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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)

Analysis of best practice examples in energy refurbishment, renewable energy sources usage and climate change mitigation in Hungary

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**This document has been produced with the financial assistance of the European Union. The content of the document is the sole responsibility of Zala County Enterprise Development Foundation and can under no circumstances be regarded as reflecting the position of the European Union and/or the Managing Authority.

July, 2021

LIST OF TABLES

TABLE OF CONTENTS

1. Summary

This document contains a collection of case studies related to building energy refurbishment, the usage of renewable energy sources and actions related to climate change mitigation. These case studies represent good examples from the border region of Croatia and Hungary, examples from the national level as well as best practices from other European countries. The aim with these case studies is to inspire others and to serve as good examples to implement similar activities in the SEPIaM-CC project's beneficiary region in Croatia and Hungary.

The first case study showcases the energy refurbishment of municipal buildings in Nagykanizsa. Twelve selected buildings are being refurbished, with the aim to test innovative energy saving methodologies and to serve as good examples to accomplish similar actions for other buildings – both within the city as well as in Zala county. The special value of this case study is its integrated nature – which is best demonstrated by the fact that the project also includes the upgrade of the city's existing energy plan into a full-fledged Sustainable Energy and Climate Action Plan (SECAP).

Two case studies demonstrate the establishment of a municipal geothermal system. The one from Mórahalom showcases a so-called cascading system, while the one from the city of Lenti is a traditional two-pipe system. Each one has its advantages and disadvantages. As the geological reserves in Mórahalom deliver methane also, it is separated from the water and is used in a co-generator to provide electricity as well as additional heat. The one in Lenti is a "future-proof" solution, allowing the connection of new users later.

Two projects are featured which demonstrate the feasibility of a one-stop-shop consulting service to accelerate the energy refurbishment of residential buildings. One is from Vienna and the other one is a service covering whole Hungary. Both projects are funded from the Horizon 2020 programme and a special feature of them is that both will be financially fully self-sustaining after the project's end. Acting as catalysts to reduce barrier against energy-refurbishing, these projects promise CO_2 emission reductions in the range of over 10,000 tons.

One best practice demonstrates the high-quality refurbishment of multiapartment homes in the city of Köln, Germany. This exemplary renovation has already earned the title „Klimasiedlung", and serves as a testing ground and example for the remodelling of similar condominiums elsewhere in Germany as well as in Europe. Besides energy-refurbishment, the overall living quality was improved by engaging residents (e.g. through smart energy management), improving mobility offers (shared mobility and electric mobility), renewing the green areas as well as upgrading the buildings (e.g. adding elevators and new balconies).

One good practice demonstrates the feasibility of innovative energy refurbishment of classified historic buildings. The municipal library of Lendava (Slovenia) was connected to the city's geothermal network and a high-performance, paraffin-based energy storage system was added. As a result of these and other connected actions (e.g. smart building management) the building's CO_2 emissions were reduced to zero.

2. Introduction

Climate protection, energy-efficiency and use of renewable energies is high on the political agenda in Europe. The EU's "Green Deal" is now moving towards implementation, and new, ever stricter regulations are introduced to steer this block of countries towards a sustainable future. While the commitment is there and each member state is taking steps in this direction, the success of this vision will be determined by how it is implemented locally, i.e. in our cities and towns. This is also why initiatives such as the Covenant of Mayors have been created. After all, European settlements 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 SEPIaM-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-refurbishment 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 is clearly there – but a number of barriers still prevent the implementation of such projects on a large scale. Therefore, we have collected this collection of case studies to show that it is very much possible to think big in our micro-region and to spread the word that already a lot has been done. The idea behind selecting these case studies is to pick the ones that demonstrate solutions that can be replicated elsewhere also. In order to accelerate the exchange of experience, at each case study we have provided the contact information of the demonstration project owners.

Examples have been collected from the Croatian-Hungarian border region, from national level, as well as from Europe. Special attention has been given so that at each case study 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).

These case studies 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 experience 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 mitigation project preparation and implementation.

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

3.1. Best practice examples in energy refurbishment

1. Table - Energy refurbishment of municipal buildings in Nagykanizsa

Num.	1	
Title of best practice	Energy refurbishment of municipal buildings in Nagykanizsa	
Brief description	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	Municipality of Nagykanizsa László Balogh, mayor Tel: +36 30 2040-865 E-mail: balogh.laszlo@nagykanizsa.hu	
Funding scheme	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	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.	

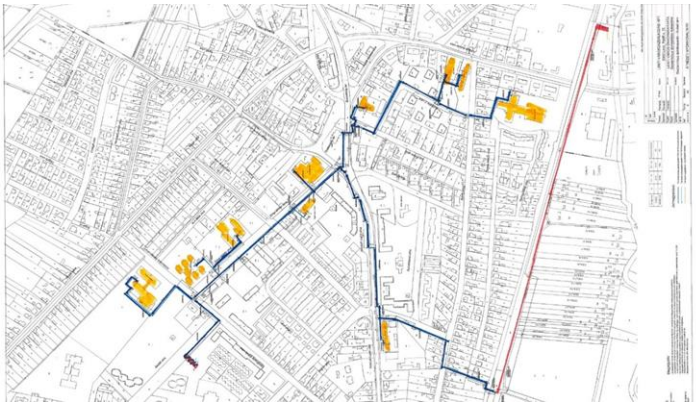
3.2. Best practice examples in renewable energy sources usage

2. Table - Development of a geothermal heating system in the public institutions of the City of Lenti

Num.	2	
Title of best practice	Development of a geothermal heating system in the public institutions of the City of Lenti	
Brief description	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 presently 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. (This is 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	László Horváth Mayor of Lenti Tel: +36 92 553-913 E-mail: polgarmester@lenti.hu	

Funding scheme	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	Map of the pipelines and the location of municipal institutions:  Launch of drilling activities: 

3. Table - Mórahalom geothermal cascade system

Num.	3
Title of best practice	Mórahalom geothermal cascade system
Brief description	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.	
Detailed description	**Location**	Mórahalom, Hungary
	Concept and background	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”, 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.

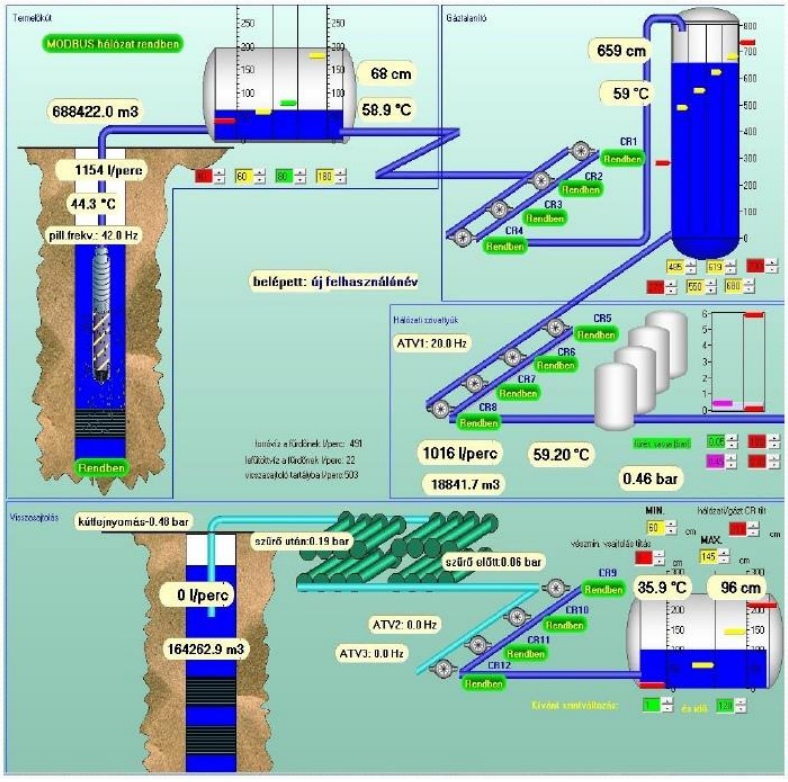
	Objectives and main activities	Fuel costs of public institutions in the town were growing steadily. In 2007 alone the needed co-funding rate has increased from 59% to 70%. Therefore, the main objective of the municipality was to convert the heating system of public institutions in a way so that it leads 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	Municipality of Mórahalom 6782 Mórahalom Szentháromság tér 1. Hungary www.morahalom.hu Phone: +36 62 281-022 info@morahalom.hu	
Funding scheme	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	System layout:  Production well site: devapourisers (green containers) supplying CH_4 to run co-generator (located in container on the right-hand side) 

Co-generator prevents atmospheric CH_4 emission and produces enough electric power to run the entire system:

System layout:



	Main pump: 

3.3. Best practice examples in climate change mitigation

4. Table - renoHUb project – a one-stop-shop consulting service for residential building energy refurbishment in Hungary

Num.	4	
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	Kinga Bíró Energiaklub E-mail: biro.kinga@energiaklub.hu https://renohub-h2020.eu	
Funding scheme	Coordination and support action for the call H2020-LC-SC3-EE-2018 Total cost: 1,558,298 EUR Reimursement rate: 100%	
Photos		

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

4.1. Best practice examples in energy refurbishment

5. Table - Stegerwaldsiedlung, Köln – An exemplary energy retrofitting of a 1950's housing estate

Num.	5	
Title of best practice	Stegerwaldsiedlung, Köln – An exemplary energy retrofitting of a 1950's housing estate	
Brief description	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	RheinEnergie AG Tel: +49 221 178-4040 energiedienstleistungen@rheinenergie.com	
Funding scheme	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	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:

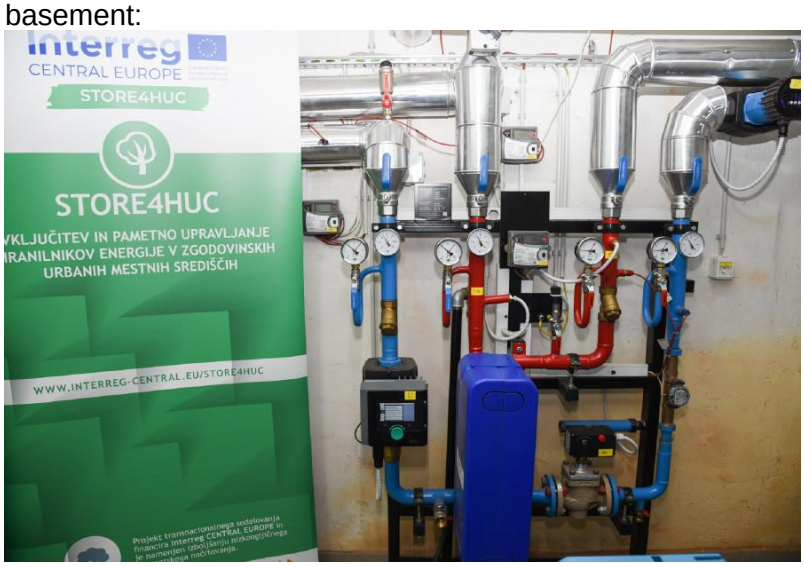
Air heat pumps complement district heating:

4.2. Best practice examples in renewable energy sources usage

6. Table - Paraffin based latent heat storage in connection with geothermal district heating system in Lendava

Num.	6	
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 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	Municipality of Lendava E-mail: obcina@lendava.si Web: www.lendava.si Tel.: +386 2 577 25 00	

Funding scheme	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	A listed cultural heritage building was energy refurbished (built 1906):  The geothermal heat exchanging substation in the building's basement: 

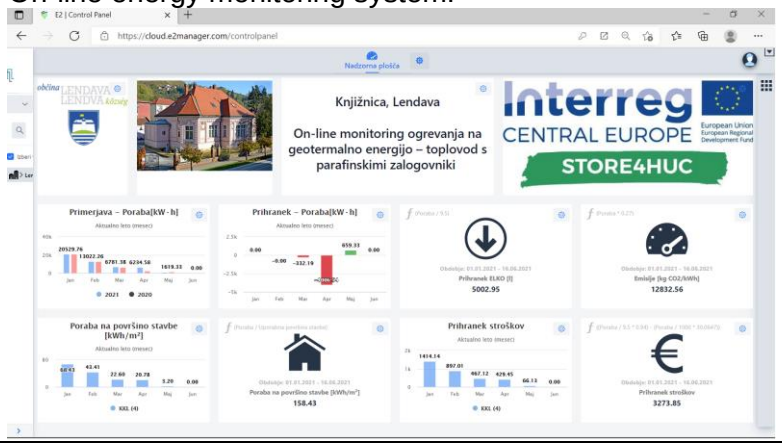
Phase-changing paraffin cells and heat storage:





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



	On-line energy monitoring system: 

4.3. Best practice examples in climate change mitigation

7. Table - RenoBooster project – climate change mitigation through innovative advisory and funding services for house refurbishments in Vienna

Num.	7	
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).
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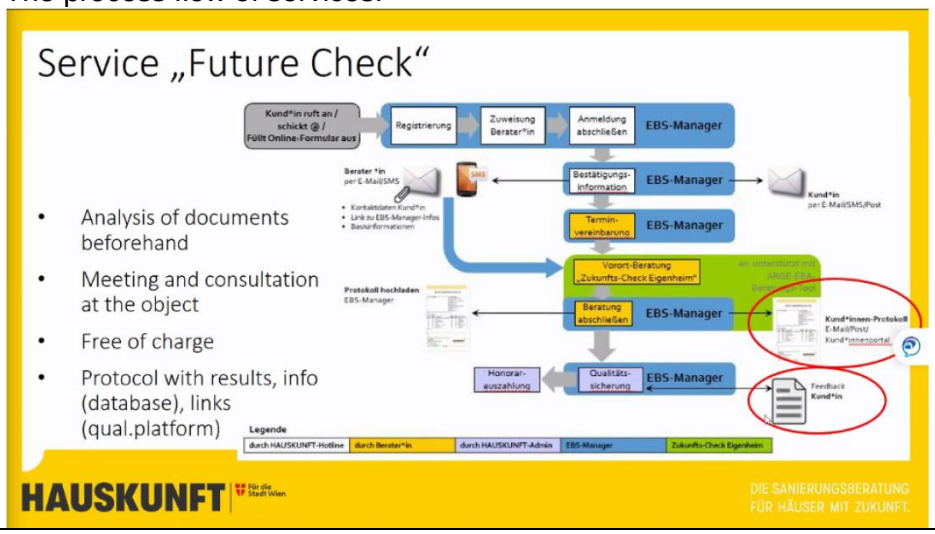
Funding scheme	100% cost reimbursement through Horizon 2020 project	
Photos	A platform for project preparation and construction for building energy-refurbishment: 	

Hauskunft is the brand for the quality-oriented one-stop-shop consulting service established by RenoBooster:

HAUSKUNFT | Für die Stadt Wien

DIE SANIERUNGSBERATUNG FÜR HÄUSER MIT ZUKUNFT.

The process flow of services:



5. Problems occurred during the best practice research and development of the analysis

During the development of these best practice cases some challenges had to be overcome. It is best to call them challenges rather than problems, as they also serve as a learning opportunity. A good example is the limited availability of information in the needed detail. One reason is that some of the featured projects are still in the implementation phase and it is too early to draw solid conclusions. In those cases where projects were funded from European or national projects, financial information was easier to collect. However, in cases where business interests are also represented (e.g. in public-private partnerships) the distribution level of financial information was either non-public or only gross figures were available.

Attention was given so that the case studies represent a diversity of good practices. This way we hope to maximise the value of this document. However – especially on the local level – it was difficult to identify suitable case studies in each type of categories that we have been looking for. Therefore a significant part of the research work included background information collection, so that from a longer list the most useful case studies could be selected. This involved significant research and networking, ranging from literature review to direct expert contacts.

Another challenge was that the amount and structure of available information varied significantly from case study to case study. A lot of information gaps had to be bridged so that eventually such a collection could be developed where the structure, length and description of each case study came into coherence.

Apart from these challenges, no bigger problems occurred during case study development. This is most importantly due to the experience of assigned staff as well as because of the efficient cooperation among the SEPIaM-CC project partners.

6. Conclusions

Based on the case studies contained in this document the following main conclusions can be drawn:

- The present rapid increase of construction prices presents a significant challenge in implementing infrastructure-oriented climate change mitigation actions. Most of these actions were financed from European and nationally funded development projects, which were prepared years ago and which have a strict ceiling for the amount of eligible costs. This challenge can be minimised by shortening project development cycles and by including adequate buffer in the planned budget. Luckily, in our region no project had to be suspended due to construction price hikes, which is a great achievement.
- Integration is very important for the success of a demonstration project. Therefore, each of these case studies demonstrates that by including a number of mutually reinforcing measures, the end result is much more robust than just implementing one single demonstration measure. On the other hand, planning and implementing a bundle of measures increases the complexity of planning and process management also. It is an important lesson learnt that it is better to focus on a few lighthouse projects rather than implementing a larger number fragmented mini-projects.
- The amount of innovative energy-related demonstration projects tend to be proportional with settlement size. This is largely due to the available financial and human resources. Therefore, all our examples come from towns/cities and no villages are included (although they are the greatest in number in our border region). Focusing on small towns, most of these featured good practices serve as good examples that innovative energy solutions and CO_2 emission reduction is very much a viable option even even in these settlements.
- Hard and soft measures must go hand-in-hand. Two case studies represent soft measures (consultancy services) and all the other are essentially infrastructure-related works. However, in all cases measures were complemented by significant communications and cooperation activities. This most importantly meant involving the relevant stakeholders (residents) into the planning process as well as communicating the projects' aims and upcoming steps from an early stage. An important finding is that if there is no proper involvement of residents, either the public acceptance of the implemented measure may be low, or in the worst case their implementation may be seriously hindered.
- In terms of CO_2 emission reduction, those projects have been found to have the highest impact, which serve as a sort of catalyst in the refurbishment process. Experience shows that it is most difficult to "get the ball rolling". So there is a need for external impetus to make the initial steps easier. In this regard, one-stop-shop consultancy services play an important role, leading to far reaching positive impacts.

7. References

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