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SEPlaM-CC

SEPlaM-CC – Raising capacity of cross-border public institutions in sustainable energy planning and management and climate change mitigation

(HUHR/1901/3.1.1/0048)

Joint analysis of best practice examples in energy refurbishment, renewable energy sources usage and climate change mitigation with the overview of similarities and differences between two states

Project partners:

MEĐIMURSKA ENERGETSKA AGENCIJA d.o.o.

ZALA ZMVA 1992

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January, 2021

Table of contents

List of tables

1. Introduction

The European Union (EU) is a front runner when it comes to energy and climate policies and has set significant targets to become climate neutral by 2050. Policies on the EU level are set and current directives have mostly been transposed in the Croatian and Hungarian national legislation, but a lot of actual work still has to happen and it will happen regionally and locally. Public authorities, i.e., local and regional governments develop energy and climate related plans where they tend to set targets for energy efficiency, renewable energy and reduction of greenhouse gas emissions in their administrative area. They define these targets in both qualitative (kWh saved, reduced CO_2 emissions, etc.) and quantitative (increased competence and awareness) form which allows them to monitor the achievement of defined targets and if necessary to define corrective and preventive measures. In order to ensure that the development and enactment of such documents is not just a dead letter on paper, the relevant institutions are launching energy and climate projects to support the achievement of the goals set out in these documents.

Accordingly, cities, regions and municipalities are, in practice, the ones implementing national and European legislation and directives, especially those related to energy efficiency, the utilization of distributed renewable energy sources as well as dealing with the evermore important issues related to climate change. If not responsible for the actual implementation, they are at minimum in charge of enabling it through the removal of administrative barriers and the creation of favorable local conditions in tandem with the national governments. This comes into effect through binding mechanisms, such as the distribution of the local and regional budgets, and spatial planning and zoning restrictions as well as voluntary ones, such as Sustainable Energy and Climate Action Plans (SECAPs) or similar action plans and strategies that lack a means of enforcement. Cities and municipalities often lack capacity since they do not have a structured decision-making process which could allow them to drive the implementation of energy efficiency and climate change mitigation and adaptation measures. They are usually limited to subsidy schemes, resulting in poor value for money and a lack of long-lasting impacts. Furthermore, climate change issues are merely addressed superficially, if at all, especially those related to climate change adaptation. Energy and climate are broad, horizontal topics, which influence, and are influenced by a wide variety of sectors as well as decisions made at all levels.

Regardless, many local and regional government units tend to launch energy and climate related projects in order to contribute to their economic development and improve the living conditions of their citizens. This document developed within project SEPlaM-CC – Raising capacity of cross-border public institutions in sustainable energy planning and management and climate change mitigation (HUHR/1901/3.1.1/0048) analyzes best practice examples of projects, initiatives and activities related to energy refurbishment, the use of renewable energy sources and climate change mitigation on national (project partner countries – Croatia and Hungary) and international level. Project partners identified a total of 19 national and international national best practice examples, which are elaborated in detail in the following chapters.

2. Best practice examples in energy refurbishment, renewable energy sources usage and climate change mitigation on national level

In process of searching best practice examples in energy refurbishment, renewable energy sources usage and climate change mitigation in order to develop and prepare this document, a significant number of best practice examples in Croatia, Hungary and worldwide were identified. However, when analyzing the examples, it was concluded that the detailed information on best practices is dispersed and provided in different languages and format which made the whole process of developing this document a little more difficult but not impossible. Project partners managed to identify total of 19 best practice examples in energy refurbishment, renewable energy sources usage and climate change mitigation (Table 2.1).

Table 2.1 Analyzed best practice examples within SEPlaM-CC project

Num.	Name of best practice
1	Energy refurbishment of high school in Velika Gorica
2	Energy refurbishment of kindergarten Buje and Italian kindergarten Mrvica
3	Energy refurbishment of municipal buildings in Nagykanizsa
4	Construction of the solar power plant through the on-site power purchase agreement (PPA) project at the Zabok General Hospital
5	Municipality of Pokupsko Biomass District Heating Power Plant
6	Development of a geothermal heating system in the public institutions of the City of Lenti
7	Mórahalom geothermal cascade system
8	On the Sunny Side (hrv. na sunčanoj strani)
9	NEWLIGHT project
10	renoHUb project – a one-stop-shop consulting service for residential building energy refurbishment in Hungary
11	Energy jump (Energiesprong)
12	Social Housing energy renovation in Porto - Portugal – 2013-2020 period
13	Stegerwaldsiedlung, Köln – An exemplary energy retrofitting of a 1950's housing estate
14	Shallow Geothermal Heating and Cooling at the Parliament of Andalusia
15	Solar Pecka
16	Paraffin based latent heat storage in connection with geothermal district heating system in Lendava
17	Energy access SMEs development project
18	Aspern Seestadt Vienna
19	RenoBooster project – climate change mitigation through innovative advisory and funding services for house refurbishments in Vienna

2.1. Croatia

Croatian government acknowledges the importance of investing in energy and climate related projects which can be seen from the agreement of The European Investment Bank (EIB) and the Ministry of Economy and Sustainable Development of the Republic of Croatia on expanding cooperation on the development and financing of key energy, sustainability and climate-related projects in the country. Under the Memorandum of Understanding signed by mentioned institutions, the two sides have agreed to develop joint operations in the following areas:

(i) renewable electricity generation and transmission distribution infrastructure;
(ii) clean energy and energy efficiency measures, and renovations and conversions of buildings;
(iii) green mobility;
(iv) support for the Croatian economy's transition to a circular economy.

2.1.1. Best practice examples in energy refurbishment

Table 2.2 Best practice examples in energy refurbishment in Croatia

Num.	**1**	
Title of best practice	**Energy refurbishment of high school in Velika Gorica**	
Brief description *Shortly describe the scope of best practice*	Buildings of City of Velika Gorica high schools with gymnasium (vocational, economy and grammar school) were fully retrofitted. The retrofit included new thermal insulation of the whole building envelope, with reconstruction of roof and all outdated installations. The project resulted with significant decrease in energy consumption and thus lower energy bills, and it also promotes utilisation of RES. The air-water heat pump was installed for heating and cooling of two gymnasium buildings, with full new ventilation systems. Remote metering was installed for all energy and water consumption thus enabling better management of consumption and promoting further energy and emission savings through energy planning optimisation. The overall result of the project, in addition to achieved energy and emission savings, was that the comfort of teaching and studying has been significantly improved. The project had thus directly benefited more than 1 300 students and school staff. The retrofit will also contribute to lower maintenance and operation costs and, due to improved comfort, to better quality of schooling.	
Detailed description	**Location**	City of Velika Gorica, Zagreb County, Croatia
	Concept and background	The school building was built in year 1985, using materials and design methods which do not meet today's energy efficiency standards. The project combined construction, mechanical and electrical engineering methods which resulted in energy efficiency improvements, energy savings and utilization or renewable energy sources. Financial savings resulting from energy savings and CO_2 emission reductions will enable quality improvements in conducting educational activities, while providing indoor comfort for students, teachers, and other school staff. The renovation project

		included thermal retrofitting of the building envelope – walls, windows and doors, reconstruction and insulation of the roof, installation of the air-water heat pump for heating and cooling of the gymnasium, and utilisation of RES. The project also contributed to boosting local business, particularly construction, thus contributing to overall economic development of the region.
	Timeframes	22/02/2019 – 22/05/2022
	Objectives and main activities	Aim of the project was to improve energy efficiency by implementing energy retrofit measures and by using RES. The project is demonstrating great potential and synergies of multiple benefits arising from energy retrofits of the buildings in the public sector, especially schools. In addition, besides energy and financial savings, the project is directly contributing to teaching next generations on benefits of energy efficiency and RES utilization. The project included the following main activities: - Reconstruction of the exterior walls - Replacement of the windows and doors - Reconstruction of the roof - Renovation of the heating system including new system for domestic hot water preparation and installation of the air-water heat pump for heating, cooling and ventilation in the gymnasium (2 separate buildings) - Reconstruction of indoor lighting replacing existing lighting with LED - Replacement of all outdated installations and installation of remote energy and water consumption metering
	Barriers and problems occurred	- Short implementation period – only 24 months for public procurement and construction works - Complex public procurement procedure - Performing construction works during teaching hours - Aligning additional user requirements with the project during construction works
	Main results and findings	- Improvement of energy class from D to A (heat transfer coefficient of the exterior walls U≤0,25W/m^{2}K, U≤0,20W/m^{2}K for ceiling towards the unheated area and U≤1,40W/m^{2}K for window frames with U≤1,10W/m^{2}K for glass); - Improvement of quality of working and learning conditions for teachers, other staff and students; - Boosting local business and economy; Overall implementation of all measures results with 81.24% savings in heating, 75.72% savings in primary energy and 81.24% CO_2 emission savings

Contact details of the responsible investor *Short description and contact details of the investor*	Zagreb County, Ulica grada Vukovara 72/V, 10 000 Zagreb, tel.: 00385 1 6009 461 Authorised for conducting the role of Head of the Administrative Department for Economy and EU funds, Damir Fašaić, dipl. oec., tel.: 00385 1 6009 461, e-mail: d.fasaic@zagrebacka-zupanija.hr
Funding scheme *Please describe financing and co-financing method with financing amounts*	European Structural and Investment Fund, European Regional Development Fund, Operational Programme Competitiveness and Cohesion 2014-2020 Zagreb County: Total project net value: 30 817 443,78 HRK Total eligible costs: 30 340 441,28 HRK ERDF grant: 15 155 068,10 HRK Zagreb County own funding: 15 662 375,68 HRK
Photos *If possible, include max 5 photos, pictures, charts, etc. of best practice*	   

Num.	**2**	
Title of best practice	**Energy refurbishment of kindergarten Buje and Italian kindergarten Mrvica**	
Brief description *Shortly describe the scope of best practice*	Project of energy refurbishment of the kindergarten in Buje with the net value of 7 million HRK (around 930k EUR) is the most valuable project implemented in City of Buje, supported by the EU funding. It is a remarkable example of how an older building can be fully retrofitted and turned into modern educational facility. The retrofit has resulted in switching the energy class of the building from E to a high A+ thus contributing to significant energy savings of more than 50%. The project included retrofit of the whole exterior building envelope (roof, walls, windows and doors) and instalment of the heat pump and photovoltaic panels. In addition to achieving significant energy and CO_2 savings, the project has contributed to boosting local economy, to increasing the production of RES powered electricity and to improvement in quality of schooling and working in the kindergarten. The overall functionality of the kindergarten was improved and better environment for children and staff was ensured.	
Detailed description	**Location**	City of Buje (Croatia)
	Concept and background	The building where the two main kindergartens of Buje are sited (Croatian speaking kindergarten and Italian speaking kindergarten Mrvica) was built in 1983 and it has an area of 1 637 m^2. Prior to renovation, the building (by its construction characteristics) did not meet the requirements of the functionality of the space for its purpose and energy efficiency. Therefore, the purpose of the project was to bring the building into architectural functionality and higher energy efficiency. At the end, after renovation was completed, this resulted with a better working environment both for users and for the employees. The project with a total value of 7 million HRK was mostly financed from EU funds and is a great example of how a very old building can get a new shine. After the renovation, the kindergarten building moved from E class to high A + class and thus brought energy savings of more than 50%.
	Timeframes	From November 2019 to April 2021
	Objectives and main activities	Reduction of CO_2 emissions and increase of energy efficiency is sought to be achieved through European legislation, cross-sectoral cooperation, connecting international, national and regional stakeholders and EU projects. In Croatia, as in the entire European Union, almost 50% of final energy consumption is used for heating and cooling, of which 80% in buildings. The City of Buje is among the first local authorities in the Region of Istria to be involved in reducing harmful gas emissions and slowing down climate change, all through the key energy sector. Implementation of energy renovation measures included increasing the thermal protection of the roof above the heated space, increasing the thermal protection of the external wall, replacing the external

		carpentry, installing a new highly efficient heating system (heat pump), replacing the existing DHW system with RES using production of electricity from RES for the needs of ETC.
	Barriers and problems occurred	The age of the building (40 years), the location (steep and slippery terrain and the old reinforced concrete prefabricated structure) were a challenge in terms of works to be done very carefully to avoid damages to the building itself and to its stability.
	Main results and findings	The achieved energy savings Qh, and is 69 647.69 [kWh/a] (or 55.89%), and the reduction of CO_2 emissions is 20.52 [t/year, and the facility has switched to energy class A
Contact details of the responsible investor *Short description and contact details of the investor*	City of Buje-Buie, local authority, Istarska n. 2; 52460 Buje (Croatia), Tel: + 385 52 772 122, Fax: + 385 52 772 158, e-mail: info@buje.hr, www.buje.hr, Mayor: Fabrizio Vižintin	
Funding scheme *Please describe financing and co-financing method with financing amounts*	External financing: EU funds: total Euro 1 390 691,22 HRK = 185 425,50 EUR Croatian Ministry for regional development and EU funds: 2 588 602,13 HRK = 345 146,95 EUR Internal auto financing by the City of Buje: total Euro 2 958 019,51 HRK = 394 402,60 EUR	
Photos *If possible, include max 5 photos, pictures, charts, etc. of best practice*	 	

	 

2.1.2. Best practice examples in renewable energy sources usage

Table 2.3 Best practice examples in renewable energy sources usage in Croatia

Num.	**3**	
Title of best practice	**Construction of the solar power plant through the on-site power purchase agreement (PPA) project at the Zabok General Hospital**	
Brief description *Shortly describe the scope of best practice*	Zabok General Hospital is a significant electricity user, and as it is suitably located for installation of photovoltaic power plant it was decided to consider possibility of renewable energy production for own purposes. As the initial investment is significant and posed a barrier to implementation if the hospital was to fund the entire investment, the public- private model was chosen. The power purchase agreement (PPA) was defined and signed between the hospital and private investor enabling hospital to save on initial investment costs, and after expiration of the PPA to have lower electricity bills and thus to redirect savings into better healthcare.	
Detailed description	**Location**	Zabok General Hospital, Bračak 8, 49210, Bračak (Croatia)
	Concept and background	Hospitals are recognized in all countries of the world as critical places in terms of the importance of uninterrupted supply of electricity and other energy sources. The goal of each hospital is to provide primary health care to its users and most of the institution's budget is used for this purpose. The idea of the solar power plant construction project was to reduce the cost of electricity in the long run and to free up a part of the institution's budget that can be redirected to items directly related to primary health care.

	Timeframes	2018-2019
	Objectives and main activities	Main objective was to provide hospital with solar electricity through installation of photovoltaic panels, without requiring significant investment from the hospital. After defining the technical solution in accordance with all existing restrictions (available roof area available, connection power etc.)- the objective was to close the financial structure without the need for Hospital's participation. The PPA was chosen as optimal financing mechanism and main activities included: - Designing an implementation model, presentation to stakeholders and consulting with authorities - Development of the PPA contract (electricity supply/works contract, along with roof lease contract) and adoption by stakeholders - Preparation of project technical details and consulting with the local DSO - Public procurement - Selection of PPA provider - Execution of works - Trial operation and commissioning
	Barriers and problems occurred	When implementing the project of any kind in public buildings - the implementation depends either on the availability of grants or on the possibilities of using alternative implementation mechanisms. Most of the barriers are related to the financial nature. Technical problems in solar power plant projects are mostly regulated on national level and although it sometimes takes time - there is a solution to every technical problem if specifically communicated with a local DSO.
	Main results and findings	Main result of the project is a 420 kW solar power plant installed at the rooftop of Zabok General Hospital. After the contract with PPA provider is finished - a plant becomes the ownership of the Hospital and more visible cost savings are occurring.
Contact details of the responsible investor *Short description and contact details of the investor*	Key stakeholder: Zabok General Hospital, Bračak 8, 49210, Bračak (Croatia) Secretary: +385 (0)49/204-000 Technical, financial and legal assistance (outsourced): North-West Croatia Regional Energy Agency Project leader: Marko Vlainic, mvlainic@regea.org, +385 91/3885-341	
Funding scheme *Please describe financing and co-financing method with financing amounts*	The project was funded through an on-site Power Purchase Agreement (PPA) scheme. Power Purchase Agreement (PPA) often refers to a long-term electricity supply agreement between two parties, usually between a power producer and a customer (an electricity consumer or trader). An on-site PPA (one of the PPA variations) is a direct physical supply of electricity, necessitating physical proximity of plant and consumer. An on-site PPA means that the generation plant is located behind the metering point of the consumer and consumption profile of the consumer usually	

	dictates the specific installation and also the parameters of the PPA contract. The investment amounted to 300 000 EUR and was 100% financed by PPA provider. Duration of PPA contract is set to 10 years.
Photos *If possible, include max 5 photos, pictures, charts, etc. of best practice*	  
Num.	**4**
Title of best practice	**Municipality of Pokupsko Biomass District Heating Power Plant**
Brief description *Shortly describe the scope of best practice*	In 2015 in Municipality of Pokupsko first communal biomass district heating system has started its operation. The constriction of the system was fully financed by the IPARD Pre-accession program, and subsequently additionally financed by Croatian Environmental Protection and Energy Efficiency Fund. Pokupsko is situated in the southern part of Zagreb County, and it is a home to 2 224 inhabitants (2011 census). Almost 70% of the area is covered with forests and this is one of the main reasons why the biomass heating plant has been established right here. The installed power of the district heating system is 1MW and it is providing heat to about 30 end users (including all public buildings) which have been

	connected free of charge. The management of the system is done by the newly founded utility. Total value of the investment was about 7 milion HRK, and the project has contributed to energy savings through provision of a more efficient heating source, reduction of the local pollution and cost savings. The final result is that currently more than 75% of energy needs in Pokupsko are satisfied through local resources, with the plans to reach 100% within next five years.	
Detailed description	**Location**	Municipality of Pokupsko, Zagreb County (Croatia)
	Concept and background	Municipality of Pokupsko, like most rural areas in Croatia, has faced many problems. Despite its hurdles of facing degrowth and development issues, today Pokupsko is a shining example of sustainable development and proudly stands side by side with the best in Europe. By continuously investing in various projects, municipality has used different available sources of funding in Croatia and EU to increase the quality of life for those who have decided to stay and live in this area. It should be noted that the biomass heating plant in Pokupsko is the only one that managed to obtain funding through the IPARD pre-accession program, although the IPARD Operational Program provides for the financing of a total of 12 such heating plants in Croatia. The heating plant is intended for heating all public buildings and households in the municipal centre. The video about the biomass district heating plant in the municipality of Pokupsko is available at: https://www.youtube.com/watch?v=kd7TYl5XaHI.
	Timeframes	06/2008: Start of concept development 01/2011: Application to IPARD 27/11/2015: Official opening
	Objectives and main activities	The main objective was to provide municipality area with more sustainable and more affordable heating. Main project activities included a lengthy preparation phase where all terms and conditions were agreed upon with the local community, followed by the development of project application to the EU funding and finalised with the implementation phase. The project also included setting up a new communal service provider (utility) who would be in charge of power plant and its operation.
	Barriers and problems occurred	The preparation process for this project was lengthy – it took 6 years to prepare all the paperwork, and only 6 months to build the production facility and district heating infrastructure.
	Main results and findings	The project was successfully implemented after 7 years due to lengthy preparation phase. The installed power of the power plant is 1MW and as a district heating plant it is providing heat to about 30 end users which have been connected free of charge and it was built to enable future expansion. The management of the system is done by the newly founded utility.

		The project was awarded with the prestigious EUSEW (EU Sustainable Energy Week) award in the public sector category.
Contact details of the responsible investor *Short description and contact details of the investor*	North-West Croatia Regional Energy Agency, Andrije Žaje 10, 10000 Zagreb, Croatia Velimir Segon, Deputy Managing Director, vsegon@regea.org www.regea.org	
Funding scheme *Please describe financing and co-financing method with financing amounts*	The construction of the heating plant was financed by grants provided by the Municipality of Pokupsko through the pre-accession program IPARD Measure 301, to which the Republic of Croatia was entitled before full membership in the European Union, as well as funds from the Environmental Protection and Energy Efficiency Fund. The total construction costs for the part financed through the IPARD program were around 6.2 million HRK (excluding VAT, because the projects from the IPARD program are exempt from VAT), which a company that performs works selected through public procurement. In addition to these costs, there were additional costs for the installation of thermal substations in the amount of about 2.6 HRK (including VAT) for which co-financing of the Environmental Protection and Energy Efficiency Fund was provided.	
Photos *If possible, include max 5 photos, pictures, charts, etc. of best practice*	 	

2.1.3. Best practice examples in climate change mitigation

Table 2.4 Best practice examples in climate change mitigation in Croatia

Num.	**5**	
Title of best practice	**On the Sunny Side (hrv. na sunčanoj strani)**	
Brief description *Shortly describe the scope of best practice*	A matchmaking platform "On the Sunny Side", connecting citizens interested to invest in their own roof-top PV system with solar entrepreneurs – namely project designers and solar installers – has been launched in October 2020. "On the Sunny Side" is a digital tool for citizens interested to invest in their own rooftop PV system, where they can: (1) become part of the first joint/cooperative procurement of PV systems in Croatia, making procurement and installation of quality equipment more affordable, and (2) get full support of ZEZ team and trusted entrepreneurs at every step of implementation of PV system. The project was developed and is being implemented by the Green Energy Cooperative (ZEZ) and it has aim to contribute to about 10% of the installed capacity needed for achieving national target for 2030. In January 2021, Google launched Google.org Impact Challenge for Central and Eastern European countries to help organizations work to reduce the digital divide and promote inclusive economic growth. Google recognised the potential „On the Sunny Side" to contribute to their goals and bring innovation to the sector of small-scale solar.	
Detailed description	**Location**	Croatia, nationwide
	Concept and background	There is huge untapped potential for solar PV in Croatia. Green Energy Cooperative (ZEZ) wants to encourage citizens to become actively involved in the energy transition, as prosumers and investors, and not only be passive bystanders (which is often the case with big RES projects such as wind farms). In order to achieve their mission, ZEZ is focusing on strong partnerships, collaborating with local solar companies and local authorities and digital tools, community activation and matchmaking platform for roof-top solar.
	Timeframes	July 2020 – ongoing
	Objectives and main activities	The platform is at the core of the commercialisation strategy to setup a pathway for achieving a systemic change and enabling around 10 MW of installed capacity annually. In Croatia it could contribute to around 10% of the national target set for 2030, which would entail an investment in the range of 10-15 million EUR each year and open a market pathway for 3 000 – 8 000 jobs annually in solar rooftop energy. The main objective in development of the platform was to create and offer citizens a one-stop solution for roof-top solar PV systems for self-consumption, with incorporated cooperative approach and values in the business model behind. The main service is the provision of services surrounding rooftop solar systems. Communication activities that took place during the project have provided a wide outreach.

		Some of the communication activities, such as the Good Energy Tour, will be replicated to expand the outreach.
	Barriers and problems occurred	There is still low awareness among Croatian citizens on benefits of utilizing RES, such as PVs. Thus ZEZ focused their effort on educational activities, for both citizens and solar entrepreneurs, to become solar ambassadors in their local communities. At this point platform is fully manual and consists of individualized case-specific offers. The current set-up of relies on openly available tools and elements, while a future iteration could include custom-build rooftop configurators.
	Main results and findings	- Good Energy Tour in 11 cities - 30 000 platform visitors and more than 700 expressions of interest from citizens. - A community Solar Club (FB page) of more than 3 000 citizens/members interested to invest in solar PVs - 103 PV System Electrical Design Projects have been developed in the demo site Varaždin out of which, 53 have been developed and submitted to the national fund for subsidies, and 21 projects (total capacity of 98 kW) have been installed in 2020.
Contact details of the responsible investor *Short description and contact details of the investor*	Green Energy Cooperative (hrv. Zelena energetska zadruga, ZEZ), is a RES cooperative and social enterprise based in Zagreb, Croatia. Contact: Melani Furlan, project manager melani.furlan@zez.coop	
Funding scheme *Please describe financing and co-financing method with financing amounts*	The SOL4ALL project has been initiated with the support of the EIT Climate KIC (for period of July 2020 to December 2020), amounting to 80 000 EUR. ZEZ has attracted additional investment for the project activities through sponsorship agreements with Raiffeisen bank (amounting to 50 000 EUR).	
Photos *If possible, include max 5 photos, pictures, charts, etc. of best practice*	 	

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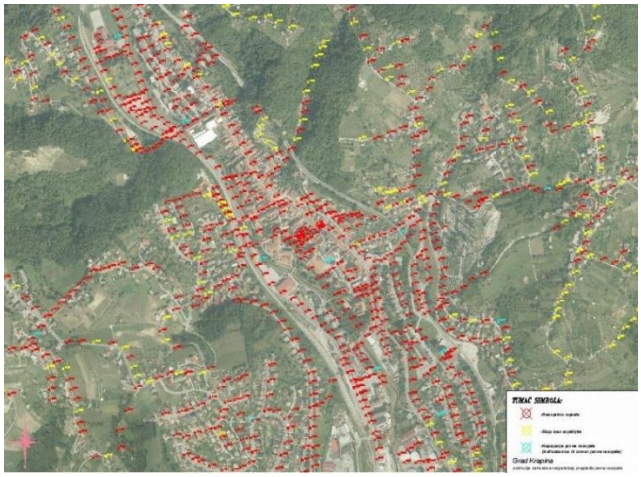
<tr><td></td><td colspan="2"> 
</td></tr>
<tr><td>Num.</td><td colspan="2">6</td></tr>
<tr><td>Title of best practice</td><td colspan="2">NEWLIGHT</td></tr>
<tr><td>Brief description
Shortly describe the scope of best practice</td><td colspan="2">The NEWLIGHT project was initiated as a follow-up to the project Masterplan of public lighting, with the aim of reconstruction and construction of energy sustainable and environmentally friendly public lighting in the Zagreb and Krapina-Zagorje counties (a total of 57 local governments participated with 48.000 inhabitants benefiting). The total capital investment triggered by the project was about 14 million Euros. The project development services supported the preparation and implementation of EE measures in public lighting. The North-West Croatia Regional Energy Agency prepared all tender documentation and launched public procurement for streetlight energy audits in 57 local authorities. The investments foreseen were implemented mainly through Energy Performance Contracting (EPC) with some local authorities opting for the Design and Build (D&B) – traditional contract model. The project has also achieved significant energy and CO_2 emission savings– 21.38 GWh (saved/year) and CO_2 reductions – 7050 CO_2 eq t. The project was awarded with the prestigious European Energy Services Award (EESA).</td></tr>
<tr><td rowspan="4">Detailed description</td><td>Location</td><td>Zagreb County, Krapina-Zagorje County, Croatia</td></tr>
<tr><td>Concept and background</td><td>Improving energy efficiency of the public lighting offers one of the quickest payback periods out of all energy efficiency measures. At the same time, Croatia was still faced with low energy efficiency and poor quality of public lighting in many areas. Local authorities were not capacitated to undertake all steps needed to change needed to their public lighting systems, and there was poor availability of potential sources for co-financing or utilisation of ESCO models. REGEA thus, with support of ELENA funding, supported the refurbishment of luminaires in the two counties to increase the energy performance of public lighting. The implemented EE measures included mainly replacing the luminaires with more efficient technologies such as LED. Public lighting energy audits (inventory) details of existing systems from around 72 200 lighting points have been collected and analysed. This resulted in a unique database, which has been used for technical and financial investment assessment.</td></tr>
<tr><td>Timeframes</td><td>October 2015 – October 2018</td></tr>
<tr><td>Objectives and main activities</td><td>Main objective was to improve energy efficiency of the public lighting system, thus reducing energy costs and saving CO_2 emissions while at the same time providing</td></tr>
</table>

		better quality of public lighting for the inhabitants. Main activities were: - Preparation of tender documentation for the implementation of public procurement for the provision of detailed energy audits of public lighting systems; - Implementation of detailed energy audits of the existing public lighting system; - Development of action plans for the implementation of modernization and reconstruction of the public lighting system; - Preparation of tender documentation for the selection of contractors, with emphasis on ESCO sources of funding; - Preparation of the main project for the construction of new lighting; - Application to European and national sources of financing for the execution of works on the modernization and reconstruction of the public lighting system; - Project management.
	Barriers and problems occurred	- Incomplete database of the existing situation - Underdeveloped ESCO market - the need to inform and educate all stakeholders - Technical barriers included low price of electricity - Low availability of traditional co-financing and knowledge and access to the alternative financing (EPC/PPP)
	Main results and findings	- 57 energy audits completed - GIS based database with more than 2 million attributes from 57 local authorities prepared - 57 Action plans - Detailed analysis of market conditions - Out of 72 200 existing luminaires, more than 54 000 (approx. 75%) were reconstructed in 26 municipalities using four financial models. - 26 public authorities engaged in tendering process - 13 EPC procurement processes - 8 traditional procurement processes - 1 D&B procurement process - 4 Leasing procurement processes
Contact details of the responsible investor *Short description and contact details of the investor*	Project beneficiary: North-West Croatia Regional Energy Agency, www.rega.org, newlight@regea.org	
Funding scheme	Total investment in implementation phase: 14.36 MEUR - 13 EPC procurement processes	

Please describe financing and co-financing method with financing amounts	- 8 traditional procurement processes - 1 D&B procurement process - 4 Leasing procurement processes Total PDS costs: EUR 704 469 90% (634 022 EUR) provided through ELENA, the remaining 19% provided by Zagreb and Krapina-Zagorje County
Photos *If possible, include max 5 photos, pictures, charts, etc. of best practice*	   

2.2. Hungary

Hungarian government as well as Croatian is also aware of importance of investing in energy and climate related projects and actions. By encouraging such initiatives, Hungarian government shows the effort to create long-term conditions for the sustainable development of Hungary through:

(i) improved protection and conservation of the environment;
(ii) the development of sustainable energy and climate management practices;
(iii) the development of systems to monitor weather and climate conditions;
(iv) the strengthening of Hungarian energy and hydrocarbon management systems.

2.2.1. Best practice examples in energy refurbishment

Table 2.5 Best practice example in energy refurbishment in Hungary

Num.	**7**	
Title of best practice	**Energy refurbishment of municipal buildings in Nagykanizsa**	
Brief description *Shortly describe the scope of best practice*	In Nagykanizsa still a relatively large part of the municipal building stock is ahead of deep renovation. To tackle this situation a large-scale municipal energy refurbishment programme has been launched, which includes 12 intervention sites. The 12 smaller and bigger municipal facilities represent a diversity of institutions, and serve as local good practice examples for follow-up energy refurbishment activities. The renewal of these 12 buildings is embedded into the city's overall environmental strategy, therefore the project also includes the upgrade of the city's Sustainable Energy Action Plan (SEAP) into a full-fledged Sustainable Energy and Climate Action Plan (SECAP). As a third element, the physical accessibility of the buildings will also be improved.	
Detailed description	**Location**	Nagykanizsa, Hungary
	Concept and background	Energy refurbishment activities have a long history in Nagykanizsa – especially in the residential sector. A good example is a "one-stop-shop" consulting service hosted by the local environmental consultancy IMRO-DDKK, which has led to the energy refurbishment of over 30 condominiums, saving 2600 tons of CO_2 annually. However, the energy refurbishment of public buildings has been lagging around (primarily due to lack of funds). Due to financial support of EU structural funds the necessary funding has now arrived to the city so the plans can be turned into reality.
	Timeframes	2021 – 2022
	Objectives and main activities	Within the project, twelve selected public buildings (mainly educational institutions) will become more energy efficient: high school, social service centre, municipal cultural centre, library, kindergardens, nurseries. By energy refurbishing the public buildings of the city of Nagykanizsa, local energy efficiency will be significantly boosted, along with expanded use of renewable energy

		sources. This complies with the city's goals of driving a local transition towards a low-carbon economy as well as it serves a demonstration tool for local residents and other institutions. In addition to these activities the project also includes the upgrade of the Municipal Sustainable Energy Action Plan (SEAP) of Nagykanizsa into a more comprehensive Sustainable Energy and Climate Action Plan (SECAP). Third, physical accessibility of the buildings will also be improved.
	Barriers and problems occurred	The construction activities are being carried out presently, in times when construction material prices have radically increased. Therefore, there is a very high risk that the available project budget (drafted years ago) may not be enough to cover the present costs.
	Main results and findings	The expected energy saving is the following: - GHG emission reduction: 452,852 tons/year - Reduction in energy consumption: 5,087,376 GJ/year - Newly established RES capacity: 257,856 kW - Energy from RES: 786.264 GJ/year The project is presently being carried out therefore it is still too early to establish main findings. However, the expectation is that these selected pilot sites will contribute to increased public and residential awareness of saving energy and will accelerate the process of energy refurbishment locally.
Contact details of the responsible investor *Short description and contact details of the investor*		Municipality of Nagykanizsa László Balogh, mayor Tel: +36 30 2040-865 E-mail: balogh.laszlo@nagykanizsa.hu
Funding scheme *Please describe financing and co-financing method with financing amounts*		The project has been 100% financed from EU structural funds. Project ID: TOP-6.5.1-19-NA1 Project name: Energy refurbishment of municipal buildings Total cost: HUF 1,308,999,999 (ca. EUR 5.6 million)
Photos *If possible, include max 5 photos, pictures, charts, etc. of best practice*		Deep renovation of a school building:  Inauguration of the first refurbished kindergarden:

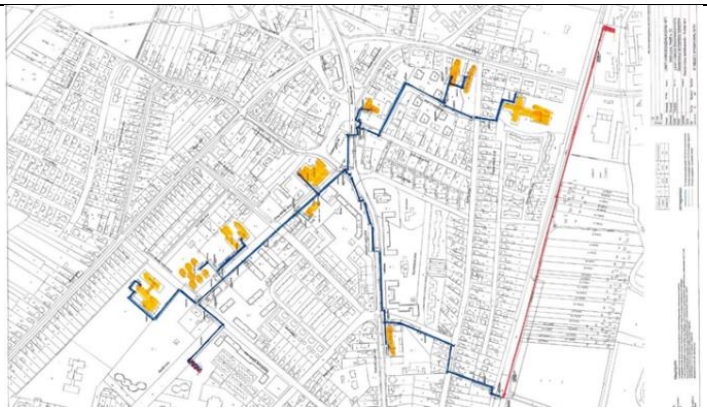
	 Energy refurbishment will not only increase energy performance but will improve the visual appeal of the façade. Physical accessibility will also be implemented, giving equal chances to everyone.

2.2.2. Best practice examples in renewable energy sources usage

Table 2.6 Best practice examples in renewable energy sources usage in Hungary

Num.	**8**	
Title of best practice	**Development of a geothermal heating system in the public institutions of the City of Lenti**	
Brief description *Shortly describe the scope of best practice*	As part of this project a geothermal system is being constructed, which consists of one production well and one re-injection well. At this project phase geothermal heat will be provided for 10 local municipal institutions. Due to the funding scheme present, no private consumers can be connected to the system, however, it is designed in a way so that in later stages the system can be expanded.	
Detailed description	**Location**	Lenti, Hungary
	Concept and background	The conceptual background of this initiative is that in Lenti there is a significant geothermal asset within the administrative area of the town, which is well mapped by former oil mining activities. Previously, thermal water was only used for heating in the local thermal bath (Lenti Spa). Serving as a local good practice for the utilisation of RES instead of natural gas, it led to the elaboration of the present project concept, which substantially increases geothermal energy use in the town.
	Timeframes	2017 – 2021
	Objectives and main activities	The main objective of this project is to cover the space heating demands of the city's public institutions from geothermal heat. The main activities are the following: • Extraction of thermal water from the production well with base depth of 1,480 m (wellhead temperature 69 °C, water volume 32-35 m^3/h) and transfer to the heating centre with the help of installed booster pumps.

		• Connecting potential heat consumers directly to a simple two-pipe thermal transmission line network. Total network length is 3 km's. • Feeding through thermal heat exchangers installed in the boiler rooms of ten municipal institutions. • Automatic operation of the system with a dispatcher central computer and telemechanical remote monitoring. • Reinjecting thermal water in a well with a base depth of 1,450 m.
	Barriers and problems occurred	The main barrier has been the rapid increase of construction prices. In a ten-year period, the cost of drilling one geothermal well has essentially doubled. This was probably the main difficulty, as geothermal projects have a rather long planning and permission phase. Whereas this project was 100% financed from EU and national project funding, where planned amounts had to be declared up front. Another difficulty was that although the local spa already has a functioning thermal well, due to the water's classification as medicinal water legal regulations did not allow utilising it for heating. Therefore, new wells had to be drilled.
	Main results and findings	From this year 8344 GJ renewable heat is produced annually. The rated power is 1860 kW. The replacement of natural gas heating has contributed to 520 t / year CO_2 emission reduction. (ca. 60-70% emission reduction.) An advantage of this system (as opposed to a cascading system – see Mórahalom case study) is that it is a double pipe system, which allows the connection of new heat consumers in the future (e.g., residential condominiums).
Contact details of the responsible investor *Short description and contact details of the investor*	László Horváth, Mayor of Lenti Tel: +36 92 553-913 E-mail: polgarmester@lenti.hu	
Funding scheme *Please describe financing and co-financing method with financing amounts*	The project has been 100% financed from EU structural funds. The project code is: TOP-3.2.2-15-ZA1 The project title is: Establishing a municipally defined renewable energy-based energy supply, adjusted to local conditions and embedded in a complex development programme Funding amount: HUF 998,431,834 (ca. EUR 3 million)	
Photos *If possible, include max 5 photos, pictures, charts, etc. of best practice*	Map of the pipelines and the location of municipal institutions:	

<table>
<tr><td></td><td colspan="2"> 
Launch of drilling activities:

</td></tr>
<tr><td>Num.</td><td colspan="2">9</td></tr>
<tr><td>Title of best practice</td><td colspan="2">Mórahalom geothermal cascade system</td></tr>
<tr><td>Brief description
Shortly describe the scope of best practice</td><td colspan="2">In 2008 a geothermal district heating system was developed in the South Hungarian municipality of Mórahalom (5800 inhabitants). The system, consisting of one production well and one reinjection well supplies geothermal heat to 12 municipality-owned public buildings. (1.5 MW heat power in total.) This is a cascading system, meaning that it is a single-pipe system in which heat levels gradually reduce as water passes through the system. As the abstracted ground water consists significant methane content (551 l /m^3) it is separated from the water to run a co-generator (124kW).This way enough electric power is generated to run the whole system, and the access heat increases the water temperature further. At the end of the loop, further heat is extracted by using heat pumps. The system has successfully reduced CO_2 emissions by 75%, leading to 1054 t / year emissions savings.</td></tr>
<tr><td rowspan="2">Detailed description</td><td>Location</td><td>Mórahalom, Hungary</td></tr>
<tr><td>Concept and background</td><td>This is a small border town in South Hungary. Like most rural settlements, it also faces significant economic and social challenges. However, with sustained efforts the municipality has successfully broke out from a vicious circle by promoting sustainable economic development.
Being a small settlement with a fraction of the income needed to implement the grand vision, they have successfully brought in a range of national and European project funding. By now, it has become a real “smart city”,</td></tr>
</table>

		showcasing a number of ecological innovations and a growing economy. This geothermal system fits into this vision, leading to significant cost savings, reduced CO_2 emissions, and a heat source independent from world market price fluctuation.
	Timeframes	A feasibility study, environmental impact assessment, detailed technical plans were developed in 2007-2008. (Using EU Interreg funds.) The contract for construction was signed in June 2008. (EU Structural Funds). The system was implemented by the end of 2010.
	Objectives and main activities	Fuel costs of public institutions in the town were growing steadily. In 2007 alone the needed co-funding rate has increased from 59% to 70%. Therefore, the main objective of the municipality was to convert the heating system of public institutions in a way so that it leads to significant cost savings while reducing CO_2 emissions. As luckily the town is situated in an area with excellent geothermal potential, the choice was to implement such a system. Earlier geological research (oil exploration) and decades of good experience (spa and greenhouses) made the choice and project preparation relatively easy. This system was implemented as part of the towns smart city strategy: related measures were also implemented, such as energetic refurbishment of public buildings, replacement of street lighting to LED, introduction of a high-power heat pump, installing solar thermal collectors and PV etc.
	Barriers and problems occurred	The main barrier was financial. This is a small municipality, which by itself cannot afford constructing such a system. However, co-financing from several EU projects has successfully bridged this barrier. Another barrier is the very limited human capacity of the municipality. In this regard the EU-funded Interreg and Concerto projects were very important, as they brought in external expertise to plan the system. Luckily, the system has fulfilled its aim and no significant technical problems were encountered in the past few years. It runs very reliably, needing very low levels of maintenance.
	Main results and findings	The system has contributed to saving ca. 120,000 EUR annually on fuel costs. This is a very significant amount in a small municipality with limited budget. It can be operated in a very cost-effective way, as it does not require constant supervision. One single technician is contracted to check the system from time to time and carry out maintenance works. A system of this caliber can only be implemented if there is on-going political, HR and financial support in the municipality. Here one part of the success was political stability: a very committed mayor, re-elected several times in the past two decades.

Contact details of the responsible investor *Short description and contact details of the investor*	Municipality of Mórahalom 6782 Mórahalom, Szentháromság tér 1., Hungary www.morahalom.hu Phone: +36 62 281-022 info@morahalom.hu
Funding scheme *Please describe financing and co-financing method with financing amounts*	The cascading system was implemented using European Union and national funds. Project preparation was implemented as part of an EU Interreg funded project. The total budget was ca. 115,000 EUR, co-funding was 2x3000 EUR (i.e., municipality and Szeged University). Building the actual system was supported by EU Structural Funds, which provided 50% of the needed funding: 850,000 EUR. A smaller contribution came from the EU Concerto programme (i.e., FP7 funded Geocom project) as well as from the EEA/Norway grants programme. Co-funding was provided from the core budget of the municipality.
Photos *If possible, include max 5 photos, pictures, charts, etc. of best practice*	System layout: 

2.2.3. Best practice examples in climate change mitigation

Table 2.7 Best practice example in climate change mitigation in Hungary

Num.	**10**	
Title of best practice	**renoHUb project – a one-stop-shop consulting service for residential building energy refurbishment in Hungary**	
Brief description *Shortly describe the scope of best practice*	The renoHUb project stands for "Integrated Services to Boost Energy Renovation in Hungarian Homes". The aim of the project is to promote the energy refurbishment of domestic residential buildings in Hungary. While substantially reducing the energy consumption and CO_2 emissions of Hungarian households it substantially increases the comfort and market value of condominiums and detached houses. This way it provides added value of lasting impact. As part of this Horizon 2020 financed project a network of offices is set up, which provides one-stop-shop services to residents and condominium managers: from planning to all the way to the actual refurbishment.	
Detailed description	**Location**	Hungary
	Concept and background	About two third of Hungary's housing stock is outdated in terms of energy performance. A comprehensive energy renovation of homes would lead to a 40-50% reduction in heating energy consumption. Recognising this vast potential, the project therefore aims to establish a domestic one-stop-shop system, based on already operating successful examples in many European countries. This system targets those who are planning energy renovation and provides them with all the necessary information in one place for the entire renovation process.
	Timeframes	15 November 2019 – 14 November 2022
	Objectives and main activities	The overall aim of renoHUb is to trigger an upscale of the energy retrofits of the Hungarian homes through the development of an integrated business model that is economically viable without direct public grant co-financing. The project targets those home owners, which are considering to implement full or partial energy saving refurbishments in their homes within the next 3-5 years. (According to recent nation-wide surveys, approximately 24% of the Hungarian households are currently planning energy refurbishments.) The project will specifically focus of these homes in multiapartment or single-family houses to facilitate to turn their plans into completed investments. The project's main activity is to develop an integrated customer-centred service model (Renovation Hub) that reduces the identified barriers, responds to the needs and that provides tailored solutions to the homeowners throughout the home renovation process. To maximise the outreach to the potentially interested homeowners the Renovation Hub includes an online platform and two information hot spots. The Renovation Hub integrates the behavioural, communication, technical/engineering, financial, capacity building, legal and where relevant

		procurement aspects of home renovation. The on-line platform includes an on-line calculator, which gives help about the needed energy saving interventions. The platform also includes a complete document template collection (e.g. price quote, contract templates) as well as technical, financial, legal information. There is also a contractor database and a knowledge sharing facility. After the homeowners have collected the necessary background information on-line, they get personal support either at one of the consulting offices or through on-line interaction. This personal consulting guides homeowners through the entire building refurbishment process, until the successful completion of the reconstruction works.
	Barriers and problems occurred	Experience shows that the implementation of energy efficiency renovations in residential buildings is greatly influenced by the available tender subsidies, primarily in the form of non-refundable grants. Currently, this type of support is not available in Hungary, so this is a major barrier. Another problem is represented by the constraints caused by the COVID situation, which do not allow or make it very difficult to make decisions in the case of condominiums, as personal condominium residents' meetings can be held only to a limited extent.
	Main results and findings	Due to the large-scale promotion of energy refurbishment a CO_2 saving of 1970 tons is expected during the project's timeframe, and 18,277 within 5 years after project end. The project will achieve a lasting result through the financially self-sustainable consulting system. Although the project is still in a relatively early phase of implementation, it can already be observed that it can significantly boost the renovation process through bridging the information gap. It is also a first-of-its-kind example on a national level where such a one-stop-shop model is implemented and it keeps on running also after the completion of the project.
Contact details of the responsible investor *Short description and contact details of the investor*	Kinga Bíró Energiaklub E-mail: biro.kinga@energiaklub.hu https://renohub-h2020.eu	
Funding scheme *Please describe financing and co-financing method with financing amounts*	Coordination and support action for the call H2020-LC-SC3-EE-2018 Total cost: 1,558,298 EUR Reimursement rate: 100%	
Photos *If possible, include max 5 photos,*		

pictures, charts, etc. of best practice	

3. Best practice examples in energy refurbishment, renewable energy sources usage and climate change mitigation on international level

Going beyond Croatian and Hungarian border, we are witnessing a global effort of national governments in investing in energy efficiency and renewable energy in emerging and developing markets.

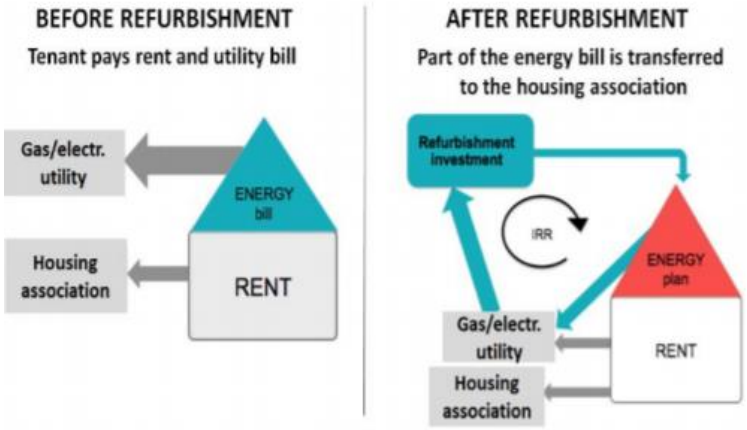
This can be seen from the best practice examples of energy and climate related projects analyzed within the following chapters.

3.1. Best practice examples in energy refurbishment

Table 3.1 International best practice examples in energy refurbishment

Num.	**11**	
Title of best practice	**Energy jump (Energiesprong)**	
Brief description *Shortly describe the scope of best practice*	Energiesprong (“Energy jump”) innovative and award-winning approach, is probably the most successful European nZEB retrofit project. It has contributed to refurbishing over 6 000 homes across Europe, w,ith over 20 000 more in the pipeline. Energiesprong works with Market Development Teams who are located in the UK, Netherlands, Germany, France and Italy. The State of New York and California work with Energiesprong inspired teams. A Net-Zero Energy house, developed by Energiesprong (Energy Jump), generates sufficient energy to heat the house, provide hot water and power its household appliances. Money normally spent on energy bills and maintenance work pays for the upgrade. Tenants no longer receive energy bills and the buildings have a 30-year performance warranty on both the indoor climate and the energy performance. The Energiesprong model is a radical transformation – both practically and conceptually – as it focuses on creating a volume market for solutions that satisfy five key criteria: guaranteed performance for 30 years, hassle-free, one-week implementation, affordability, attractiveness, from tendering to purchasing.	
Detailed description	**Location**	UK, Netherlands, Germany, France and Italy
	Concept and background	Energiesprong was commissioned by the Dutch Ministry of Interior Kingdom Relations and run from 2010 till 2016 under the experiments program of Platform31. Energiesprong resulted from this as the most successful innovative approach for net-zero energy retrofits. Since 2017 the Energiesprong approach has spread over Europe. Because the approach works with off-site manufacturing, the nuisance for residents can be kept to a minimum. As is the time that is needed to complete a retrofit. Because volume is the key to a viable path to scale, Housing Organisations are first organisations of interest. The bigger the volume, the more costs can go down and the more interesting the Energiesprong approach will get. To both Housing Organisations (home owners) and industry. As the volume goes up, the more

		promising the market will be to the construction companies [7]
	Timeframes	2010 – now
	Objectives and main activities	Energiesprong (Energy Leap) is an innovative market development programme that was launched in 2010 with a 50 million EUR government funded budget to develop attractive and viable net-zero energy retrofit solutions for the mass market by 2020 [8]. It was commissioned by the Dutch Ministry of the Interior and Kingdom Relations (BZK) and implemented by Platform31, which is a knowledge-sharing network of organisations committed to urban and regional development. It is designed to implement the Energy Innovation Agenda for the Built Environment (IAGO, 2009)4 and its primary goal is to create the market conditions for energy neutral buildings in the Netherlands. It aimed to deliver energy saving solutions to 5 000 building objects, including 2 500 new buildings and 2 500 renovated buildings . It aims to achieve a target of 45% to 80% energy savings in the built environment and energy-neutral new buildings by 2020. Longer-term, it targets a 50% overall reduction.
	Barriers and problems occurred	- Regulatory and planning barriers - Creating the necessary funding conditions - Generating demand for (not yet existing) NZEB refurbishments - Mobilising the construction sector to move towards a completely new system of working
	Main results and findings	- Over 6 000 net-zero energy houses are in use and thousands of retrofits in the pipeline - 2018, Energiesprong won the World Green Building Council award and Nottingham's Energiesprong homes won the UK Housing Award and Shift Award - 2019, Energiesprong's E=0 and Transition Zero projects won the EU Sustainable Energy Award, Energiesprong UK won the prestigious Ashden Award, solution provider Melius Homes won a Construction News Awards for its Energiesprong retrofits in Nottingham
Contact details of the responsible investor *Short description and contact details of the investor*	Energiesprong Foundation info@energiesprong.org The Netherlands All contact info available here: https://energiesprong.org/contact/	
Funding scheme *Please describe financing and co-financing method with financing amounts*	Energiesprong attracts funding through several European projects supporting this international expansion: Transition Zero (H2020), E=0 (InterregNWE) and Mustbe0 (InterregNWE). Furthermore, teams in countries have acquired funding from national funds. (https://energiesprong.org/about/). Initial funding: 50 million (Govt funding: 2010-2016) 6 billion (WSW Social Bank funding for Stroomversnelling	

	(Rapids) deal) Additional European project funding awarded: 3.6 million (Transition Zero / H2020) 5.4 million (E=O / Interreg NW Europe). 
Photos *If possible, include max 5 photos, pictures, charts, etc. of best practice*	  

<table>
<tr><td></td><td colspan="2">  </td></tr>
<tr><td>Num.</td><td colspan="2">12</td></tr>
<tr><td>Title of best practice</td><td colspan="2">Social Housing energy renovation in Porto - Portugal – 2013-2020 period</td></tr>
<tr><td>Brief description
Shortly describe the scope of best practice</td><td colspan="2">The Porto City Council, through Domus Social, E.M., the municipal company in charge of Social Housing management, carried out a set of rehabilitation interventions, to improve the habitability of the building stock and increase the energy efficiency of its constituent units, thus contributing to social promotion and the quality of life of municipal tenants, mitigating potential and actual situations of energy poverty in a population in more frail economic conditions. With these interventions, it was sought to increase the thermal comfort and salubrious conditions of the occupants of the houses and the rational use of energy with the consequent reduction of energy bills, also increasing the sustainability of this building stock.</td></tr>
<tr><td rowspan="4">Detailed description</td><td>Location</td><td>Porto, Portugal</td></tr>
<tr><td>Concept and background</td><td>Municipality managed Social Housing in Porto accounts for around 13 000 dwellings and almost 30 000 inhabitants, or 13% of the total population. Energy audit and certification studies were developed for ten housing clusters in a total of 2 158 dwellings. These studies included the assessment of opportunities to improve energy performance and resulted in projects for energy efficiency interventions contemplating a total of 2 540 dwellings. Based on the impacts obtained and with the estimates of reduction in energy use and CO_2 emissions resulting from the studies, it was possible to extrapolate and estimate the impact of the interventions for all the dwellings subject to intervention between 2013 and 2020. The implementation was carried out in a mix of own and ERDF funds (Norte2020).</td></tr>
<tr><td>Timeframes</td><td>2013 – 2020</td></tr>
<tr><td>Objectives and main activities</td><td>The main objectives were to improve the habitability and increase energy efficiency, while improving thermal comfort, reducing energy bills and fighting energy poverty. The energy efficiency measures applied to the dwellings in the social housing clusters were essentially thermal insulation of the external walls, thermal insulation of the roofs, installation of more efficient glazing and, whenever possible and feasible, installation of solar thermal collectors for the preparation of domestic hot water.</td></tr>
</table>

	Barriers and problems occurred	- Need to comply with the norms to meet new energy requirements, which increased complexity - Need for financing the necessary renovation works - Carrying out the needed for renovation works while reducing the impact in the tenant's day-to-day life.
	Main results and findings	- 11 groups of social housing intervened - 125 buildings/blocks - 2 540 dwellings - 130 400 m^2 of total useful area - 7 year period (2013-2020) - 56 M EUR investment - Mix of own and ERDF funds (Norte2020) - 47% reduction in final energy use (9,4 GWh) - 50% reduction in CO_2 emissions (3 584 tCO_2) - Increased production of renewable energy
Contact details of the responsible investor *Short description and contact details of the investor*	José Ferreira – Domus Social, EM e-mail: jferreira@domussocial.pt	
Funding scheme *Please describe financing and co-financing method with financing amounts*	The project was financed by City of Porto, complemented with ERDF funds (Norte2020).	
Photos *If possible, include max 5 photos, pictures, charts, etc. of best practice*	 	

Num.	**13**	
Title of best practice	**Stegerwaldsiedlung, Köln – An exemplary energy retrofitting of a 1950's housing estate**	
Brief description *Shortly describe the scope of best practice*	After the grave World War II. destruction in Köln (Germany) there was a need for a large number of new dwellings – quickly and cheaply. The Stegerwaldsiedlung includes 16, largely four-level buildings, altogether 594 flats (in total 33.500 m²). As part of the comprehensive renewal of the estate, all buildings and green areas were qualitatively upgraded to highest standards. This way the Stegerwaldsiedlung not only offers higher life quality but it can also be called "Klimaschutzsiedlung", i.e., a housing estate with very low climate impact.	
Detailed description	**Location**	Mülheim district of Köln, Germany
	Concept and background	As the Estates were built back in the 1950's, even in spite of proper maintenance there was a need for deep renovation by the end of the millenium. In line with Köln's exemplary smart city strategy, the idea was to improve inner-city quality of life by a comprehensive renewal of this city quarter. Measures focused not only on simple energy renovation, but the idea was to upgrade the overall living environment so that the area becomes attractive to middle class tenants also. This project was to be developed into a good example, so that based on the experiences other similar estates can be deep renovated also.
	Timeframes	Planning and permissions: 2012-2015 Construction: 2016-2019
	Objectives and main activities	The main objective was to make improvement in the following areas: energy efficiency (i.e., building insulation), sustainable heat supply, renewable electricity generation, smart building management, electromobility. Main activities included insulating the entire building (external walls, attics, bottom floor; adding 3-pane windows), changing gas heating to district heating (1743 kWp), installing 968 kWp PV modules, 41 air-water heat pumps, 16 power storage batteries, installing e-mobility charging stations, adding e-bikesharing and e-carsharing services, constructing 689 new flats in the roof space, adding new external elevators and balconies, renewing green space, installing smart meters in flats, involving tenants in energy management.
	Barriers and problems occurred	Deep renovation of existing building stock is one of the greatest challenges to achieve Europe's climate goals. While it is difficult enough for single-family houses also, it is even more so for large housing estates where hundreds of families need to be involved, brought on board and re-located during construction time. Such re-location is difficult in itself, but in Köln where there is very little publicly owned backup dwelling space it is even more so. Besides tenants, planners and project developers had to cooperate with a large number of stakeholders: energy company, mobility service providers, municipality, foreign project partners, authorities, architectural planners etc. While the complexity

		and integration of this project is its greatest innovation, this is also what made project development and implementation more difficult.
	Main results and findings	After years of preparation and construction the project was successfully concluded and the entire Stegerwaldsiedlung was refurbished to highest standards. This way it has fulfilled its original role to serve as a testing ground and example for the integrated renewable of other similar estates. An important finding is that communication is of extreme importance for the success of such a project. Tenants have to be involved and motivated from early planning phases, so that they take ownership of the project and use newly installed devices properly. (This is especially true for smart building management services, where tenants can actively steer their own energy use.)
Contact details of the responsible investor *Short description and contact details of the investor*		RheinEnergie AG Tel: +49 221 178-4040 energiedienstleistungen@rheinenergie.com
Funding scheme *Please describe financing and co-financing method with financing amounts*		Co-financing came from a number of sources: GrowSmarter project *(Horizon 2020 lighthouse project, where this site was one of 3 European demonstration areas. Total project budget was 25 million EUR)* RheinEnergie (project developer) Deutsche Wohnungsgesellschaft mbH, Köln City of Köln Smart City Cologne
Photos *If possible, include max 5 photos, pictures, charts, etc. of best practice*		The location:  A typical view: 

	New external elevators and balconies were added, the roof space was converted into flats, the roof is covered by PV:  Air heat pumps complement district heating: 

3.2. Best practice examples in renewable energy sources usage

Table 3.2 International best practice examples in renewable energy sources usage

Num.	**14**
Title of best practice	**Shallow Geothermal Heating and Cooling at the Parliament of Andalusia**
Brief description *Shortly describe the scope of best practice*	The Andalusian Parliament is the legislature of the Spanish Autonomous Community of Andalusia. The seat of the Parliament is located in Seville, the capital city of Andalusia. Its building is the former historic Hospital of the Cinco Llagas (Five Wounds Hospital). Built in 1546, used as hospital until 1972, and renovated in 1992, when this large building was retrofitted to be the seat of the Andalusian Parliament. Sevilla has a Mediterranean-oceanic climate and is probably the hottest spots in Europe. Cooling needs are essential but heating is very necessary also. Heating and cooling needs are served by very low enthalpy geothermal energy (heat pump) by exchanging energy water-to-water with an underground shallow water reservoir lying 10-20 meters above the ground

	at a very constant temperature of 18-22ºC along the year. There is no water consumption (close circuit). This temperature stability is critical for a high performance. This way, the water reservoir acts as a "seasonal heat reservoir" in a much more much more efficient way than standard air-to-air model. [14] This project is an excellent example of integrating RES into historic and cultural buildings.	
Detailed description	**Location**	Seville, Andalusia, Spain
	Concept and background	Heating and cooling needs of the Parliament are assisted with a geothermal shallow energy installation (very low enthalpy geothermal energy) by exchanging heat with underground shallow waters. The project used is a safe and eco-friendly method of extracting heat from underground water (or bedrock), in order to heat or cool buildings. The water reservoir lies 10-20m below the ground, and separated by 150m from the re-injection zone, at a very constant temperature of 18-22ºC along the year. This temperature stability is critical for a high performance. This way, the water reservoir acts as a "seasonal heat reservoir", giving back away in winter the heat injected in summer. Heat is extracted from underground waters in winter (18ºC underground water temperature, +5ºC typically outdoors) and re-injected in summer (22ºC underground water temperature, +40ºC typically outdoors). Most of these features can be directly implemented in existing European historic buildings. [13]
	Timeframes	2016 – 2017
	Objectives and main activities	The main objective was to design and integrate a modern, eco-friendly and efficient heating and cooling system into a building which has significant historic and cultural heritage. The system needed to accommodate needs of Mediterranean-oceanic climate, and to be integrated in a way it utilises potential of locally available RES. Shallow geothermal cooling and heating was chosen as a solution, using water for heat transfer and utilising potential of reservoir's temperature stability when placed some 10-20m below the ground. This approach is easily replicated on similar sites and locations offering solution for heating and cooling while meeting the requirements of protection of historic buildings. This solution assures high comfort and energy savings compared to standard HVAC alternatives.
	Barriers and problems occurred	- There is significant potential for replication, however, depending on the availability of an underground water reservoir - Large initial investment - Heritage restrictions and conservation requirements - Environmental regulation on drilling works and underground water bodies
	Main results and findings	- The geothermal facility saves energy both in winter and summer due to the energy demand reduction, but also because in medium seasons there is

		simultaneous production of both heating and cooling. The thermal devices can produce 7ºC and 45ºC water at the same time at the same machine, avoiding the use of chillers and boilers. - External extreme temperatures do not affect the coefficient of performance of the heat pumps because the water reservoir keeps a stable temperature. [13]
Contact details of the responsible investor *Short description and contact details of the investor*	Andalusian Energy Agency, Joaquín Villar, joaquin.villar@juntadeandalucia.es, www.agenciaandaluzadelaenergia.es/knowthe-agency	
Funding scheme *Please describe financing and co-financing method with financing amounts*	For a total power of approximately 5 MW of refrigerating production equipment, the cost of the wells was approximately 345 000 EUR. The budget includes water extraction and reinjection wells, as well as a network of buried pipelines. The project was financed by Parliament´s own funds.	
Photos *If possible, include max 5 photos, pictures, charts, etc. of best practice*		
Num.	**15**	
Title of best practice	**Solar Pecka**	
Brief description *Shortly describe the scope of best practice*	“Solar Pecka” initiative enabled implementation of the first photovoltaic (PV) system in a rural area in Bosnia and Herzegovina (BiH) has been installed on the roof of the Visitor Center Pecka near the city of Mrkonjić Grad thanks to an online crowdfunding campaign that attracted donors from the country, the region, and all over the world. As part of this initiative, an online fundraising campaign was launched to raise funds needed to install a system of solar panels and collectors on the roof of the Visitor Center Pecka. The campaign had a wide outreach, reaching also neighbouring countries and has gathered a total of 6.687 USD. The funds gathered were used to install 300l solar thermal collector and photovoltaic panels, making it the first of a kind project in Bosnia and Herzegovina, and proving that it is possible to find alternative solutions to implement such needed projects even with the lack of funding.	
Detailed description	**Location**	Mrkonjić Grad, Bosnia and Herzegovina

	Concept and background	The initiative "Solar Pecka" was initiated by the Visitor Center Pecka from Mrkonjić Grad and the Center for the Environment from Banja Luka in May 2019. The 'Coalition for Sana' was also involved, which has been working for a long time to protect this area. The building targeted with this project was an old school building which, with the support of the Municipality, was given to a group of enthusiasts in 2014, and which was then reconstructed in the Center for Sustainable Tourism in the Rural Community. The Center has quickly become an unavoidable destination for many tourists, and for many school excursions. The initiators wanted to encourage and promote use of RES and show that energy can be obtained in this way. In addition, a new socio-educational dimension was added to the Visitor Center: the example of using the sun to produce energy through the direct participation of citizens and private individuals, through this unique model of joint investment.
	Timeframes	May 2019 – June 2021
	Objectives and main activities	A total of ca. 13 000 USD was needed to install the complete system (5.4 kW) on the roof of the Visitor Center and realize the idea. The aim was to provide the Center with solar energy for both electricity and domestic hot water production and to set an example for rural Bosnia and Herzegovina, as well as for all other communities on how RES can be accessible. "Solar Pecka" ensured the educational component – by showing in practice the benefits of solar energy. "Solar Pecka" is a pioneering project which demonstrates that sustainable citizen energy projects in BiH are feasible despite numerous financial, technical, and regulatory challenges", says Nestor Ruiz, coordinator for the Solar Pecka initiative at the CZŽS. The main activities were the fundraising campaign which was focused mostly on crowdfunding as the main mechanism, installation of the photovoltaic and solar thermal panels, and promotional campaign.
	Barriers and problems occurred	- Lack of funding - Administrative barriers - Longevity of the project since initiation until realisation - Low awareness amongst general population
	Main results and findings	- 226 individuals and organisations took part in the crowdfunding gathering a total of 6 687 USD, thus surpassing the goal set to 6 000 USD - 300l solar thermal collector installed - 4.5 kW photovoltaics installed - High visibility and access to general public
Contact details of the responsible investor	Center for Environment, https://czzs.org/?lang=en Miše Stupara 5, 78 000 Banja Luka info@czzs.org	

Short description and contact details of the investor	+387 51 433 140, +387 51 433 142
Funding scheme *Please describe financing and co-financing method with financing amounts*	Deploying the entire planned PV system, with a capacity of 5.4 kW, requires a total of 13 000 USD, and the second phase of the project should be implemented with the support of associations and businesses. A total of 6 687 USD was gathered through the fundraising campaign.
Photos *If possible, include max 5 photos, pictures, charts, etc. of best practice*	  

Num.	**16**	
Title of best practice	**Paraffin based latent heat storage in connection with geothermal district heating system in Lendava**	
Brief description *Shortly describe the scope of best practice*	This is an example of high-quality energy refurbishment of a XIX. century listed building. Before reconstruction, the municipal library of Lendava (North Slovenia) was heated using fossil fuel (heating oil), in an inefficient way (i.e. 201 kWh / year / m^2). As part of the measure the earlier 16,8 tons / year CO_2 space heating related emissions were reduced to zero due to a range of innovative interventions. First, the building was connected to the town's geothermal network (at exploitable temperatures of only 50 degrees). Second, an innovative paraffin-based heat storage system was installed, which helps to bridge peak demand times. Due to a range of energy saving measures the building's energy demand was reduced by 5.5%.	
Detailed description	**Location**	Lendava, Slovenia
	Concept and background	The energy refurbishment of historic buildings is always a great challenge. A number of mainstream measures are either not possible or desirable (e.g. external insulation or installing plastic windows). Therefore, there is a need for innovative solutions, which can be replicated at other historic buildings also. The renewal of the town's library served this purpose and it has proved to be an excellent testing ground.
	Timeframes	April 2019 – March 2022
	Objectives and main activities	The main objective of the work was to reduce the costs and CO_2 emissions connected to building operation. In order to achieve this the building was connected to the city's geothermal system. The heat exchanger was located in a small basement room. In another room two steel storage tanks (2x1000l) were installed, filled with paraffin-based phase change material (2160 pieces of Ø42 x 310mm sticks; 50°C). This heat storage is very important to balance low incoming temperatures and to bridge peak demand.
	Barriers and problems occurred	As the building is located at the end of the geothermal district heating cascade, available heat temperatures are very low (i.e., at 55 degrees inlet as low as 47 degrees). Therefore, this situation called for very efficient energy use. Second, the old building had very small basement room to install heat storage tanks. Therefore, paraffin was chosen, as it efficiently absorbs/releases heat energy and takes less space than water storage tanks. Being a building listed in the Register of Slovenian Cultural Heritage, project developers had to comply with a number of legal requirements.
	Main results and findings	Due to optimized energy distribution solutions an energy saving of 4000 kWh was achieved (i.e., 3%). This means that annual CO_2 emissions of 22 t/year were avoided. The main conclusion is that it is very much possible to upgrade the energy performance of historic buildings – one only needs to make careful planning and use innovative

		technical solutions, such as in this case paraffin-based heat storage.
Contact details of the responsible investor *Short description and contact details of the investor*	Municipality of Lendava E-mail: obcina@lendava.si Web: www.lendava.si Tel.: +386 2 577 25 00	
Funding scheme *Please describe financing and co-financing method with financing amounts*	The investment was financed from the Slovenian-Hungarian Interreg project called Store4HUC. The total planned budget for this pilot measure was 100,000 EUR incl. VAT.	
Photos *If possible, include max 5 photos, pictures, charts, etc. of best practice*	A listed cultural heritage building was energy refurbished (built 1906):  The geothermal heat exchanging substation in the building's basement: 	

Phase-changing paraffin cells and heat storage:

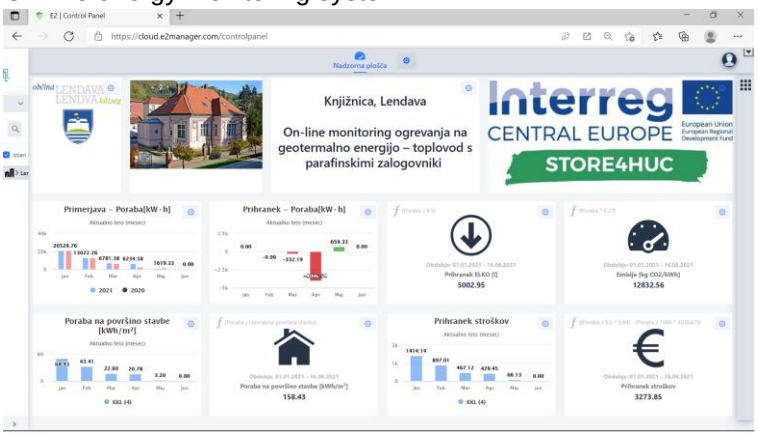




Laying pre-insulated pipes to connect to the geothermal district heating grid:



On-line energy monitoring system:



3.3. Best practice examples in climate change mitigation

Table 3.3 International best practice examples in climate change mitigation

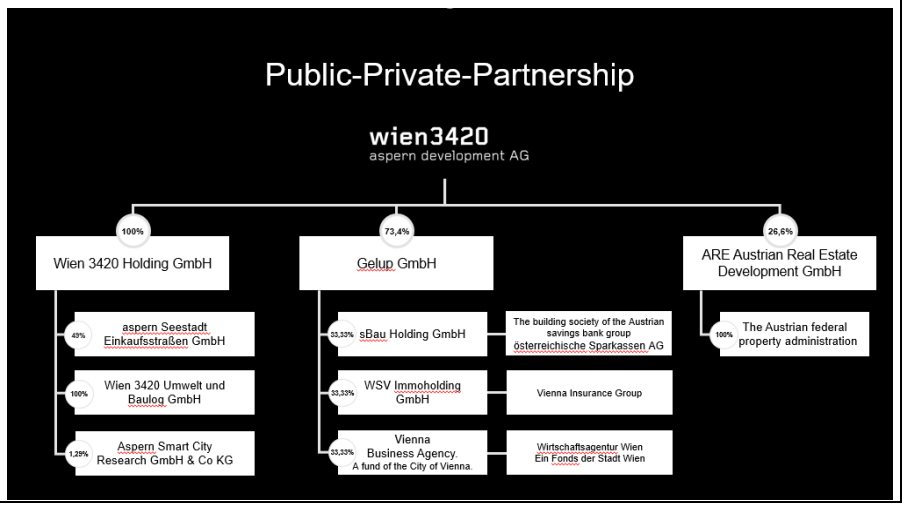
Num.	**17**	
Title of best practice	**Energy access SMEs development project**	
Brief description *Shortly describe the scope of best practice*	Recognising the significant struggles rural populations in Central Asia face in terms of accessibility of reliable and affordable energy services, project was developed and implemented in Tajikistan and Kyrgyzstan. Aim of the project was to provide affordable and accessible sustainable energy solutions such as DIY solar thermal collectors, installing mini electricity RES powered grids, providing public institutions such as hospitals with hot water, and developing and testing innovative business models for local SMEs. Project was focused on using locally available and intermediate technologies and empowering local population, to take part in the process. The focus was on wide typology of interventions including setting a basis for reforms in the energy sector, awareness rising through demonstrating the economic benefits of the green energy solutions and building capacity of technical experts for installation and repair of the green energy equipment, etc. Project has been formally launched in January 2018, building upon previous experiences from the United Nations Development Programme (UNDP) Green Villages Initiative implemented in Kyrgyz Republic and Tajikistan.	
Detailed description	**Location**	Tajikistan and Kyrgyzstan
	Concept and background	Rural population in Central Asia is facing many struggles with severe energy poverty. They often lack access to sufficient amounts and quality of all energy services. Other big problem is poverty and lack of employment opportunities. Thus, the project was developed, piloting innovative sustainable solutions for villages in Kyrgyzstan and Tajikistan providing affordable and accessible energy solutions, empower local population to take part in the process and strengthening and promoting local SMSs. Project also aimed to utilise innovative financing mechanisms such as crowdfunding and using locally available materials and intermediate technologies. The project's goal was to offer a comprehensive strategy to scale-up private sector engagement in energy access by improving the risk-return profile of private investment in energy access products and services.
	Timeframes	2 years, starting in 2018
	Objectives and main activities	The key objective was to expand energy access and provide reliable, affordable, and sustainable energy products and services for the rural population of the Kyrgyzstan Tajikistan facing energy poverty, through promoting scalable, private sector-led business models and de-risking their investment. Project activities focused on introducing and testing new technologies and energy services in selected villages. 12 policy recommendations were developed for green energy development, working closely with national stakeholders. The project cooperated with the most suitable microfinance

		institutions for stimulating investments in green energy project.
	Barriers and problems occurred	- Lack of access to finance and limited market demand for renewable technologies - Immature renewable energy market with limited number of high-quality products and equipment suppliers; and - Low technical capacity of local enterprises.
	Main results and findings	- More than 16 000 households benefited from the RE - 31 public buildings equipped with PV and sustainable water heating Kyrgystan: - 5.2 kW photovoltaics - 3 650 litres of installed solar water heating systems - 8.8 kW cooling and 8.9 kW heating - air-to-air heat pumps - Solar driers with 101 m2 of drying area and 21.9 kW backup electric capacity. Tajikistan: - 83 kW photovoltaics, including 25 kW installed within 7 mini-grids (off grid) pilots - 8 300 litres of installed solar water heating systems
Contact details of the responsible investor *Short description and contact details of the investor*	The project is funded by Organization for Petroleum Export Countries (OPEC) Fund for International Development.	
Funding scheme *Please describe financing and co-financing method with financing amounts*	In total, 10 micro-finance institutions (MFIs) and banks have been featured on the Energy Access Platform. In parallel, the project tested crowdfunding products, leveraging impact in establishing micro-financing incentives for investors and users of the RE technologies. The project also tested four new business models for SMEs under various agreement modalities such as concession, energy cooperative, rental, and as pay-as-you-go model. Although, COVID-19 has brought unexpected challenges in fully supporting these business models, the pilot activities have proven to be impactful for further scaling up in future projects, improving access to modern, affordable, and sustainable energy services. Total Budget: 406 000 USD 800 000 USD (OPEC Fund) 1 050 000 USD (UNDP parallel funding) 180 000 USD (Government parallel) 376 000 USD (Other donors parallel)	

Photos

If possible, include max 5 photos, pictures, charts, etc. of best practice

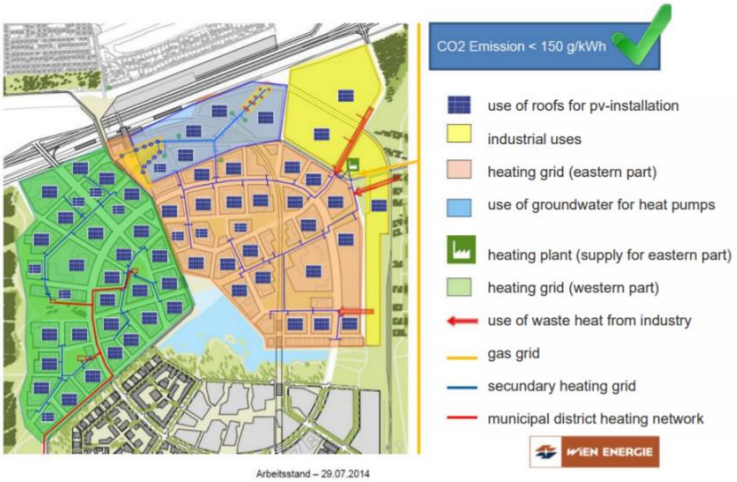
Num.	**18**	
Title of best practice	**Aspern Seestadt Vienna**	
Brief description *Shortly describe the scope of best practice*	Aspern Seestadt is one of Europe's largest urban development projects. The fast-growing 22nd district in the north-east of the Vienna, a new urban centre is taking shape – a smart city with a heart, designed to accommodate the whole spectrum of life. A multi-phase development foresees the creation of high-quality housing for over 25 000 people and, eventually, thousands of workplaces. Aspern Seesstadt Vienna has the potential for 20 000 workpaces with total investment volume of 5bn EUR. The City of Vienna and a network of strong partners from business and the public sector are the organisations behind Aspern Seestadt. The development agency Wien 3420 AG is in overall charge of the project. Around 50% of the Seestadt are reserved for parks and green spaces. These smartly planned and designed public spaces enable a balanced life and work in the country and yet in the middle of the pulsating city with all its urban amenities. 40% cycling and walking, 40% public transport and only 20% car traffic - this is the targeted distribution of local traffic in Seestadt. Numerous measures contribute to this goal and make a valuable contribution to climate protection.	
Detailed description	**Location**	Aspern Seestadt, 1220 Wien
	Concept and background	With the aim to redesign the old airfield the project was initiated in 2003. The goal of the project was to design a smart and sustainable city which had all the needed services easily accessible by foot or by bike and with good connection to the city centre. The innovative mobility concept Aspern mobil is all about sustainability. The target is that 40% of trips at Seestadt will be made by public transport, 40% by bike or on foot, and only 20% by car, moped or motorbike. The innovative mobility concept Aspern mobil is all about sustainability. The aim: a mobility mix that conserves resources and contributes to a superlative quality of life. And, with the diverse range of mobility options available, you're always one step ahead.
	Timeframes	2003 – 2028
	Objectives and main activities	The aim: a mobility mix that conserves resources and contributes to a superlative quality of life. Step by step, milestone by milestone - until 2028 Aspern is growing urban lakeside of Vienna in area of 2.4 million m². Living space is created for over 20 000 people and with similar number of job openings. In 2003 the project team was formed and the planning initiated. In 2004 public consultations and appointment of “on-site experts” took place together with the launch of master plan competition for the former airfield redesign and reuse. The masterplan was approved in 2007, and in 2008 the competition for public space planning concept was initiated. 2009 was the start of dismantling of old roadways, and in 2011 the first construction started. Underground stations were opened already in 2013 followed by the first wave of residents in 2014. By 2017 already more than 6000 people lived in Seestadt. The

		process continues with focus on sustainability and smart city design.
	Barriers and problems occurred	- Removing transportation barriers between green and transport areas - Setting up official quantifiable targets for such a large project - Making decisions with unknown framework conditions
	Main results and findings	- More than 120 businesses already located in Seestadt - By 2028, Aspern Seestadt will boast homes for over 20 000 people, plus almost as many workplaces - 2 900 already completed flats - 1 500 people already work there - 2 900 balconies and terraces - 56 bikes and e-bikes to rent and share - 7 communal underground garages for cars - 25 minutes to the city centre by metro - Car sharing system - Work sharing system - Short distances and design for commuting on foot or by bike - Focus of green spaces
Contact details of the responsible investor *Short description and contact details of the investor*	Wien 3420 Aspern development AG and the City of Vienna's Aspern Seestadt Project Management unit are the two essential points of contact for all stakeholders at Seestadt.	
Funding scheme *Please describe financing and co-financing method with financing amounts*	The financing is built on Public-Private-Partnership model, built on the following pillars of the funding model: - Start-up funding from equity capital - Acquisition of property depends on intended use - Purchase price of properties fixed from the outset - 50% co-funding of infrastructure by the City of Vienna - Phase-by-phase construction of infrastructure - Income and expenditure are index-linked - Expansion phases pre-funded through down payments received or advance sales - No funding from banks 	

Photos

If possible, include max 5 photos, pictures, charts, etc. of best practice

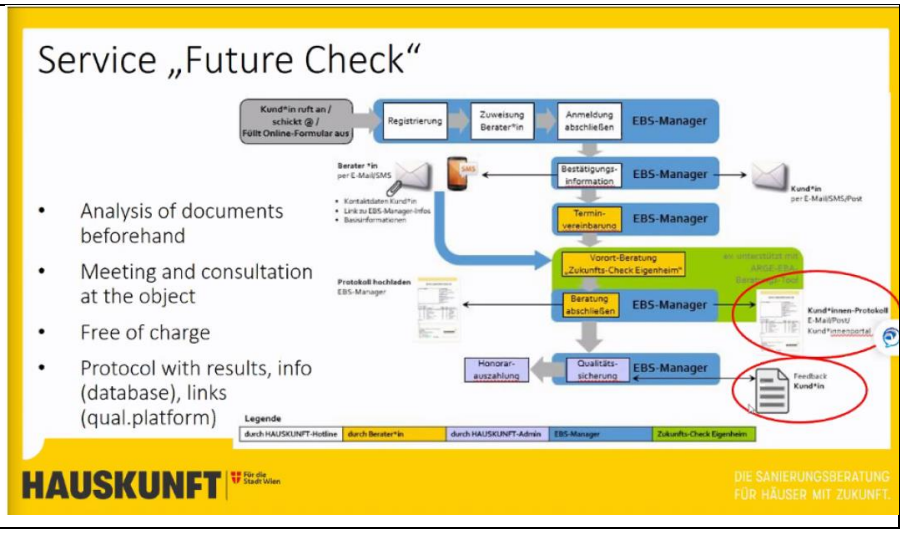
Illustration 10: Heat supply concept for aspern Seestadt North – minimum scenario



Source: Wien Energie, 2014

Num.	**19**	
Title of best practice	**RenoBooster project – climate change mitigation through innovative advisory and funding services for house refurbishments in Vienna**	
Brief description *Shortly describe the scope of best practice*	In the "RenoBooster" project key players from the municipal administration, the real estate industry, energy consulting and opinion research have joined efforts to improve the range of support available to home owners and administrators. A One-Stop-Shop consulting service shall use the newly developed services for the first refurbishment projects in Vienna. Simultaneously, legal framework conditions and subsidies are examined in order to create an optimally coordinated service. A web portal will provide access to all essential services and information.	
Detailed description	**Location**	Vienna, Austria
	Concept and background	The energy-related refurbishment of residential buildings has many advantages. It increases living comfort - in winter and summer - and is an important driver for local jobs and added value. The high-quality energy-efficient refurbishment of buildings also makes a very important contribution to achieving the city's energy and climate goals. In practice, however, owners willing to renovate are often confronted with complex technical, financial and legal challenges that the existing service infrastructure does not meet. By creating additional support services and bundling the various services and information in a central contact point ("one-stop shop"), the planning, execution and financing of house renovations will be made considerably easier. This is intended to increase both the number and quality of refurbishments.
	Timeframes	May 2019 – October 2022
	Objectives and main activities	A "One-Stop-Shop" - as it is supposed to exist in all member states according to the new EU building directive - should bundle the offers and thus simplify, accelerate and improve renovations. Vienna is therefore one of the first European cities and regions to develop such a service. The RenoBooster project has set up a service centre initially called RenoHub. It targets private property owners. In addition to accelerating the number of refurbished dwellings per year (target: 10-30,000 per year), the RenoHub also wants to increase the quality of deep renovations. For this they have established “Hauskunft”, which is the brand for the quality-oriented consulting service. It started consulting services only this year and already more than 500 coaching activities were completed. It also provides seed funding for home owners to prepare energy refurbishment (max. 5000 EUR).
	Barriers and problems occurred	A large survey has already been conducted to uncover the main barriers. It has shown that target groups often either don’t know what to do or don’t want to deal with the headaches related to reconstructing their homes. Energy-efficiency and cost savings were also found not to be main motivators for home reconstruction.

	Main results and findings	The main result is to increase the quality and quantity of private renovations. The one-stop-shop service should trigger investments in the value of at least 110 million EUR / year, leading to at least 1000 tons / year CO_2 savings by improving energy-efficiency by at least 5 GWh. Another main result is the creation of a professional database with at least 2000 planning and construction professionals. The survey mentioned earlier has shown that in spite of relatively poor interest in energy refurbishment, there is a growing interest towards using renewable energies (primarily PV).
Contact details of the responsible investor *Short description and contact details of the investor*	Stephan Hartmann City of Vienna E-mail: Stephan.hartmann@wien.gv.at Judith Neyer Urban Innovation E-Mail: neyer@urbaninnovation.at	
Funding scheme *Please describe financing and co-financing method with financing amounts*	100% cost reimbursement through Horizon 2020 project	
Photos *If possible, include max 5 photos, pictures, charts, etc. of best practice*	A platform for project preparation and construction for building energy-refurbishment:  Hauskunft is the brand for the quality-oriented one-stop-shop consulting service established by RenoBooster:  The process flow of services:	


Service „Future Check“
Analysis of documents beforehand
Meeting and consultation at the object
Free of charge
Protocol with results, info (database), links (qual.platform)
Kund*in ruft an / schickt @ / Füllt Online-Formular aus
Registrierung
Zuweisung Berater*in
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Bestätigungs-information
Termin-vereinbarung
Vorort-Beratung „Zukunfts-Check Eigenheim“
Beratung abschließen
Honorar-auszahlung
Qualitäts-sicherung
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Kund*innen-Protokoll
Feedback Kund*in
Legende
durch HAUSKUNFT-Hotline
durch Berater*in
durch HAUSKUNFT-Admin
EBS-Manager
Zukunfts-Check Eigenheim
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DIE SANIERUNGSBERATUNG FÜR HÄUSER MIT ZUKUNFT

4. Overview of similarities and differences in best practice examples between two states – Croatia and Hungary

Climate change is real – and its effects can already be felt all around the world. In order to counteract the destruction of the planet, inhabitants need to live more sustainably and stop wasting resources. This will require enormous changes, such as moving away from fossil fuels like coal and towards low-emission power sources like wind or solar energy. This structural change has great potential – if it is shaped justly. All over the world are existing advocates for a socio-ecological transition, which will be an answer to both the ecological and the social questions. The vision of all countries over the world should include low-emissions, resource-conserving and socially inclusive economic systems in which everybody has a chance for a decent life that is based on human rights principles. In order to facilitate this goal, countries are building stable, broad and progressive coalitions between the ecological movement, politics and trade unions that pave the way towards a more sustainable future.

Climate change mitigation, energy-efficiency and use of renewable energies is high on the political agenda in Croatia and Hungary. The EU's Green Deal is now moving towards implementation with introducing ever stricter regulations to steer EU's Member States towards a sustainable future. While the commitment is there and Croatian and Hungarian governments are also taking steps in this direction, the success of this vision will be determined by how it is implemented regionally and locally. This is also why initiatives such as the Covenant of Mayors have been created where members are many cities and in later years municipalities from Croatia and Hungary. After all, many settlements in mentioned countries host the bulk of economic activities – and to a large extent also cities and towns are the ones that need to endure the negative consequences of climate change and extreme weather events.

Europe's border regions, such as the one supported by the SEPlaM-CC project in Croatia and Hungary, face special challenges in this regard. In both countries the area features settlements that are predominantly rural in nature. Mostly only smaller towns are present (e.g., Čakovec in Croatia) and larger cities, such as Nagykanizsa (population 47 thousand) are rather the exception. This situation means that from an economical point of view most settlements have very limited capacities to implement large-scale energy and climate related activities. Most of the local and regional municipalities also have limited personal capacities and know-how in this field. The intention to improve energy-efficiency, save costs and reduce climate impact clearly exist in Croatia and Hungary – but a number of barriers still prevent the implementation of such projects on a large scale. Therefore, within this document we have collected several national best practices to show that it is very much possible to think big. The idea behind selecting these best practices is to pick the ones that demonstrate solutions that can be replicated elsewhere also.

In order to accelerate the exchange of experience, at each best practice we have provided the contact information of the demonstration project owners. Special attention has been given so that each best practice includes the description of practical difficulties also (to show that you are not alone!). Whenever it was possible, we

included relevant experiences about overcoming them. Each case study demonstrates innovations of some kind: be that technical (e.g., an innovative heat storage solution) or more of social nature (e.g., involving local residents in the decision-making process).

Best practice examples in energy refurbishment in both countries show tendency in refurbishment of public buildings such as kindergartens and municipal buildings which serve local communities. The selected best practices resulted in a significant reduction in energy consumption and lower energy bills while the use of RES is also being promoted. These projects combine construction methods, mechanical engineering and electrical engineering resulting in improved energy efficiency, energy savings and the use of renewable energy sources. Both examples in Croatia have resulted in the change of older buildings into a completely modern buildings while energy efficiency improvements (from energy class E to A+) with significant energy savings of more than 50%.The Hungarian examples of energy refurbishment of municipal buildings in Nagykanizsa is a big project, which launched a comprehensive program of energy renovation of municipal buildings, which are built into the overall environmental strategy of the city. Since we talk about large investments, both projects rely on EU funds. Additional problems occur due to the prices of construction materials, which have risen radically.

When talking about investments in RES usage, there are slight differences between countries. Best practice examples in RES usage in Croatia include installation of solar power plant at hospital and biomass district heating power plant, while in Hungary due to large geothermal potential in the border area, geothermal heating systems in the public institutions of the City Lenti and Mórahalom geothermal cascade system have been installed.

As can be assumed, hospitals are big electricity and heating consumers. According to that, it was suitable for installing a solar power plant in order to produce energy and accomplish visible cost savings, i.e., free up the budget to be invested in better health care for citizens. In 2015, Municipality Pokupsko launched the project of installing biomass district heating power plant which resulted in energy savings, reduction of local pollution and cost savings. This ensured municipality to satisfy more than 75% of energy needs from local resources. These projects could not be realized without additional funding sources.

Geothermal heating system in public institutions of the City Lenti consist of one production and one re-injection well. Serving as a local good practice to use RES instead of natural gas, the project led to the elaboration of an existing project concept that significantly increases the use of geothermal energy in the city area. The main goal of this project is to cover the needs for space heating of public institutions from geothermal energy. Second best practice in Hungary refers to installation of a heating system in the southern Hungarian municipality Mórahalom which consists of one production well and one reinjection well supplying geothermal heat to 12 public buildings owned by the municipality. The goal of all mentioned best practices was to reduce fuel consumption, and to reduce CO_2 emissions. A common problem faced by the implementers of these projects were the limitation in human capacities and finances, and therefore the exclusive reliance on EU Funds.

Another field of action both in Croatia and Hungary include climate change mitigation activities whereas local governments are aware of the importance of launching activities related to climate change mitigation and adaptation. In Croatia, a platform "On the sunny side" was launched in 2020, which connects citizens interested in investing in their own roof PV, through the purchase of photovoltaic systems. Because of untapped potential for solar energy, the project aims to encourage citizens to be actively involved in the energy transition, as consumers and investors, and not just to be passive observers. The main goal of the platform development was to create and offer citizens a solution for rooftop solar photovoltaic systems for their own consumption. The NEWLIGHT project was launched with the aim of reconstruction and installation of energy-sustainable and environmentally friendly public lighting in Zagreb and Krapina-Zagorje counties. The fact that this practice is recognized as successful is also proven by receiving the prestigious European Energy Services Award (EESA). On other side, the goal of the Hungarian project renoHUb is to promote energy refurbishment of domestic residential buildings in Hungary. Although energy refurbishment significantly reduces energy consumption and CO_2 emissions in Hungarian households, it also increases the comfort and market value of condominiums and detached houses. As part of this project funded by Horizon 2020, a network of offices has been established where services to tenants and apartment managers in one place: from planning to renovation are provided.

Analyzing the previous three best practice examples, it can be concluded that they are quite similar, as in each of the cases citizens are offered to use services that will help them in increasing energy efficiency of their homes by implementing energy refurbishment or by installing RES systems on roof of their homes. "On the Sunny Side" and renoHUb projects have a similar goal, supporting citizens through consulting services to use the potential of solar energy and reduce energy consumption and CO_2 emissions. These two projects have an important role which lead to far-reaching positive effects. What can be concluded is that in both countries the projects rely on local partnerships to acquire the community and influence climate change mitigation.

Presented examples of good practice in all three segments can motivate policy makers to change and help in achieving national climate change mitigation goals. A common problem which can be identified in all segments in both countries is the problem of funding, i.e., lack of it, low awareness and administrative difficulties. Further cooperation and application of examples of good practice can achieve the process of energy transition, better adoption of knowledge, technology and processes needed to achieve the desired effects. Additional problem is connected to increasement of prices of construction materials prices, which produces many challenges in the implementation of energy and climate related projects both in Croatia and Hungary. In terms of reducing CO_2 emissions, all selected best practice examples have the greatest impact, serving as a kind of catalyst in the recovery process. Experience shows that the hardest thing is to "roll the ball". Therefore, an external stimulus is needed to facilitate the initial steps.

5. Conclusions and recommendations

There is a significant number of best practice examples in energy refurbishment, renewable energy sources usage and climate change mitigation available. All the information used for developing this comprehensive analysis is however dispersed, provided in different languages and format. Formats available seldomly include comprehensive up-to date best-practice data bases and they are often in form of individual, and hard to identify stories, and brochures. These chosen best practices also feed into other activities implemented within the SEPIaM-CC project. Therefore, they were chosen and written in a way so that they complement other activities as well as serve as a background material for the implementation of later activities. Most importantly, this document aims to accelerate the exchange of experiences among experts and decision-makers, both within the country as well as across the Croatian-Hungarian border. Probably this is its greatest value, as again and again the experience shows how important proper communication and exchange of experience is in climate change mitigation projects preparation and implementation.

Best practice examples can serve as excellent tool for motivating change in new locations implemented by new actors and also for sharing knowledge between various stakeholders worldwide. Availability of such information can ensure that there is greater uptake of RES and EE technologies and quicker achievement of climate change mitigation goals. Greater availability of extensive and thorough information on best practice examples is likely to contribute to transferring the know-how and avoiding the repetition of same mistakes and easier overcoming of the typical barriers.

Sharing knowledge and lessons learned can help speed up energy transition process and enable quicker and better uptake of technologies and mechanisms needed for achieving climate neutrality. Local champions often struggle with similar barriers and problems, such as lack of financing, low awareness, and administrative struggles. Lack of financing, as shown through this analysis, can be overcome with financing mechanisms alternative to conventional public funding such as public private partnerships, crowdfunding, EU funding, loans, and energy communities. With careful planning and strategic approach low awareness can be bypassed in the beginning phase of project initiation, while overcoming administrative barriers requires evidence-based advocacy and lobbying.

There is a great potential in further development of similar analyses to offer comprehensive and easy to access database for all interested stakeholders, enabling quicker and smarter transition towards carbon neutral society.

6. References

[1] Analysis of best practice examples in energy refurbishment, renewable energy sources usage and climate change mitigation, prepared by IMRO-DDKK Nonprofit Ltd., available at: https://www.menea.hr/wp-content/uploads/2022/02/Analysis-of-best-practice-examples_SEPlaM-CC_ZMVA.pdf.

[2] Analysis of best practice examples in energy refurbishment, renewable energy sources usage and climate change mitigation, prepared by North-West Croatia Regional Energy Agency, available at: https://www.menea.hr/wp-content/uploads/2022/02/Analysis-of-best-practice-examples_MENEA.pdf.