conducted a crowdfunding campaign for the installation of a 30-kW solar PV plant on the roof of the business center in the town of Križevci (21,000 inhabitants, continental Croatia) in 2019. Individuals in this case lend money to ZEZ based on long-term loan agreements, according to which an individual can lend money to a legal entity for an interest rate equal to or higher than 3%. ZEZ then invests in a solar PV plant on the roof of the center owned by the city of Križevci. The center is a limited liability entity in one hundred percent ownership of the city. ZEZ will own the plant for 10 years, after which the plant is handed over to the city. The city, meanwhile, pays ZEZ a lease for the PV plant during this 10-year period, which it pays for the savings it achieves by consuming the electricity produced. Based on a long-term loan agreement, ZEZ pays individuals the prescribed interest rate. In the case of this solar PV plant, it is 4.5% and is more than the required minimum. The difference in the minimum and actual rate comes from the administrative costs of project management. So, in this case, the cooperative collects money from investors, invests in the power plant, leases the power plant to the city, the city pays the cooperative rent, and finally the cooperative pays 4.5% to investors annually.

[1] Križevački sunčani krovovi

[2] Križevački sunčani krovovi – ZEZ Invest

	The solar PV plant produces electricity that is intended mainly for its own consumption. This is allowed under Croatian law. However, the project does not receive any additional support for the electricity sent to the grid. The center will receive HRK 0.45 / kWh for the energy produced, and this purchase price depends on individual negotiations with the supplier. ZEZ received a lump sum in advance from the City of Križevci, amounting to 25 to 30% of the project costs. ZEZ also received 1% of the value of the investment for the purpose of project administration (interaction with investors, etc.). This is financed by the users of the photovoltaic power plant, which have nothing to do with the 4.5% offered to investors. The motivation of the city of Križevci for the implementation of the project is the implementation of measures determined by SEAP, exposure to the media, the plant is retained after a period of 10 years (when this period ends, they no longer must pay rent and make direct profit from savings).
Rated power:	30 kW
Estimated yearly yield:	40,000 kWh
Total investment:	30,400 €
Minimum investment:	130 €
Return:	Up to 4.5%
Type of participation:	Long term loan investments
Number of involved citizens:	53 citizens
Type of citizen involvement:	Investors, not decision makers
Financial framework:	Private investments (citizens) EU grants
Institutional / legal structure:	Cooperative
Political framework (national):	Zakon o energiji (NN 68/01, 177/04, 76/07 i 152/08) Zakon o tržištu električne energije (NN 177/04, 76/07 i 152/08)
Resource involved / technology:	Sun / Solar

The following sketch represents the network structure of this partnership:

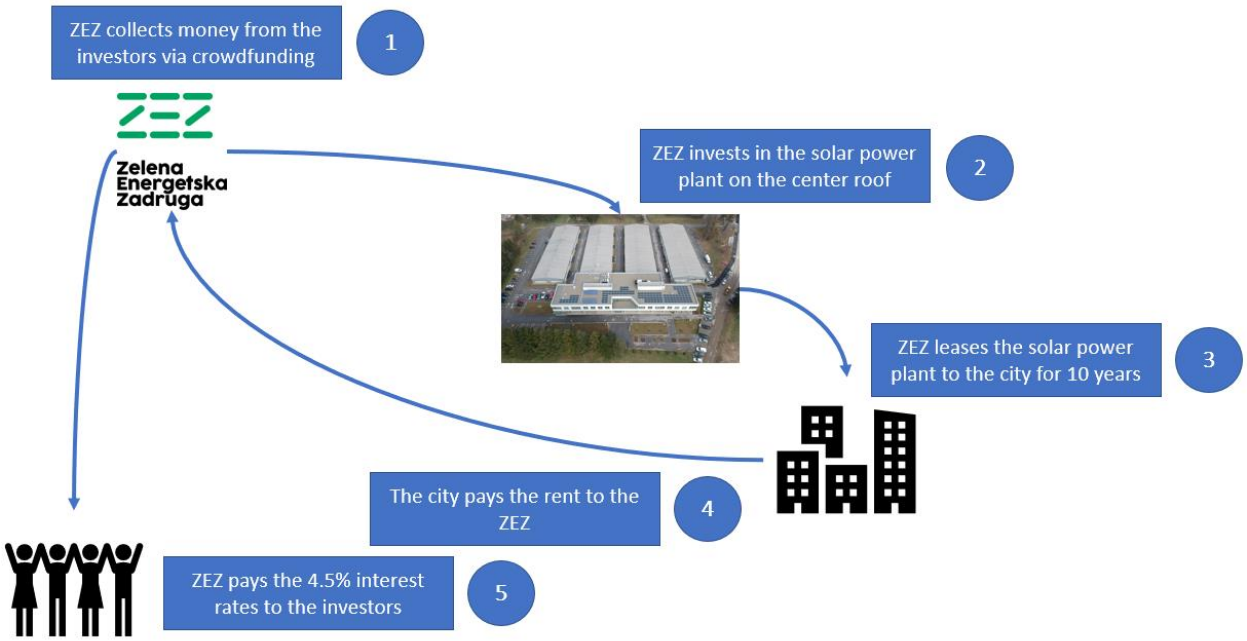

Image 8: Scheme of business flow set for "Križevci solar roofs" project, Source: Authors – The scheme was synthesized based on the business flow set by the "Križevci solar roofs" project

Below are attached 2 images of the project as well as the link to You Tube video where more info on project is available (in English subtitles).

Image 9: Križevci solar roofs - Križevački sunčani krovovi, Source: https://www.poslovni.hr/sci-tech/krizevacki-suncani-krovovi-ponovno-sjaje-351087

Image 10: Križevci solar roofs - Križevački sunčani krovovi, Source: https://zezinvest.community/krizevacki-suncani-krovovi/

Image 11: Križevci solar roofs - Križevački sunčani krovovi (Link to YouTube)

2.2.2. Energy independent school Ostrog

Another example is an elementary school that hoped to become one of the world's first energy independent schools and has used crowdfunding platform Indiegogo to get there.

The school, located in the Dalmatian town of Kaštel Lukšić, hoped to collect enough funds for a PV system on its roof through a crowdfunding campaign on Indiegogo. The school hoped both local communities and individuals from Croatia and abroad will donate to the project.

More information on the project is available in the table below.

Table 6: Details on the Energy independent school Ostrog

Name of the project:	Energy independent school Ostrog [3]
Year of commissioning:	2014
Country:	Croatia
Description of the project:	Elementary school "Ostrog" in Kastel Luksic near Split is the first energy independent school in Croatia and the world. Not only do they produce electricity, but also earn on it, and devise new environmental projects. Photovoltaic power plant of 25 kilowatts is located on the roof of educational institution. Several years ago, in Kastel Luksic they started putting solar panels, now they produce energy from the sun and save money. They are the first energy-independent school in Croatia and in the world. The school wanted to install a solar power plant on its roof to help generate its own electricity and become of the few energy independent schools in the world. The school said that with savings made by lowering their power bill, they will be able to invest in equipment and learning aids to help children's education at the school. Ostrog Primary school have set the bar on Indiegogo at 10,000 USD in 2014. The school's crowdfunding campaign however was matched by the United Nations Development Programme (UNDP), for every 1 dollar donated, the UNDP donated $1.50 to the project. For the first time in Croatia, ZEZ implemented innovative financing models such as crowdfunding for a solar power plant, which provided initial funding for an energy independent primary school, net metering and a cooperation agreement between the ESCO and local government representatives. Through a crowdfunding campaign, through the Indiegogo platform and local action, they raised about 130,000 HRK for the school.

[3] Croatian School Wants to be 'World's First Energy Independent School'

Rated power:	25 kW
Estimated yearly yield:	36,000 kWh
Total investment:	17,200 €
Minimum investment:	1 €
Return:	4 – 6% (estimated)
Type of participation:	Crowdfunding
Number of involved citizens:	189 supporters on Indiegogo
Type of citizen involvement:	Investors, not decision makers
Financial framework:	Crowdfunding UNDP funds
Institutional / legal structure:	Cooperative
Political framework (national):	Zakon o energiji (NN 68/01, 177/04, 76/07 i 152/08) Zakon o tržištu električne energije (NN 177/04, 76/07 i 152/08)
Resource involved / technology:	Sun / solar

Below are 2 images attached of the project as well as the link to the Vimeo video where more info on project is available (in English subtitles).

Image 12: Energy independent school Ostrog, Source: https://www.indiegogo.com/projects/energy-independent-school#/

Image 13: Info pack about Ostrog school on Indiegogo, Source: https://www.indiegogo.com/projects/energy-independent-school#/

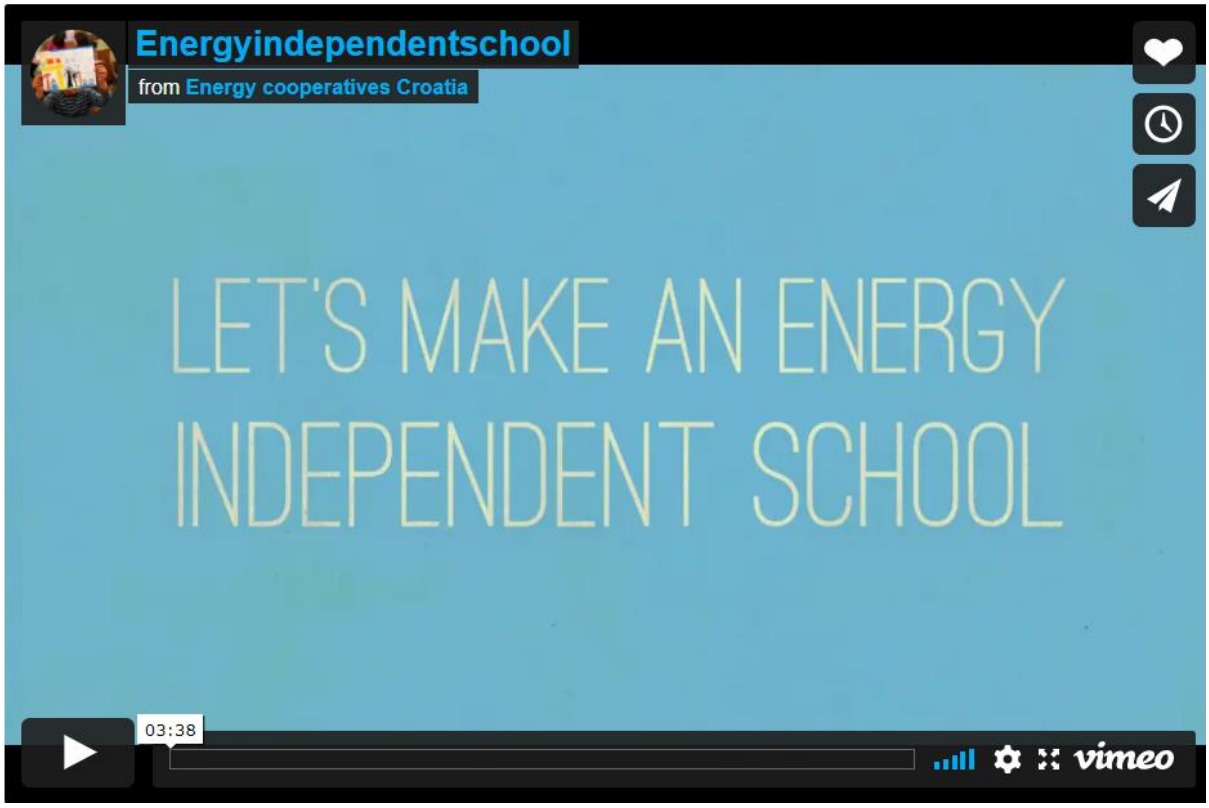

Image 14: Energy independent school Ostrog (Link to Vimeo)

2.3. ITALY

2.3.1. Ecologically Equipped Production Area

Table 7: Details on Ecologically Equipped Production Area in Villaselva

Name of the project:	APEA: Area Produttiva Ecologicamente / Ecologically Equipped Production Area in Villaselva, Forli (FC)
Year of commissioning:	2015
Country:	Italy
Description of the project:	In the productive area of Villaselva, next to the city of Forlì, a plant which uses the solar energy is at disposal for the needs of heat, cold and electricity of the factories nearby. It is one of the first examples of renewable energy system devoted to the substitution of fossil fuels in the production of heat for the industry sector. The 1.4 MWt solar thermal system uses 2,800 m^2 of solar tracking parabolic mirrors on a 20,000 m^2 field to concentrate the solar radiation and heat up the oil used as an energy vector up to 175 °C. The plant is connected as a heat generator to the local district heating net, which distributes hot water to the area. A 16.3 kWp photovoltaic system covers with renewable energy the electric consumptions of the entire plant and as it is connected to the national grid, it makes the extra amount of energy available for other connected consumers. The existing enterprises of the Ecologically Equipped Production Area and the new ones which will be established in future, can choose to cover their thermal needs with renewable energy connecting through a heat exchanger to the district heating net and use the hot water produced by the solar thermal system for the needs of heat in their production cycles or even to produce the cold they may need using absorbers. The project won the Klimaenergy Award 2015 for the category “Municipality of 20,000 to 150,000 inhabitants”
Rated power:	1.4 MWt solar thermal, 16.3 kWp photovoltaic
Estimated yearly yield:	1,300 MWht/y, 19MWhe/y
Total investment:	
Minimum investment:	
Return:	
Type of participation:	The enterprises of the APEA can connect to the district heating net and buy renewable energy for their thermal uses

Number of involved citizens:	Several factories are already connected, new settlements are foreseen soon
Type of citizen involvement:	Industry sector
Financial framework:	The project was financed by the European Regional Development Fund (ERDF) through the Emilia-Romagna Region (POR-FESR)
Institutional / legal structure:	Municipality of Forlì, in-house energy society
Political framework (national):	
Resource involved / technology:	Solar thermal, concentration, sun-tracking; photovoltaic.

Image 15: Solar thermal power station near Forli, Source: FMI

Image 16: Solar thermal power station near Forli, Source: FMI

Image 17: Location of the solar thermal power station near Forli, Source: FMI

2.3.2. GECO: Green Energy Community

Table 8: Details on GECO

Name of the project:	GECO – Green Energy Community – District energy community in Bologna
Year of commissioning:	Ongoing, started in 2019
Country:	Italy
Description of the project:	GECO – Green Energy Community is a project designed to support the establishment of new local energy communities in a replicable way. Its first commitment took place in Bologna in the Pilastro/Roveroni district, where a plan of urban regeneration was already planned by the Municipality of Bologna. In this frame, the Energy and Sustainable Development Agency (AESS), in collaboration with the national research institute ENEA and the University of Bologna, with the support of a Climate-Kic project started a path addressed to the citizens and the productive area towards the implementation of a district energy community among both inhabitant and factories. The benefits of such an Energy Community have repercussion both on private and public sides. The foreseen activities involve many different fields and issues: • legal aspects of the implementation of the brand-new laws on Energy communities. • definition and test of new business models. • increase the generation, storage and self-consumption of electric energy together with the use of smart devices to manage the exchange of energy in the whole district. • development of a blockchain platform to handle the energy flows. • creation of an energy community through the engagement of citizens and local stakeholders promoting actions to foster commitment, formation, dissemination, and promotion of behavioural changes in the community. Website: https://www.aess-modena.it/it/projects/geco-green-energy-community/
Rated power:	
Estimated yearly yield:	
Total investment:	
Minimum investment:	
Return:	

Type of participation:	District citizens: residential, industries
Number of involved citizens:	Addressed to the whole neighborhood of Pilastro and the more than 900 factories of the district
Type of citizen involvement:	Creation of a district energy community
Financial framework:	Climate-Kic, Municipality's regeneration planning
Institutional / legal structure:	Energy and Sustainable Development Agency, District development Agency, Municipality of Bologna, ENEA, University of Bologna
Political framework (national):	
Resource involved / technology:	

Image 18: Logo of the GECO-project, Source: https://www.aess-modena.it/it/projects/geco-green-energy-community/

2.3.3. Collective self-consumption in social housing buildings

Table 9: Details on Social-housing collective

Name of the project:	Social-housing collective self-consumption pilot project in Padova (PD)
Year of commissioning:	2020 (under construction)
Country:	Italy
Description of the project:	The project is developed by a social housing institute (Qui Abito), an energy cooperative (E' Nostra), some technical partners and a national research institute on energy (RSE). In a complex of 4 buildings made of 92 apartments (some of them assigned by the municipal social services) and some common parts, on each rooftop is installed a 10-12 kWp photovoltaic system dedicated to the energy needs of the flats and of the common heat-pump and hot water electric systems. The research aspects of the project are about to analyse the energy consumption data of the users in order to study and improve the model of the grid and the cost allocation. Besides the domestic loads, batteries and mobility charge columns.
Rated power:	45 kWp
Estimated yearly yield:	47,250 kWh
Total investment:	
Minimum investment:	
Return:	
Type of participation:	Collective self-consumption
Number of involved citizens:	92 Families
Type of citizen involvement:	Residential, social housing
Financial framework:	Pilot project, before the approval of the new national law about energy communities and collective self-consumption
Institutional / legal structure:	Municipal, Energy Cooperative, Social housing Institute
Political framework (national):	
Resource involved / technology:	Photovoltaic, batteries, local smart grid, mobility charge systems

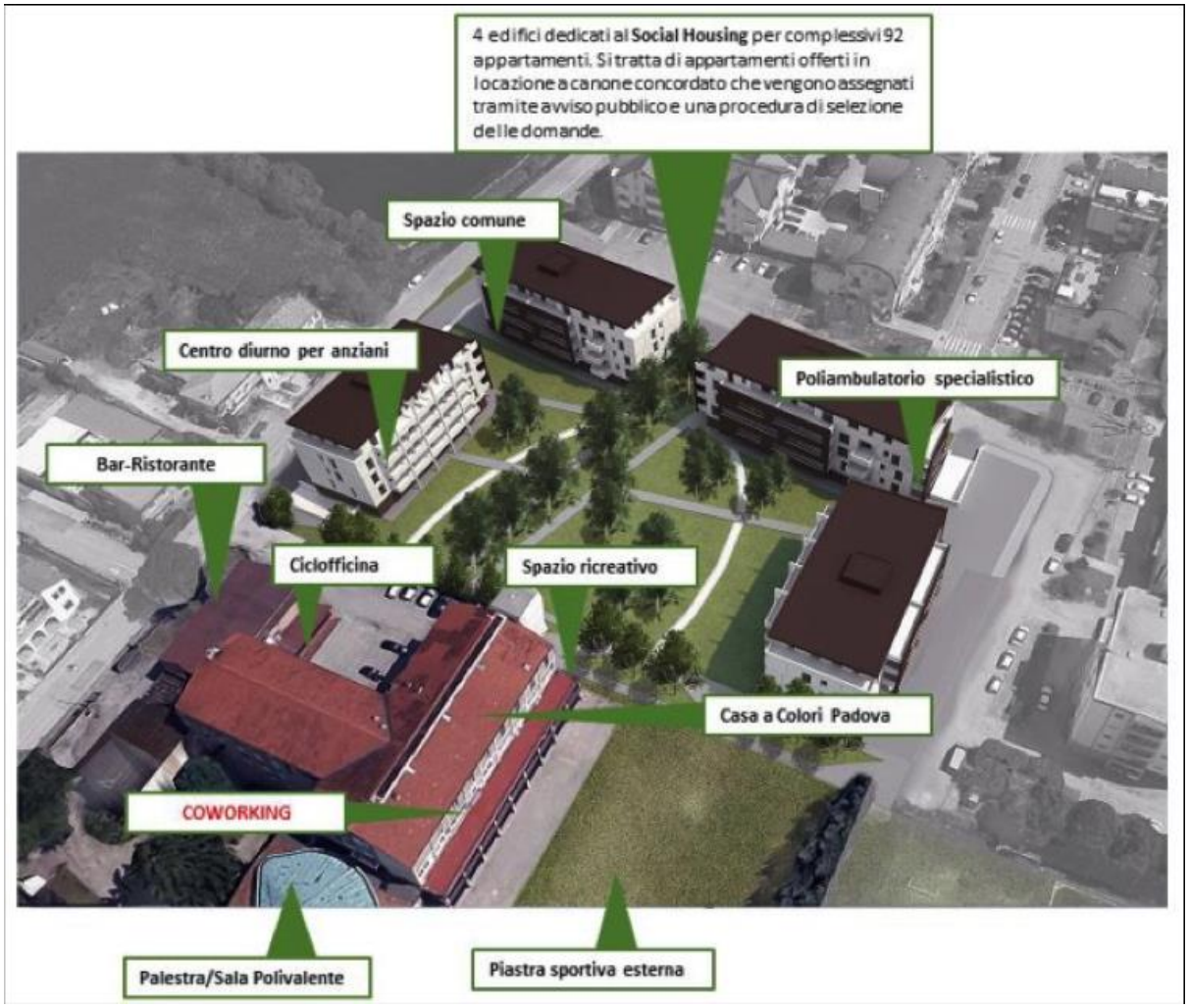

Image 19: Planning of the housing complex, Source: https://www.enostra.it/news-eventi/selezionato-da-rse-il-pilota-sullautoconsumo-collettivo-di-enostra/

2.4. POLAND

2.4.1. Photovoltaic farm in Marianka

Włodawa Cluster of Sustainable Energy and Renewable Energy Sources (Włodawski Klaster Zrównoważonej Energetyki i Odnawialnych Źródeł Energii) was established in order to ensure local energy security, develop prosumer energy and increase competitiveness and economic efficiency of the local economy. The concluded agreement is aimed at producing, trading and distributing energy that is generated from renewable sources.

The establishment of the cluster also resulted from the desire to decentralize and develop self-sufficient local energy based on renewable energy sources. The cluster was established on 12 April 2017, and its members include local governments, enterprises and other entities interested in achieving its goals. In 2018, due to operation of the described cluster, its member in the form of Laze Lublin Sustainable Energy Agency LLC (Laze Lubelska Agencja Zrównoważonej Energetyki Sp. z o.o.) received a subsidy for the implementation of the investment described below.

Table 10: Details on photovoltaic farm in Marianka, Włodawa poviat, Lubelskie Voivodeship

Name of the project:	Construction of a photovoltaic farm in Marianka, Włodawa poviat, Lubelskie Voivodeship.
Year of commissioning:	2019
Country:	Poland
Description of the project:	Thanks to the functioning of Włodawa Cluster of Sustainable Energy and Renewable Energy Sources (Włodawski Klaster Zrównoważonej Energetyki i Odnawialnych Źródeł Energii), Laze Lublin Sustainable Energy Agency LLC (Laze Lubelska Agencja Zrównoważonej Energetyki Sp. z o.o. constructed a photovoltaic installation that uses panels with a graphene coating, which was the first in Poland and one of the first to be completed in Europe. The installation includes 3225 pieces of highly efficient 310 W photovoltaic panels. The module's efficiency factor was determined at 18.85 %. The described farm is equipped with devices and systems for continuous monitoring of its operation, making maximum use of the possibilities of the installation for energy production and monitoring possible failures. Caused by the very good insolation conditions and advanced technology, the power plant is able to produce about 1100 MWh of electricity annually. The expected lifetime of the solar farm is 25 years. Thanks to the investment, it was possible to reduce carbon dioxide emissions to the atmosphere by 697.4 Mg CO_2.
Rated power:	0.99 MW
Estimated yearly yield:	1,100 MWh

Total investment:	1,058,081.45 €
Minimum investment:	243,344.48 €
Return:	4.00 – 4.50 %
Type of participation:	Own contribution and subsidy (partial payment claims)
Number of involved citizens:	-
Type of citizen involvement:	Investor
Financial framework:	77.03 % EU funds 22.97 % own contribution
Institutional / legal structure:	Cooperation between the energy producer (investor) and energy recipient (distribution system operator)
Political framework (national):	The Act of 10 April 1998 Energy Law The Act of 20 February 2015 on renewable energy sources
Resource involved / technology:	Sun / Photovoltaic

Image 20: Photovoltaic power plant in Marianka, Source: oze-invest.pl

Image 21: Photovoltaic power plant in Marianka, Source: oze-invest.pl

Image 22: Photovoltaic power plant in Marianka, Source: oze-invest.pl

2.4.2. Green Energy for Starachowice

Thanks to the cooperation of producers and recipients of thermal energy, an innovative solution was introduced in the city of Starachowice, consisting in the recovery of waste heat from printing processes and its transfer to ensure thermal comfort in public buildings and individual recipients. The implementation of the investment allowed for a significant reduction in coal consumption and a reduction in the emission of pollutants into the air.

Table 11: Details on Green Energy for Starachowice Starachowicki poviat, Świętokrzyskie Voivodeship.

Name of the project:	"Green Energy for Starachowice", Starachowicki poviat, Świętokrzyskie Voivodeship
Year of commissioning:	2018
Country:	Poland
Description of the project:	In September 2018, a heat recovery installation from the production processes of the Walstead Central Europe printing house was launched in Starachowice. The entire installation, along with a technically advanced automation, operation and control system, has been planned for the specific requirements of the printing house and the heating network. Surplus heat energy produced during printing processes is returned to the district heating network. In the event that the printing presses are not working, the heating plant uses the same installation to supply network heat to the Walstead facilities. A joint project based on the supplier and recipient of energy is a new level of cooperation in the interests of the quality of the natural environment. The implementation of the action allowed for real savings in energy consumption and reduction of pollutant emissions into the air. The power of the installation is 2.1 MW, and thanks to its operation it is possible to reduce coal consumption by 1,500 tons per year. The energy mix used enables heat recipients to obtain NO SMOG boards, which inform that the building does not emit any poisonous substances and does not pollute the air, creating smog.
Rated power:	2.1 MW
Estimated yearly yield:	22 TJ
Total investment:	89,887.64 €
Minimum investment:	-
Return:	-
Type of participation:	Own contribution
Number of involved citizens:	-
Type of citizen involvement:	Investor

Financial framework:	Private investments
Institutional / legal structure:	Cooperation between the supplier and recipient of thermal energy
Political framework (national):	The Act of 10 April 1998 Energy Law, The Act of 20 February 2015 on renewable energy sources.
Resource involved / technology:	Heat/Recovery of waste heat from industrial processes

Image 23: Waste heat recovery installation, Source: Celsium Sp. z o.o., Kazimierz Cuch

Image 24: Waste heat recovery installation, Source: Celsium Sp. z o.o.

2.4.3. ECO-effective Niemce Commune, stage IV

"ECO-effective Gmina Niemce stage IV" is a project aimed at installing photovoltaic cells and biomass central heating furnaces in residential buildings in the Niemce Commune. The task is a continuation of projects from previous years, in 2021 the commune plans to start the fifth stage of the project.

Table 12: Details on ECO-effective Niemce Commune, stage IV, Lublin poviat, Lubelskie Voivodeship.

Name of the project:	ECO-effective Niemce Commune, stage IV, Lublin poviat, Lubelskie Voivodeship
Year of commissioning:	2020
Country:	Poland
Description of the project:	The project implementation consisted in the assembly of 611 sets of photovoltaic installations and 72 ecological central heating boilers powered by biomass. An informational and educational campaign was conducted simultaneously with the construction works, to popularize the technology of producing clean energy. The main goal of the project was to increase the use of renewable energy sources among the inhabitants of the Niemce Commune, to reduce the costs associated with the purchase of electricity and heat, and to reduce the emission of pollutants into the air. Thanks to the implementation of the project, carbon dioxide emissions were reduced by 1,005.67 Mg/year. The project "ECO-effective Gmina Niemce" has been implemented continuously since 2013. In 2021, the implementation of the fifth stage of the project is planned, its implementation depends on obtaining funding from the European Union.
Rated power:	3.51 MW (PV: 1.989 MW, Central heating boilers: 1.51 MW)
Estimated yearly yield:	Electricity: 2,237.19 MWh/year Thermal: 507.50 MWh/year
Total investment:	1,901,436.33 €
Minimum investment:	206,169.63 €
Return:	-
Type of participation:	Cooperation between the Niemce Commune and residents
Number of involved citizens:	683
Type of citizen involvement:	Participation in the project – citizens as direct users of the installation being the subject of the project
Financial framework:	80 % EU funds 20 % own funds of residents and the commune of Niemce

Institutional / legal structure:	Real estate lending agreement for purposes related to the implementation of the project
Political framework (national):	The Act of 10 April 1998 Energy Law, The Act of 20 February 2015 on renewable energy sources.
Resource involved / technology:	Sun / Photovoltaic Biomass / Heating boilers

Image 25: Rooftop PV installation, Source: Urząd Gminy Niemce

Image 26: Biomass boiler, Source: Urząd Gminy Niemce

2.5. SLOVENIA

2.5.1. Luče – the first local energy community (Project COMPILE)

The village of Luče in the Savinjska Valley has become the first self-sufficient energy community in Slovenia. Petrol, together with its partners Elektro Celje and the Faculty of Electrical Engineering of the University of Ljubljana took care of the technical integration of the network as part of the Compile project. The system in Luče represents the first such energy community in Slovenia, which can fully cover the needs for electricity only based on production from renewable sources.

Luče represents a case of a rural low voltage network with a weak and unstable connection to the medium voltage grid. Luče has also a relatively weak local power grid which often encounters power failures and limits the integration of renewable energy sources (RES), as the voltage during the day rises above the limits. Outages are most common during times of extreme weather events like storms and thunderstorms. The initiator of the Luče Energy Community (EnC) is a local frontrunner who already installed PV, wind, EV charging point at home and who engaged the neighbours and municipality of Luče to establish EnC.

Based on the management of individual facilities and the energy community, five times higher production from solar power plants for the members of the energy community was achieved than the first permitted network. The reliability of the power supply has also increased.

Table 13: Details on the Project COMPILE

Name of the project:	Project COMPILE
Year of commissioning:	2020
Country:	Slovenia
Description of the project:	Within the Energy Community of Luče, 102 kW of solar power plants were installed at nine facilities. A system battery (150 kW / 333 kWh) was installed, which is connected to the part of the network that supplies 35 measuring points. These are mostly residential houses, farms, work buildings, as well as a small business, a biomass boiler room, a fire station, a cultural center and a post office. In addition, five house batteries (2 x 10 kW / 23.2 kWh, 10 kW / 11.6 kWh, 5 kW / 9.8 kWh and 3.5 kW / 7 kWh) were installed. These enable the island operation of an individual facility and improve the voltage conditions at the facility, which can increase production from a solar power plant, which would otherwise be limited.
Rated power:	102 kW
Estimated yearly yield:	
Total investment:	

Minimum investment:	
Return:	
Type of participation:	
Number of involved citizens:	35 measuring points - mostly residential houses, farms, work buildings, small business, a biomass boiler room, a fire station, a cultural center, a post office
Type of citizen involvement:	Residents of the village
Financial framework:	
Institutional / legal structure:	
Political framework (national):	
Resource involved / technology:	Sun / Photovoltaic

More information: https://www.compile-project.eu/sites/pilot-site-luce/

Image 27: Village of Luče, Source: Petrol

Image 28: System battery in Luče, Source: Borut Hočevar

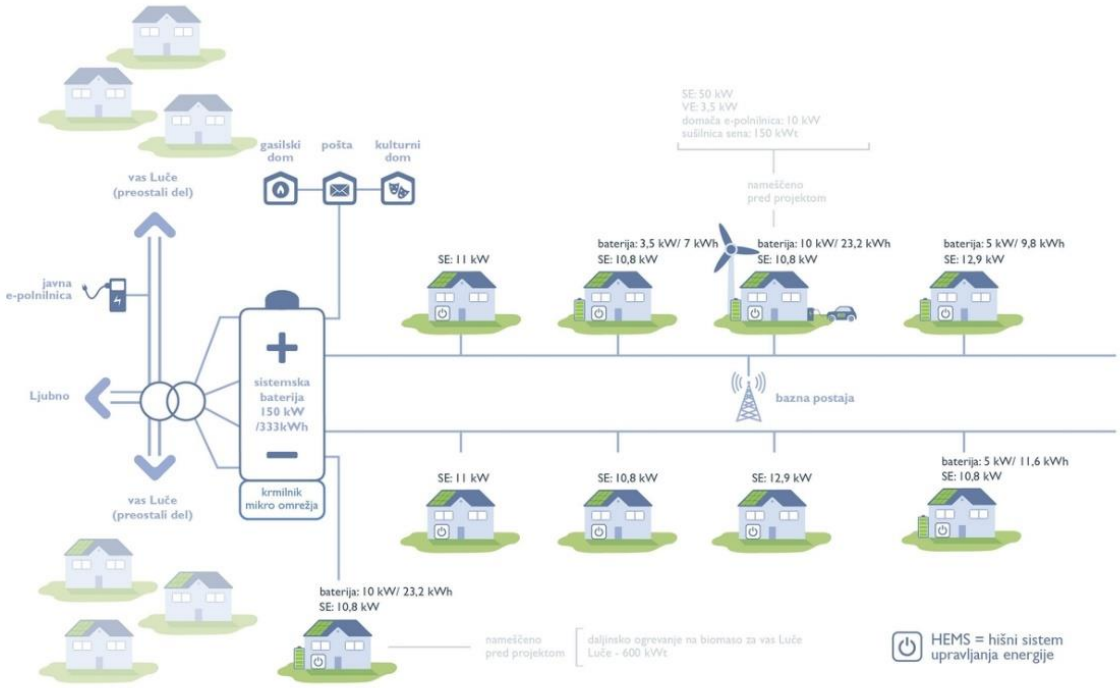

Image 29: System diagram, Source: Petrol

2.5.2. Jesenice – first solar power plant on a multi-apartment building

In 2018, the Slovenian Ministry of Infrastructure issued a new regulation on self-sufficiency in electricity from renewable energy sources, which enabled the expansion of the provision of own production and consumption of electricity produced from the sun. With the introduction of group self-sufficiency, customers in multiresidental buildings have also been given the opportunity to avoid future increases in the price of electricity and to make the green transformation easier. In February 2019, GEN-I built the first solar power plant on a multi-apartment building.

Table 14: Details on the solar power project in Jesenice

Name of the project:	Jesenice – the first solar power plant on a multi-apartment building
Year of commissioning:	2019
Country:	Slovenia
Description of the project:	The solar power plant on a multi-apartment building with 23 apartments in Jesenice has 36.7 kW of power and will produce 37,000 kilowatt hours of green electricity annually. 129 solar panels are installed on the roof of the building. At the annual level, it will reduce carbon dioxide emissions by 17 tons, and will enable annual savings in the use of electricity by more than 4,500 euros. The power plant is designed in a way that allows the vast majority of the produced electricity to be consumed by the residents themselves, and only a small part is returned to the grid. The owners of the € 36,400 investment, which will be fully recouped in seven years, will cover most of the energy needs in the building with their own production. 15.1 kW of modules are intended for use for the needs of common areas and a heating station, and the remaining 21.6 kW for consumption in each of the 23 apartments.
Rated power:	36.7 kW
Estimated yearly yield:	37,000 kWh
Total investment:	36,400 €
Minimum investment:	None of the residents have borrowed and will not pay higher electricity bills than before. The deposits will remain the same, on average around 20 EUR per apartment, but the cost of electricity will be only half, and the other half of the amount will be used for seven years to repay the investment. In the eighth year, electricity bills per apartment will be lower by 10 or 11 EUR per household.
Return:	7 years
Type of participation:	
Number of involved citizens:	23 apartments
Type of citizen involvement:	Apartment owners in the multi-apartment building

Financial framework:	
Institutional / legal structure:	
Political framework (national):	
Resource involved / technology:	Sun / Photovoltaic

Image 30: The first solar power plant GEN-I Sonce on a multi-apartment building in Jesenice, Source: GEN-I

Image 31: Installation of solar panels, Source: GEN-I

2.5.3. Budanje – first self-sufficient RES community

In December 2020 GEN-I Group set up a first self-sufficient RES community in Budanje (Ajdovščina). The pilot project of renewable energy sources Budanje is the first case in Slovenia in which the locals will be supplied with green energy from a solar power plant, which is located on a public building - primary school.

Table 15: Details on Budanje

Name of the project:	Pilot project Budanje
Year of commissioning:	2020
Country:	Slovenia
Description of the project:	The community includes seven residential houses, whose electricity consumption is equal to the projected annual production of the solar power plant. The project was created with the support of the Municipality of Ajdovščina, the installation of a 55.68 kW solar power plant, which will produce approximately 58,500 kilowatt hours of electricity annually.
Rated power:	55.68 kW
Estimated yearly yield:	58,500 kWh
Total investment:	
Minimum investment:	
Return:	
Type of participation:	
Number of involved citizens:	7 residential houses
Type of citizen involvement:	Local population
Financial framework:	
Institutional / legal structure:	
Political framework (national):	
Resource involved / technology:	Sun / Photovoltaic

Image 32: Solar power plant in Budanje, Source: Luka Cerlevaris

Image 33: Solar power plant in Budanje, Source: GEN-I

2.5.4. Loški potok – wood cooperative

Founded in 2017, the Loški potok Wood Cooperative is a Slovenian example of a widely used cooperative model of using wood biomass for heating. The wood biomass district heating system is intended to provide heat to buildings owned by the municipality (municipal building, health centre, home for the elderly, primary school, cultural and tourist centre) and some private business and residential buildings.

Table 16: Details on Loški potok – wood cooperative

Name of the project:	Wood cooperative Loški potok
Year of commissioning:	2017
Country:	Slovenia
Description of the project:	Based on a public tender, the municipality granted the cooperative a heat distribution concession for a period of 15 years, and the cooperative undertook to transfer the entire system, including heat sales, to the municipality's ownership and management free of charge. Most of the funds for the construction were obtained from non-repayable European cohesion sources, and the rest as a bank loan. They supported the establishment of the cooperative in order to maintain financial resources in the local environment, both in the form of earnings and jobs. They intend to transfer the entire financial surplus to a lower price of thermal energy and a higher price of wood biomass, which they buy from cooperatives. In 2018, 860 MWh of heat was supplied to customers. The municipality previously used about 90,000 liters of heating oil per year to heat its facilities. In 2018 Municipality saved € 30,000.
Rated power:	659.40 kW
Estimated yearly yield:	978.90 MWh
Total investment:	
Minimum investment:	Each member must enter a share (mandatory share). The obligatory share for a member is: - for individuals EUR 200 - for sole entrepreneur EUR 1,000.00 - for other legal entities EUR 2,000
Return:	
Type of participation:	
Number of involved citizens:	22 members who are the owners of the cooperative according to the Cooperatives Act
Type of citizen involvement:	
Financial framework:	

Institutional / legal structure:	
Political framework (national):	
Resource involved / technology:	Wood / Biomass heating

Image 34: Wood biomass boiler room, Source: Dovolj za vse

Image 35: Wood biomass, Source: Dovolj za vse

2.6. HUNGARY

2.6.1. Pilot project promoting the establishment and operation of energy communities

Table 17: Details on a pilot project in Hungary

Name of the project:	Pilot project promoting the establishment and operation of energy communities
Year of commissioning:	2020
Country:	Hungary
Description of the project:	The aim is to support the implementation of workable and traceable pilot projects that can serve as an example to others and explore the difficulties, barriers and opportunities of exploring the potential of energy communities and user's behavior, as well as proposing the necessary regulatory environment.7 projects have been funded.
Rated power:	
Estimated yearly yield:	
Total investment:	
Minimum investment:	
Return:	
Type of participation:	
Number of involved citizens:	
Type of citizen involvement:	
Financial framework:	
Institutional / legal structure:	
Political framework (national):	
Resource involved / technology:	

More information can be found here:
https://nkfih.gov.hu/

https://nkfih.gov.hu/english/other-funding/pilot-project-promoting-the-establishment-of-energy-communities-2020-314-zfr-ekm