Survey on existing demand-response (DR) actions and collective actions in the heating and cooling sector and overview of legal and other requirements and challenges

Deliverable 2.3

Project Coordinator: Austrian Energy Agency – AEA

Work Package 2, Sub Task Leader Organization: WIP

April 2020

This project has received funding from the
European Union's Horizon 2020 Research and
innovation programme under grant agreement No 847087.

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Project coordination and editing provided by Austrian Energy Agency.

Manuscript completed in April, 2020

This document is available on: www.replace-project.eu

Document title	Survey on existing demand-response (DR) actions and collective actions in the heating and cooling sector and overview of legal and other requirements and challenges
Work Package	WP2
Document Type	Deliverable
Date	30 April 2020
Document Status	Final Version (v1.0)

Acknowledgments & Disclaimer

This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 847087.

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1 | General information

With heating and cooling (HC) comprising 50 % of the final European energy consumption and over 68 % of all gas imports (European Commission, 2019), permanently reducing consumption and increasing the share of renewables in this sector is paramount for a successful Energy Union. In particular, the fact that 80 million out of 120 million installed space heating systems in Europe currently achieve an energy label class C or D gives rise to major concern (EHPA, 2019). REPLACE therefore aims to boost the phase-out of inefficient and old heating and cooling systems by targeting consumers, investors/owners as well as intermediaries (installers, plumbers, and chimney sweepers) and helps them to make or support the making of informed decisions.

In WP2, an analysis of infrastructural requirements, legal and regulatory framework for the decarbonisation of the heating and cooling sector is carried out. Task 2.3 of WP2 is a survey on existing Demand-response (DR) actions and Collective Actions (CAs), including Renewable Energy Communities (RECs) and Citizens' Energy Communities (CECs), in the heating and cooling sector and an overview of legal and other requirements and challenges in the sector.

2 | Executive Summary

Demand Response (DR) actions

Altogether, 19 DR actions can be found in this report. Not in all countries, demand response actions exist for the heating & cooling (HC) sector (Slovenia and Spain). For these countries, examples of the classical DR actions in the electricity sector are provided, which also have a beneficial impact on the environment by energy saving and changing consumption patterns, lower emissions and a lower demand in high-demand periods of time. DR actions in the HC sector show a variety in the REPLACE target countries. From the aim to influence consumers' behaviour in heating via different tariffs in Croatia, over PV electricity supply peak shaving by producing domestic hot water in Bulgaria, to the use of smart meters in a DH network in Austria for consumption optimisation of different load control strategies at a residential complex of 133 units. Interesting concepts were reported also from Bosnia and Herzegovina, where a solar power plant on the roof of a school in Sarajevo uses a hybrid boiler to provide hot water and electricity from the PV system, and from Germany, where decentralized buffer tanks contribute to avoiding supply peaks. In North Macedonia, the Rulebook on Renewable Energy Sources is supposed to have a considerable impact in the near future, e.g. through stimulating self-consumption of self generated PV electricity in a hybrid system.

Collective Actions (CA)

More examples are provided for Collective Actions (CA). In the REPLACE target countries, 28 examples for CA actions are shown. Very interesting is the initiative of BENÖ (Bioenergy Lower Austria) in Austria, bringing together different skills for the success of Farmers' cooperatives. Collective actions for insulation were reported from Austria, North Macedonia and Serbia. Different kinds of group purchases are realized in the target countries for wood pellets (Austria and North Macedonia), PV systems (Austria, Serbia and Spain), electricity and natural gas (Slovenia and Spain), and for pellet stoves (Slovenia). For Germany, the example of a RES cooperative to realize collective heating is given, and in Spain, a RES cooperative invested in the purchase of a hydropower plant, achieving a yearly reduction of 4,000 t CO_2-eq.

3 | Demand response (DR) actions

Following, information about Demand response (DR) actions is given. First, general definitions are presented, followed by examples about the scope of these actions. For all REPLACE target countries, DR actions are furthermore shown, if possible covering directly the HC sector.

3.1 General definitions of DR

Demand-response is a concept which originally comes from the electricity market. According to the European Commission, “Demand response is the intentional modification of normal consumption patterns by end-use customers in response to incentives from grid operators. It is designed to lower electricity use at times of high wholesale market prices or when system reliability is threatened. Demand response requires consumers to either actively respond to signals from the operator or, in what may be a more appealing option, to make use of automated solutions to enter into contracts with service providers. Demand response can be either incentive-based, where consumers are offered payments to reduce their power consumption at times of peak demand or when the system is under stress, or it can operate on a time-price principle. This option, which simply involves consumers shifting their consumption to low-cost periods, has a lot of untapped potential for industrial consumers of electricity, as many of these have the flexibility to shift significant consumption loads to off-peak hours.” (SETIS Magazine, 2014)

In the Upgrade DH project, Rutz et al. (2019) have transferred demand-response for District Heating as following:

“For DH systems, the change of the load will be able to reduce consumption peaks. These occur when many consumers need heat at the same time. This happens for example when many connected private houses request domestic hot water in the morning/afternoon e.g. for showering, or when the night-time heating reduction turned off at the same time. For these peaks of heat demand, most DH systems have some peak-load boilers, working only for a few hours a year. The problem is that they cause substantial costs and usually use fossil fuels (heating oil, natural gas) for this short-term delivery. That is the reason why there are many optimization approaches to lower/ avoid these peak loads as for example to apply accurate load prediction (Faber, Groß, & Finkenrath, 2018) or to integrate (buffer-) storages.”

Furthermore, Rutz et al. (2019) identified also the integration of (renewable) power-to-heat as DR, which means that surplus electrical power from solar or wind energy can be used to (re)charge buffer storages in heating systems (DH and individual HC systems). In this context, sector coupling, using surplus electrical power in DH and individual HC, to produce heat (power to heat) or gas (power to gas) which could either be used for electricity or heat production or in CHP (combined heat and power) systems to produce both. Individual HC can be found mostly in detached housing and in houses which cannot be connected to a DH network because of other reasons.

In general, it can be said that DR is end consumers’ behaviour that is useful for a more efficient and effective network operation and utilization with regard to

- the integration of large shares of fluctuating distributed electricity from RES
- reducing demand for electricity gird extension or reinforcement
- reducing peak heat load supply and/or grid heat losses in district heating systems

3.2 Scope of DR activities considered

DR activities that shall be considered in the target regions are either DR activities improving the electricity system operation, or DR improving an economic and ecological operation of (renewable) district heating and micro grids.

Examples of **DR activities improving the electricity system operation** could be differentiated regarding self-consumption optimized operation (i.e. DR actions with indirect positive effects, e.g. in case of electrical supply by own PV plants) or by real-time overall electrical system/grid utilization optimized steering via remote control of heating systems through distribution system operators (DSOs). Examples are:

- PV electricity supply peak shaving (in summer) by producing domestic hot water via heating rods installed in hot water boilers/storages of in-house heating systems
- applying smart grid ready heat pumps in combination with hot water storage tanks or building component activation (i.e. heat storage capacity of low temperature underfloor or wall heating systems) at in-house heating systems
- PV electricity supply peak shaving (in summer) by covering electricity self-demand of in-house air-cooling systems or heat pumps operating reversible for cooling or by operating free cooling systems (e.g. via ground water) in combination with building component activation at in-house cooling systems. In Germany, this approach is realized in the form of the so-called Mieterstrom-Modell (tenant's power model). Mieterstrom is defined as electricity, that is produced on the roof of a residential building and directly transferred (i.e. without electricity transmission) to and consumed by the end-consumers who live in the residential building or in buildings in direct vicinity (BMWi, 2020)
- More complex scenarios involving smart grids or aggregators (like virtual power plants or virtual consumers delivering different system services) are not considered here

Examples of **DR improving an economic and ecological operation of (renewable) district heating and micro grids**, shall focus on intelligent operating and control strategies, in particular to avoid or compensate for peak loads, as these represent a major problem area for the operation of local and district heating networks. In most cases, peak load boilers have to be kept available and put into operation to cover these peak loads. For cost reasons, these are usually designed as fossil-fuelled (with gas or heating oil), pure heat generators (i.e. without combined heat and power (CHP)). The operation of these peak load boilers worsens the economic (high specific heat costs due to low capacity utilization and expensive fuels) and ecological (high specific CO_2 emissions) performance of the local and district heating systems.

Possible examples are:

- The shift in the heating loads of the connected buildings.
- The use of the network as a store through flow temperature control.
- The integration of central and distributed storage.
- The partial operation of network sections (e.g. for grid parts with very low load in summer (high heat losses), grid part(s) could be supplied by solar thermal or solar PV + heat pumps instead).
- Grid-side hydraulic optimizations (e.g. grid ring closure)

- The introduction of new tariff models

3.3 European level DR issues

European level DR issues of relevance for this report are laid down in the Electricity Market Directive (regarding the framework conditions) and the EU General Data Protection Regulation (regarding the legal status of data management). Further considered can be the CEER Consultation on Dynamic Regulation to Enable Digitalisation of the Energy System by the Council of European Energy Regulators.

1. The Electricity Directive (DIRECTIVE (EU) 2019/944 on common rules for the internal market for electricity) establishes common rules for the generation, transmission, distribution, energy storage and supply of electricity, together with consumer protection provisions, with a view to creating truly integrated competitive, consumer- centred, flexible, fair and transparent electricity markets in the Union. It aims to ensure affordable, transparent energy prices and costs for consumers, a high degree of security of supply and a smooth transition towards a sustainable low-carbon energy system (Article 1). In Article 3 is laid down that Member states shall ensure that their **national law does not unduly hamper** cross-border trade in electricity, consumer participation, including through (among others) **demand response** (which is also described in Article 2, No. 20). The Directive mentions demand response explicitly in Articles 17 (Demand response through aggregation) and 20 (Functionalities of smart metering systems).

2. The EU General Data Protection Regulation (GDPR) is laid down in Regulation (EU) 2016/679 and regulates the **protection of** natural persons with regard to the processing of **personal data** and on the free movement of such data and needs therefore to be respected in all occasions when personal data is used in DR activities. In this Regulation, the requirements and rights of the natural persons are well defined. Sanctions need to be put in place if the GDPR is not respected (laid down in articles 83 and 84). This is regulated in the national GDPR adaption.

3. DR activities will require further digitalisation for which up to date not all aspects are regulated. The Council of European Energy Regulators (CEER) has therefore developed several recommendation papers, of which the paper "Distribution Systems Working Group (DS WG) - New Services and DSO Involvement" dealt explicitly with the potential role of Distribution System Operators (DSO) in the data management field. It is concluded there that DSO acts as a data provider, it is **crucial** for them **to ensure that privacy and security concerns are safeguarded**. All such "data activities", in which form they may be, require always the explicit consent of and close follow-up by National Regulatory Authorities - NRAs (CEER, 2019).

3.4 DR actions existing in partner countries

Following, identified DR actions are shown that were identified in the REPLACE partner countries.

3.4.1 DR actions existing in Austria

For the case of Austria two representative demand response cases, one in the field of combined electricity and heat utilization in the large volume residential building area, another in the field of district heating are documented in the following.

Demand Response (DR) action AT Nr 1

Energy and storage management for Community generation facilities

Place	Austria

Description of action

Before 2017 it was only single-family houses that have been able to use "their" photovoltaic electricity as they wanted. For those interested in “own” PV electricity usage in an apartment building, the legal framework made this impossible until that time. The energy was only allowed to flow into the power supply of the common rooms and other common infrastructure or into the public grid.

The 2017 amendment to the Electricity Act (Elektrizitätswirtschafts- und -organisationsgesetz – abbreviation: ELWOG) made it possible for the parties to a residential building to jointly use energy from their own generation plants. This allows multi-family houses, which have extensive roof areas, to install large-scale photovoltaic systems.

In this section a paper (Gaisberger & Rechberger, 2019) is presented, where the energy concept of an exemplary large-volume residential building was analysed and the improvement potential of different load control strategies for consumption optimisation was tested. A simulation model of the heating and electrical systems was developed. This model was simulated using different energy management algorithms and the results of these simulations were analysed.

The residential complex, which is the model for the simulations, was built in 2018. There are 133 residential units on a gross floor area of around 11,000 m². The heat supply in this building complex is provided by a gas condensing boiler and heat pump, which are controlled depending on a fixed bivalence temperature. Four buffer storage tanks at two different temperature levels serve as thermal storage units, as well as a hydraulic separator, which ensures that the mass flows between the heating circuit and heat pump are balanced. The thermal storage tanks are additionally equipped with electric heating rods. A photovoltaic system with battery storage is also installed.

Heat consumption	400	MWh/a
Hot water energy demand	229	MWh
Gas condensing boiler	2 x 200	kW
Heat pump	130	kWth
PV system	103	kWp
Battery storage	115	kWh
Heating buffer storage	1 m³	@ 45°C
Hot water buffer tank	2 x 6 m³	@ 50°C & 70°C
Electric heating elements	5 x 6	kW
Common electricity demand	16	MWh
Domestic electricity demand	430	MWh

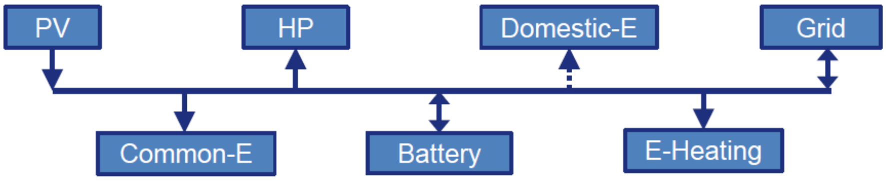
An energy concept was developed in which the central PV system is used primarily to supply general needs (including heat pump and battery storage) and the surplus is available to the tenants. Thus, an optimal use of the generated energy in the interest of the general public as well as a high economic efficiency even with low tenant participation is realisable. The latter is essential, especially due to the lack of experience.

Therefore, attempts were made to optimise the general part of own consumption (common needs) by means of different control and prioritisation concepts for general consumers, especially the heat pump and electric heating elements. For this purpose detailed simulations were carried out.

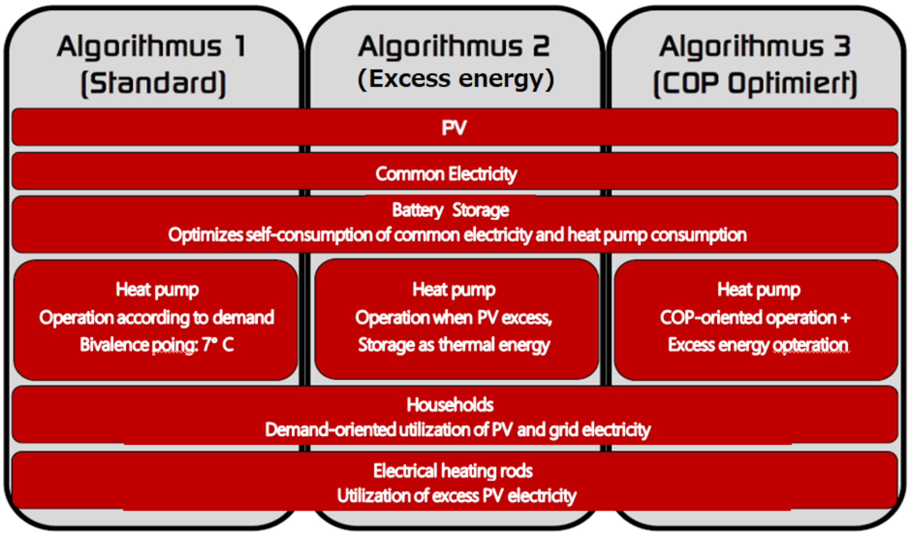
Simulation environment

Electrical area:

- Automatic prioritization (from left to right)
- Battery only supplies consumers on the left
- Simulations with and without household electricity demand
- Electrical heating elements before mains supply



Three different control strategies for the operation of the heat pump were developed to optimise the use of electricity. The reference control corresponds to the initial situation. The air-source heat pump is activated at outside temperatures above 7 °C and supplies heating and domestic hot water depending on demand. Based on this, control 2 attempts to increase the internal consumption by means of thermal storage. Control 3 continues to focus on increasing the efficiency of the system by operating the heat pump at high COP values even outside the original operating limits.



	Ratio electricity to gas price: COP > 19 ct / 4,81ct = 3,95
Actors	Related to the study presented here: • FH OÖ Forschungs & Entwicklungs GmbH • cooperative building owner General (for implementation in reality) • "Champion" of the overall model: housing association cooperative, association, contractor, energy supplier • Housing developers/house owners/facility management • Residents ("participating entitled persons") • Investors • Grid operators • Plant operators
Targets of action	Increase of the share of energy self-consumption of electricity generated by community PV plant Optimization of energy management in the general area of the building • Application planning of a heat pump under different conditions • Power2Heat • Safeguarding of an economic own consumption Integration of the residents by means of a tenant electricity model • Influence on the use of surplus electricity
Impact on the energy system	By introducing a tenant electricity model, the own consumption can be increased by approx. 30 % with the selected components of the generation plant and the existing building, independent of the control strategy. The share of own consumption thus reaches approx. 99 %. With a COP-optimised control system, the share of electric heat generators in the total heat supply could be increased from approx. one quarter to just over 50 %. **Details**: All three control strategies were examined for their efficiency and potential savings by means of detailed simulation in MATLAB/Simulink. In each case, the cases with and without tenant participation were examined. In the standard configuration without further participation of the tenants, about 70 % of the PV energy can already be used in the general area. An increase due to the alternative control strategies is only slight. If the tenants are included (balance sheet tenant electricity model), almost complete use is guaranteed in the selected configuration.

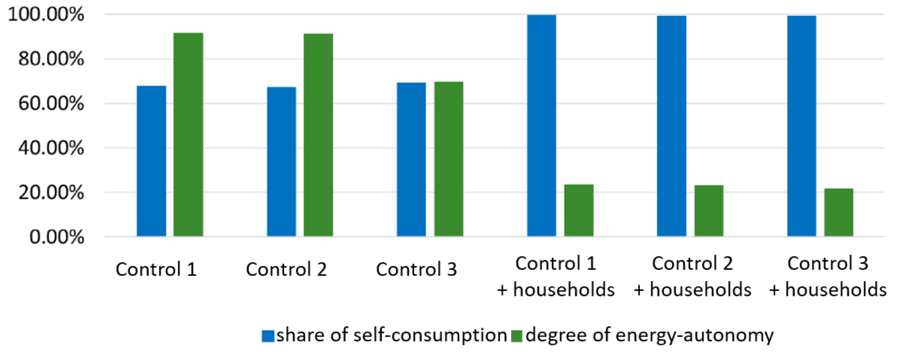


Figure 1: Share of PV generation self-consumption (blue), Energy autonomy degree (green)

When looking at the heat quantities, there are only minor differences between the model with and without tenant flow. A significantly lower use of the electric heating elements in the heat storage units can be seen, as these are connected downstream of the consumption in the households. Their share is largely taken over by the gas boiler.

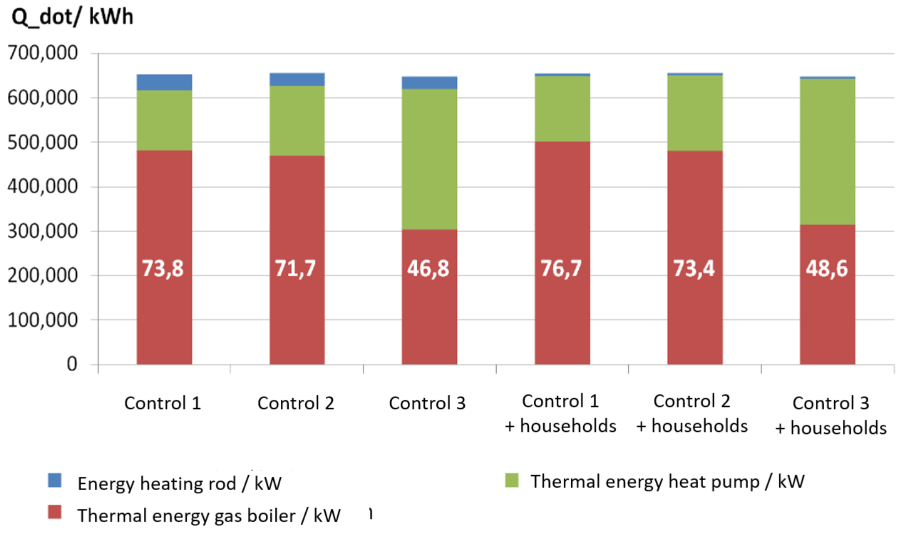


Figure 2: Heat contribution of heating rod (blue), heat pump (green), gas boiler (red).

With control strategy 3, the share of the heat pump can be increased significantly due to the optimized operating mode. This is also reflected in the costs.

Economic viability (availability of subsidies)	The energy costs of the common, general areas (see next figure) are largely defined by the gas procurement costs or are directly dependent on the energy procurement for the heating systems.

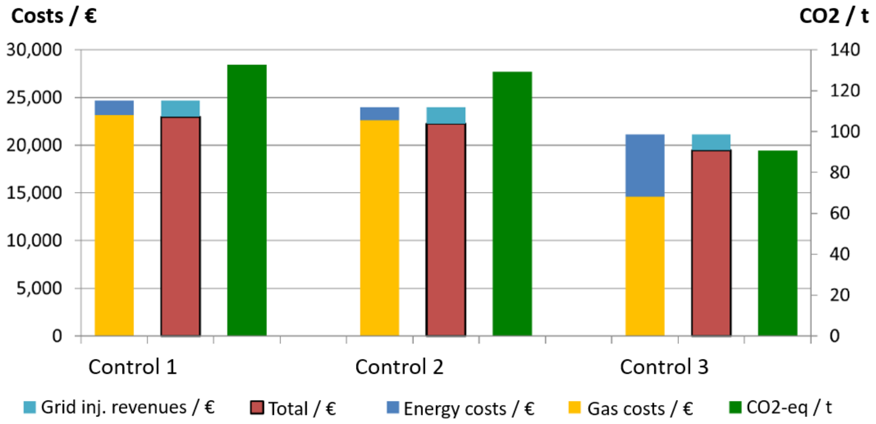


Figure 3: Annual energy costs for common uses; grid injection of surplus electricity (bright blue), Total (red), Electricity procurement from grid (dark blue), costs of natural gas (yellow) and GHG emissions (green).

If households are included in the calculation (next figure), household electricity is responsible for a central share. Due to the almost complete use of PV energy in the building, there is no significant income from feed-in of surplus electricity.

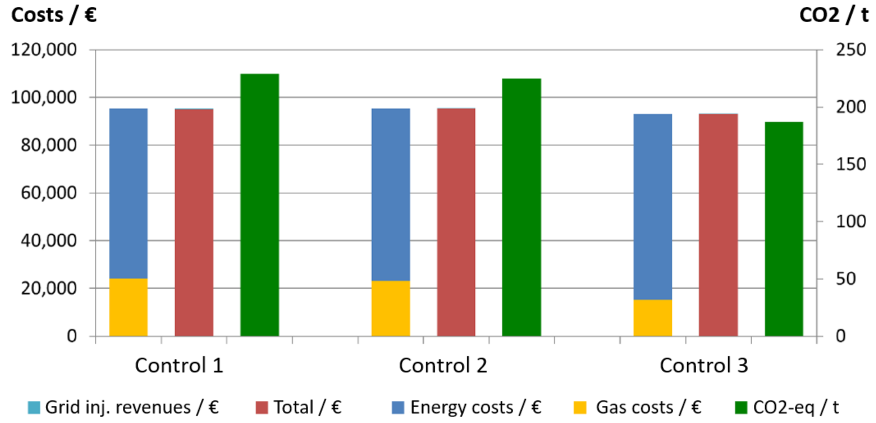


Figure 4: Annual energy costs for domestic and common uses; grid injection of surplus electricity (bright blue), Total (red), Electricity procurement from grid (dark blue), costs of natural gas (yellow) and GHG emissions (green).

Conclusions

Control strategy 2 (surplus)

- Effects rather small
- Potential for improvement (temperature limits,..)

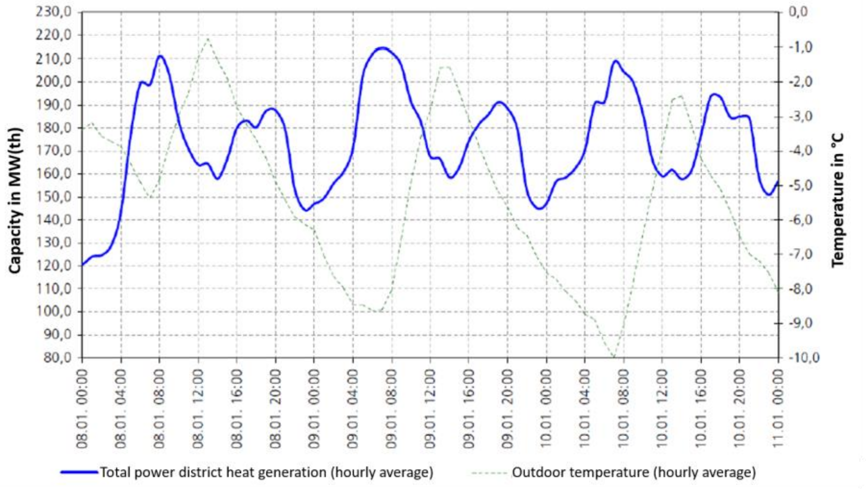
Control 3 strategy (COP Optimized)

- Significant shift of heat generation to heat pump
- Savings in energy costs
- Significant reduction of GHG emissions

By means of heat pump control, a high level of internal consumption can be guaranteed (high economic efficiency)

	Heating elements are not necessary with tenant electricity model Involvement of tenants offers potential for complete own use or alternative dimensioning of the PV system Battery storage is already optimally used by the general public / common use by households; it is technically complex and not target-oriented.
Barriers	The main barriers are lying in the installation of smart meters and in the establishment and operation of the required engineering and control systems. Allocation and billing are other challenges. Currently, the most promising tenant electricity model is the "commercial-balance sheet transfer of PV yields to households" (Amann, et al., 2016). This model requires that all participating metering points are equipped with smart meters that provide quarter-hourly metering. The surplus electricity after supply to the common demand is then distributed to the residents using a distribution key. The allocated energy from the generation plant is deducted from the measured consumption at the respective metering point when billing is made. A statutory fee is payable to the grid operator for the introduction of such a model. The generation plant is connected to the general electricity meter. This allows a "commercial-balance-sheet transfer of PV yields to households", whereby the prioritisation of general electricity demand is automatically given.
Challenges	The distribution key forms the core of this tenant electricity model: The static allocation is based on a predefined share of the surplus performance. It can happen that one resident feeds electricity into the grid while the others have to buy additional electricity. This variant is suitable, for example, if the residents participate in the investment. A dynamic distribution key exists if the surplus electricity is distributed according to consumption. This means that each housing unit can cover the same proportion of its consumption with electricity from the communal generation plant. Energy is only fed into the grid if all points of delivery are supplied at 100 %.
Manageability	The idea behind a complex distribution key is a combination of static and dynamic models. The electricity is primarily distributed according to investment share or apartment size, for example. Secondary distribution can take place according to consumption or remaining consumption. Depending on the conditions for financing the installation, the residual electricity can then be traded within the building. However, these variants cause additional calculation effort, which may require an additional instance and result in higher costs.
Replicability	Theoretically high in general. Market growth is expected, when RED II is to be implemented by the end of the year and when renewable energy communities start to diffuse into the market. DR activities as shown here then should diffuse widespread.
Ecological relevance (qualitative climate change mitigation	See figure in the economic analysis, above.

potential)	
Links for further information	https://nachhaltigwirtschaften.at/resources/sdz_pdf/schriftenreihe-2016-20_strombiz.pdf

Demand Response (DR) action AT Nr 2	
Smart Heat Networks – Intelligente Fernwärmenetze	
Place	Austria, a project within the Smart Grids Model Region Salzburg, financed by the Federal Austrian Climate and Energy Fund
Description of action	About half of the final energy used today is required as heat. Intelligent concepts for the sustainable generation, distribution and consumption of heat are essential to combat climate change and increase security of supply. According to the SmartHeatNet project (Schmidt, et al., 2013) a major problem area for the operation of district heating networks are strong temporal fluctuations of the heating load. Apart from the weather-related seasonal fluctuations (main focus of the heating load in winter), which could only be reduced by seasonal heat storage (not in the focus of the project), considerable daily fluctuations of the required heat output can be observed.  Figure 5: Load profile district heating network Salzburg, January 09 In most cases, peak load generators must be provided and commissioned to cover load peaks. For cost reasons, these are usually designed as pure heat generators fired by fossil fuels (gas or fuel oil), i.e. without combined heat and power (CHP). The operation of these peak load boilers worsens the economic (high specific heat costs due to low utilisation and expensive fuels) and ecological (high specific CO2 emissions) performance of the local and district heating systems. It is therefore expedient to reduce or completely avoid the use of peak-load boilers by means of measures - such as intelligent operating and control strategies - on the part of the customer or consumer. According to the project the definition of "smart" measures in district heating or cooling networks (generally also called "thermal networks") is driven by three

	directions: 1. On the one hand, the **smart grid approach** is essentially concerned with the management of electricity networks. The control strategies examined here, such as **load shifting**, virtual power plants, but also measures such as **new tariff models** and **interaction** possibilities **with the customer** (based on smart metering, among other things) can be transferred to district heating networks to a certain extent. 2. As the amount of heat required by passive and low-energy houses is much lower than in existing buildings, an economically and ecologically sensible supply of district heating to these buildings is inhibited. The **concept of low-temperature district heating** enables the performance of thermal networks to be increased by adapting the supply temperature to the consumers. With low flow temperatures, distribution losses can be reduced and the potential of renewable energy sources such as solar thermal and industrial waste heat can be increased considerably. In this context, **cascade connections** such as **return connections** are also to be classified. 3. As district heating and district cooling are directly related to urban areas with high energy demand densities, the **Smart Cities approach**, which is currently under intensive discussion, is used in this project for an extended definition of the term. This approach basically pursues a holistic and integrated view of the urban energy system. Electrical and thermal networks are often mentioned as key elements. An important component is the optimisation of technologies, structures and processes. From this, measures for a further investigation using the example network Altenmarkt im Pongau (Salzburg) and for scaling up to other networks were derived. Up to now, such measures have generally only been tested selectively, without analysing and specifically optimising their effects on network operation in advance.
Actors	**Project consortium** Austrian Institute of Technology (AIT) Salzburg AG for energy, transport and telecommunications Consulted end consumers
Targets of action	The focus of the SmartHeatNet project is on intelligent operation and control strategies, especially for avoiding or compensating for peak loads. These represent an essential problem area for the operation of local and district heating networks. The measures investigated here include • The shifting of the heating loads of the connected buildings • The use of the network as a storage tank through flow temperature control • The integration of central and distributed storage • The partial operation of network sections • Grid-side hydraulic optimisations • The introduction of new tariff models The aim of the SmartHeatNet project is to analyse promising approaches from

	these measures in more detail with the help of model calculations and simulation studies using an example network and to evaluate the transferability to other networks. Starting from the limited resources of the SmartHeatNet project, the following measures were considered in more detail: a. **smart grid operation**: load forecasting, integration and management of storage tanks, use of the grid as a storage tank by adaptive flow temperature control, partial operation of the grid, load shifting, hydraulic optimisation b. **Consumer interaction**: energy feedback and incentive tariffs based e.g. on smart (heat) metering, self-determined comfort c. **Temperature level adjustment**: Optimization of the return temperature, distributed low-temperature micro-networks, cascading heat energy utilization d. **Innovative planning and financing instruments**: energy spatial planning, financing and business models, legal framework e. **interfaces with other energy systems**: Optimized combination of technologies (CHP and WP), increasing flexibility for electric Smart Grids through thermal-electric coupling, optimization of power plant schedules
Impact on the energy system	**Consumer-side measures** *Load shift* Night-time reduction is a common measure to reduce the energy demand in buildings. Energy savings of up to 30 % are reported in the literature, regardless of the age and design of the building. However, the simultaneous switching of many consumers between night and daytime setpoints causes considerable peak loads in the network and thus poses a problem in the operation of district heating networks. An essential consumer-side measure to reduce peak loads examined here is the control of the heating times of the buildings (load management). Two strategies were considered for this: In the case of individual load management, adaptive room thermostats are used, which adapt the start time of the heating to the heating time of the building and the user behaviour. Since it can be assumed that the occupancy times of the consumers are similar, there is a risk here that the peak load in the network cannot be significantly reduced. An alternative strategy is the centrally controlled optimization of the heating times of the buildings from the viewpoint of the district heating operator. To develop this strategy, the thermal behaviour of the buildings (essentially the respective heat-up times) was determined by means of simplified building geometries in a parameter variation. Based on this, synthetic heating load profiles were created and validated with existing monitoring data. These were shifted with the help of an optimization algorithm in such a way that in the simulation of the model network Altenmarkt im Pongau peak load reductions of up to 30 % could be achieved in the ideal case. However, since for some buildings there was not enough data available to determine the load shift potential, the real potential for peak load reduction is reduced (otherwise there would be a risk that due to the unknown heating behaviour, the starting time would be chosen in such a way that the room temperature would not reach the

target value in time).

The effectiveness of the load shifting depends on the existing building structure. This is particularly useful if many buildings with short heating times are connected to the district heating network. In addition to a low thermal mass, this is particularly the case if the connected load of the transfer station is oversized. This occurs if the heating load calculation was not carried out correctly when the building was designed or the heating system was not adapted after a thermal renovation.

Experimental implementation

Although not provided for in the application, the experimental implementation of certain consumer-side measures was considered to have added value. During the remote control of the transfer stations in the Altenmarkt district heating network, however, it turned out that often the secondary-side control in the building partially overrode the primary-side requirement and the control was therefore ineffective.

To experimentally check the heating-up times determined in the simplified building simulation, the indoor temperatures of a building were measured during a measurement campaign lasting several days at different outdoor temperatures and night set-back times. It turned out that the simplified building simulation tended to underestimate the heat-up times of the building. For future work it is useful to improve and adapt the building models based on extensive building measurements.

Measures on the producer side

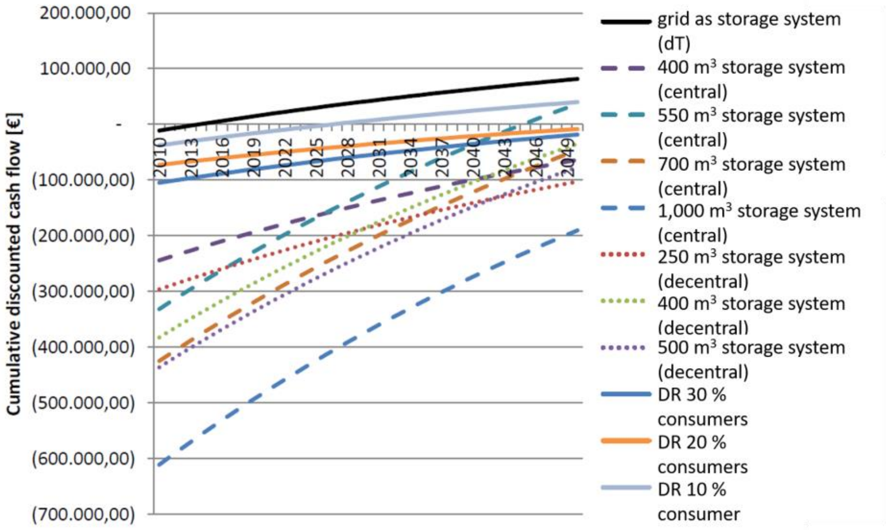
Flow temperature control

To a certain extent, the volume of the district heating network can be used as a storage facility itself, thus reducing peak loads. A control concept was developed for this purpose and tested in simulation on the Altenmarkt im Pongau model network. In the case of a simple flow temperature increase, the building control system compensates the increase in flow temperature with a time delay by reducing the mass flow (constant heating demand). This time window limits the storage capacity of the network. With the control algorithm examined here, any bypasses in the network before the peak load are opened in order to increase the mass flow in the network before the peak load and thus to be able to use the return flow for storing energy via the bypass.

Accordingly, more thermal energy can be stored in the network by coupled control of the supply temperature and mass flow (or differential pressure) than by pure temperature control. In the simulation of the model network Altenmarkt im Pongau, peak load can be reduced by up to 15 %. Since no additional investments are necessary to implement this control strategy, the flow temperature control is **particularly efficient.**

A disadvantage of using the network as a storage tank through adaptive flow temperature control is the additional load changes in the components of the district heating network caused by the temperature change, which represent an increased load and can cause premature failure. However, a fatigue analysis of a simplified network model has shown a negligible influence (at temperature jumps

	of up to 10°C). For more reliable statements, however, a more precise knowledge of the actual state of the network with regard to the load changes that have already occurred and a more detailed examination are necessary. However, very little information is available, especially for historically grown existing networks. The experimental implementation of the flow temperature control in the district heating network Altenmarkt has proven to be difficult, because the internal control of the heating plant with different generation plants makes an accurate and reliable flow temperature control difficult. A first experiment in the district heating network of the city of Salzburg (without bypasses) showed a small storage effect. *Use of heat storages* By using accumulators, a peak load reduction can be achieved if they are loaded at off-peak or base-load times and unloaded at peak load times. Heat storages are increasingly used in district heating networks in combination with CHP plants to decouple production and consumption over time. In principle, there are three options for integrating storage facilities into district heating networks: Central storage facilities near the (primary) producer in the district heating network, decentralised storage facilities as individual storage facilities at a critical point in the network and distributed storage facilities positioned directly at or near several consumers. Model calculations with simplified assumptions show that the use of storage facilities distributed in the network can reduce peak loads, but involves very high investment costs, which means that the profitability of the measure is low. More promising is the installation of a central storage facility, which achieves higher reductions of peak loads for a given investment cost than distributed storage. Compared to the flow temperature control described above, the reductions of peak loads are much higher when using storage tanks. In general it can be stated that a low number of load cycles and low costs of fossil fuels reduce the economic efficiency of storage systems. *Partial network operation* In order to reduce the relative heat distribution losses in district heating during the summer months, different variants were examined by means of model calculations for a planned network extension of an existing micro network in Neumarkt am Wallersee. It turned out that a reduction of the temperatures in the network after start-up is very interesting, especially for completed construction projects (self-contained micro network and later expansion). A shutdown of certain network sections in the summer months is interesting if the **hot water** can be produced efficiently and sustainably in summer, e.g. via a heat pump in connection with a subsidised photovoltaic system. The use of **solar thermal energy** has the advantage that existing solar energy is used to the full extent. In any case, there must be a year-round reduction in order to rule out stagnation. This reduces the profitability for the heating network operator. Conservative measures, such as the use of maximum insulation thicknesses or the use of double-pipe systems, also have a justified reason to be preferred to the measures mentioned in the operational management or conceptually more

	elaborate measures. *Hydraulic optimization* Based on the case study Siezenheim (special case of an urban subnetwork) different measures for the optimization of the hydraulic conditions in the network were investigated. Here it was shown that • At partial load or heat transfer from the Siezenheim network to the city, the improvement due to the ring closure "Kirchenstraße" is much more evident than at full load • Up to now, the transmission capacity into the city grid has been limited, as the high pressure loss would have resulted in inadmissible supply conditions (too high supply pressures or too low return pressures => depending on the setting of the pressure maintenance). • The comparison of the results with/without ring closure at maximum heat load with a situation in summer, when relatively much heat is transferred via the transfer station Siezenheim to the city grid, has shown that the improvement effect of ring closure in summer is much more evident. *Tariff models* Different tariff model**s** can create incentives on the customer side to increase efficiency and reduce peak loads. For example, billing according to the volume consumed provides an incentive to increase the temperature spread in the customer systems, which results in a reduction of the return temperature, whereby low return temperatures have positive effects for a district heating supply company in many ways. Tariffs that allow load interruption or load shifting can reduce peak loads in the grid. Incentive models through adapted tariff models are almost free of investment, but could make a significant contribution to increasing efficiency and thus directly save fossil fuels. Long-term heat supply contracts are problematic in this context. New contracts should provide additional benefits for the customer in order to achieve a WIN/WIN situation.
Economic viability (availability of subsidies)	For the economic evaluation of the investigated measures, the payback period was used as indicator.  **Figure 6: Net cash flows for**

	different scenarios When comparing the measures, it should be noted that the biomass related heat generation in the Altenmarkt district heating network is relatively large and thus the potential for reducing peak loads is comparatively low, resulting in relatively long payback periods. In the case of heating plants with a smaller biomass share, the payback periods for the measures are shorter. Especially if higher loads are to be expected due to grid extensions, the measures described above can avoid investments in a larger biomass boiler.
Barriers	**Example barrier – right from the beginning: Consumer characterisation** The district heating network Altenmarkt im Pongau was selected for the analysis of different measures, as it is a typical biomass district heating network in smaller tourist communities in Austria and monitoring data of the consumers were available in a 15 minute resolution. For the development of consumer-side measures, the consumers connected to the district heating network were evaluated. For this purpose, different data sources were available (electricity and heat meter data, cadastre data) and an inspection was carried out to obtain data such as year of construction, state of refurbishment and type of use. More than half of the consumers in the district heating network come from the "housing" sector (single- and multi-family houses). Including the "commercial and residential" class, this affects approx. 80 % of all consumers. Hotels and guesthouses account for a further share of 11 %. Within the scope of this project, algorithms for checking the integrity and plausibility of the monitoring data were developed, as well as measures for data correction. The evaluation of the monitoring data was more difficult than expected because some measurement series were not useful (data incorrect, incomplete or not available). Also, the assignment of the different data sources to the specific buildings involved a great deal of effort. On the basis of this dataset, a database of standard consumption profiles could be developed, which was used to substitute incorrect monitoring data.
Challenges	Based on the results of the SmartHeatNet project, the following measures and steps are proposed for further work: The development of guidelines and procedures for the selection of suitable measures in district heating networks. This includes an analysis of the status quo based on different indicators and the assessment of the effectiveness of different consumer and producer side measures. In particular, measures such as using the network as a storage facility require a precise knowledge of the distribution of flow and return temperatures in the network. In this sense, it is necessary to optimise and coordinate the operation of district heating networks with multiple generators with different inlet temperatures. In this way the losses can be reduced and the optimum operating point of the plants can be reached. A further important measure with regard to the evaluation of the temperature jumps necessary for the use of the network as storage is a detailed analysis of the additional mechanical load on the pipeline network. For this purpose, a methodology must be developed to map existing networks as simply as possible

<table>
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<td>and to determine the influence of additional temperature jumps, especially taking into account the usually large uncertainties regarding the preloading of the components.

The following steps are necessary to realize the load shift:

• The remote access to the customer's systems or the possibilities to modify the secondary side control.
• An essential step (especially in urban systems) is the development and implementation of a suitable ICT infrastructure for remote control of the customer's systems.
• The implementation of a suitable load shifting strategy in the district heating network control. This should be able to determine the respective start time of the heating system depending on the load forecast and the information regarding the connected building structure.
• To increase the effectiveness of the load shift strategy, it is necessary to a) obtain more information on the heating time of the respective buildings. For this purpose, the building model used so far should be extended if necessary and calibrated by means of measurements of the indoor temperatures. Furthermore, b) information on the respective customer requirements (setpoint, occupancy times) can increase the efficiency of the load transfer. This can be realized by an interface to the consumer

Another measure can be the implementation of a function to suspend or reduce the night setback above a certain outside temperature. In this way very high peak loads can be avoided on cold winter days.</td>
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<tr>
<td>Manageability</td>
<td>With support of an engineering office experienced in field of measure(s) of interest it should not be a problem, technically.</td>
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<td>Replicability</td>
<td>The replication, scaling or inter- and extrapolation of the operation strategies and control algorithms developed in this project from a local heating network to larger and more complex district heating networks is a risk factor, since the network, producer and consumer structures differ considerably. Within this project correlations were developed for two measures in order to transfer them to other district heating networks:

• the use of the network as storage and
• the load shifting.

For the other measures, the following table summarises the individual measures and assesses their relevance for urban district heating networks and for other rural networks:

Table 1: Evaluation of the implementation potential for other heating networks: urban and rural networks

<table>
<tr><th>Measure</th><th>Relevance for rural networks</th><th>Relevance for urban district heating networks</th><th>Comments</th></tr>
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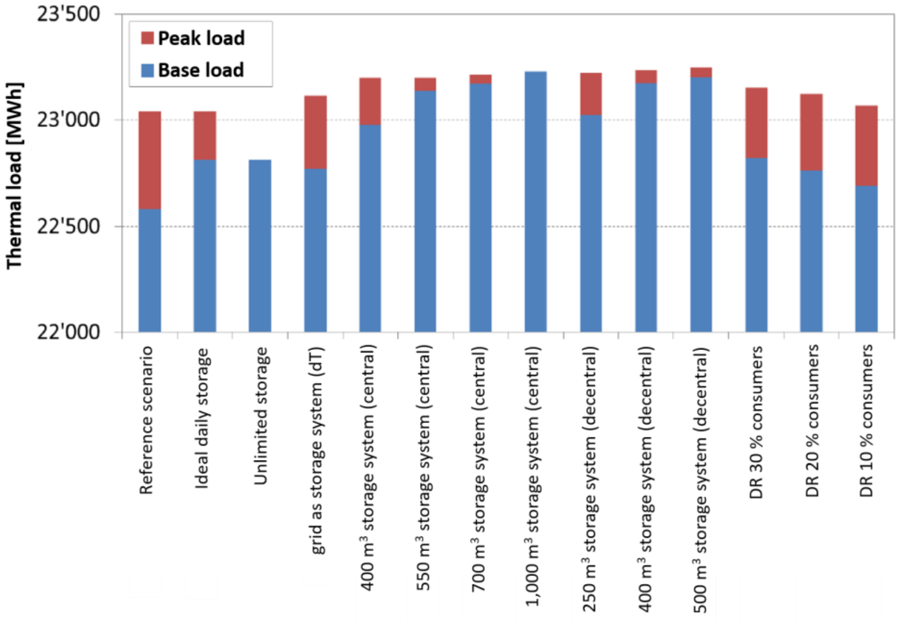
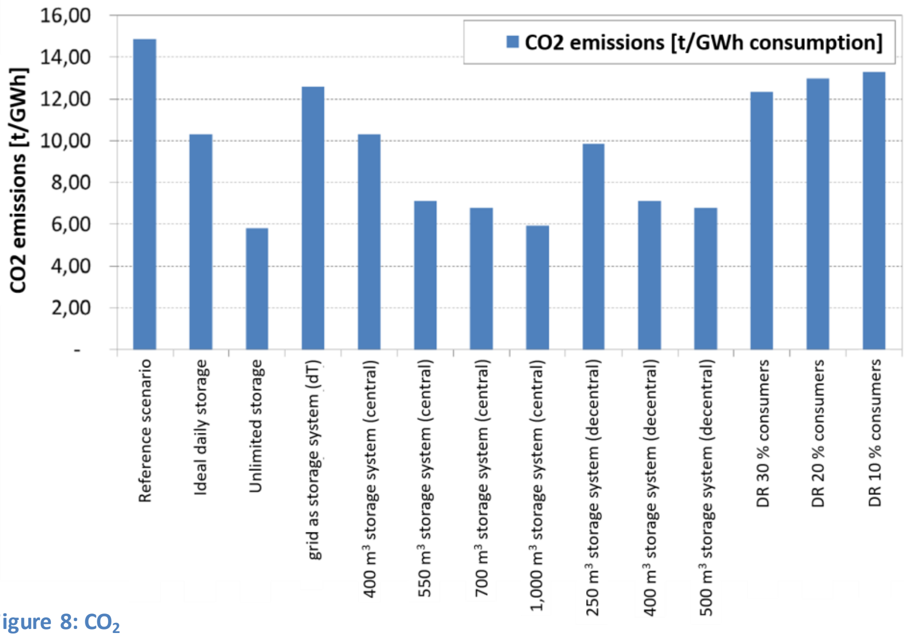
Use of the network as storage by flow temperature control	Medium to low - higher specific storage capacity - state of the network better known	Low - low specific storage capacity - large number of producers, some not controllable with regard to flow temperature control - often central storage available	Restrictions on the network side allow flow temperature control only to a limited extent => Therefore this measure will only be implemented to a limited extent.
Switching off night-time reduction	Low	Low	Low Relevance, WIN/WIN Customer/supplier situation difficult to establish
Demand side management (load shifting)	High (ind. Domestic Hot Water - DHW) Clarify implementation options	High (ind. DHW) - implementation at the largest consumption connections	Load shedding management of the largest customers, intelligent control of the hot water storage tank, ICT offensive, if necessary reintroduction of TRA (audio frequency ripple control systems)
Storage tank central	High	High	Check at any rate at rural heating plants; in the city of Salzburg a central 27,000 m³ DH storage plant is available.
Storage decentralised	Low	Low	Every decentralised storage reduces peak loads and pump energy, but a centralised solution is more economical
Distributed storage	Low	Low	Implementation in existing district heating networks difficult due to high investment costs and the legal situation with consumers

Micro networks Partial network operation	Low	Low	Largely too high material and control costs (ev. Individual assessment)
Micro grids: Optimization of temperatures & components	High	High	Return temperature reduction city grid, highest insulation standards, test on land Double pipe/PEX systems
Efficiency - tariff (return temperature reduction)	High (m³ based)	High (m³ based)	No investment costs necessary, should be pursued immediately
Return temperature reduction technical measures	High	High	See e.g. results of the detailed study Siezenheim waste heat increase potential

Ecological relevance (qualitative	**Overall assessment by the example of different heat storages strategies**

climate change mitigation potential)	Three different implementations are assumed for the load shifting (DR): Implementation at 10 %, 20 % and 30 % of the consumers (starting with the largest consumer).  **Figure 7: Distribution of heating loads (peak and base load): All scenarios**  **Figure 8: CO_2 emissions: all scenarios.**
Links for further information	energieforschung.at/projekte/595/sgms-smartheatnet-smart-grids-modellregion-salzburg-smart-heat-networks salzburg-ag.at

	ait.ac.at

Legal national status of data management, exchange and ownership

For the development of consumer-side measures, a lot of data are required from consumers (name, address, user behaviour etc.) and related to building services facilities (such as year of construction, specifications and type of use) are needed. For this purpose, different data sources are available (electricity and heat meter data, cadastre data).

The requirements of the EU General Data Protection Regulation need to be respected in all operating activities. All legal details need to be laid down in contracts related to a introduction of demand side and any other measures.

Short national summary on existing/possible implementation fields, challenges and barriers and potential outlook

In general a better economic, enabling environment that establishes an economic playing field would be a necessity to support decentralized a behaviour conducive to the supply of electricity or heat and the operation of the respective network (e.g. exemption form energy taxes, reductions in grid fees due and other charges) to roll out such models on a larger scale.

In general tariff model**s** can create incentives on the customer side to increase efficiency and reduce peak loads. For example, in the field of grid-based heat delivery billing according to the volume consumed provides an incentive to increase the temperature spread in the customer systems, which results in a reduction of the return temperature, whereby low return temperatures have positive effects for a district heating supply company in many ways.

If RECs - Renewable Energy Communities and CECs - Citizens' Energy Communities find an enabling environment the energy systems the communities build on will become more efficient as there is an economic incentive to optimize them. This offers the chance that public electricity and district heating grids can be operated both, more efficiently and can become capable to integrate even higher shares of renewable energy.

3.4.2 DR actions existing in Bosnia and Herzegovina

RES technologies contributing to final consumption of the electricity sector in Bosnia and Herzegovina (hereinafter: BiH) are hydro energy, wind, biomass and solar energy. It was planned that in 2015 the largest contribution would be given by hydro energy with 97.5 % (220.6 ktoe) of total RES energy quantity, then wind with 1.7 %, biomass with 0.6 % and solar energy with 0.2 %. Looking at the realization in 2015, hydro power plants had the biggest contribution (99,9 %), while the rest was from solar power plants. Plans until 2020 are very similar to that for 2015. Relative share of hydro power plants should be reduced to below 90 % while the biggest increase is expected from wind power plants. Their relative share should increase to 8.9 %, while the share of biomass should increase to 1.4 % (MVTEO, 2018).

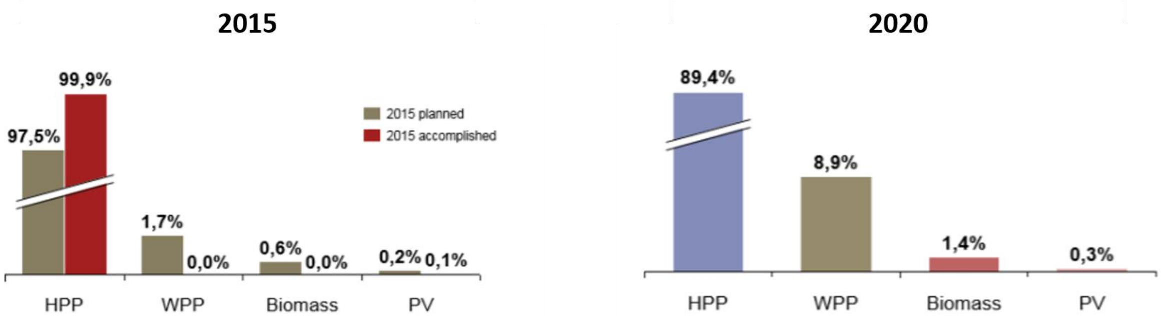


Figure 9: RES contribution in electricity sector – plan and realisation in % (GWh), 2015 and 2020 (MVTEO, 2018)

The first PV plant in BiH was built in 2012. Since then 180 PV plants were built and connected to the power grid containing installed capacity of 18 MW. This makes 0.37 % of installed capacity in BiH. Because of these particular reasons BiH must, with the utmost seriousness, begin implementing projects of construction in the field of renewable energy and other forms of green energy (Šantić & Akšamović, 2018).

Examples of **DR activities** improving the electricity system operation in BiH are mostly focused on PV electricity supply peak shaving (in summer) by producing domestic hot water via heating rods installed in hot water boilers/storages of in-house heating systems.

Demand Response (DR) action BIH No.1	
Solar Power Plant on the Roof of Primary School "Mesa Selimovic" in Sarajevo	
Place	**Sarajevo Canton, Bosnia and Herzegovina** 
Description of action	Solar power plant installed on the roof of primary school "Mesa Selimovic" in the area of Municipality Novi Grad – Canton of Sarajevo. Installed capacity of the power plant is 25 kW of which two will be used for the needs of school the rest of capacity will be directed to a Power supply network which is sufficient for approximately 20 households. Besides that, in the school is set hybrid boiler which provides hot water. The system works as follows: when the boiler is filled with hot water, then solar panels provide electricity for the school building, installed capacity of 2 kW, with a possibility of extension to higher capacities up to 100 % of energy needs the school building.
Actors	The project is developed and funded by Eko-San company.
Targets of action	Through the work on the project students had the opportunity to learn all about solar installations. The next goal is to expand the plant on this school to reach a hundred percent savings.
Impact on the energy system	The capacity of the power plant is 25 kW, of which 2 kW will be used for the needs of school. The rest of the capacity will be directed to a Power supply network which is sufficient for approximately 20 households.
Economic viability (availability of subsidies)	The total investment for the installation of solar plant on the school building was 50,000 EUR, and it is estimated that the plant will annually make a profit of 10,000 EUR.
Barriers	The main barriers during project implementation were related to collecting the necessary documentation.
Challenges	Obtaining the necessary permissions to implement the project.
Manageability	The power plant will be managed by Eko-San company which is an investor.

Demand Response (DR) action BIH No.1	
Replicability	In a short period of time after the implementation of this project, the investor has contacted by many representatives of other schools who liked this idea and would like to implement the same project and thus provide some energy for their own needs and spend clean solar energy.
Ecological relevance (qualitative climate change mitigation potential)	The project has achieved electricity savings of 50 %, which has a positive impact on the environment and climate change.
Links for further information	https://solarni.wordpress.com/2014/05/13/sarajevo-solarna-elektrana-na-krovu-os-mesa-selimovic/

Demand Response (DR) action BiH No. 2	
Energy Efficiency Project of the Sports Hall in City of Livno	
Place	**City of Livno, Bosnia and Herzegovina** 
Description of action	The Sports Hall is located near downtown Livno and is the center of town's sports activities. The windows were single paned and caused high heat loss, and combined with frequent interruptions in heating, resulted in low temperatures in the hall and inadequate thermal comfort. Because of the very high cost of fuel oil, the heating in the sports hall was often turned off to save money. To reduce costs and use a local energy source, the sports hall was connected to the existing district heating network based on biomass boilers. The type of biomass used is waste biomass - wood waste from the wood processing industry. Solar thermal panels were installed on the roof for heating domestic hot water. Installation of a Monitoring and Verification System for heat consumption with outside temperature and average inside temperature will provide the necessary information to improve the energy efficiency of the building.
Actors	USAID 3E, UNDP BiH, GIZ Energy Efficiency Project in BiH and City of Livno
Targets of action	• Reduction of heating costs and use a local energy source • Raising awareness of citizens about the benefits of energy efficiency

Demand Response (DR) action BiH No. 2	
	measures
Impact on the energy system	The project achieved reduction of energy consumption by 40 %. Implemented Energy Efficiency measures: • Installation of district heating supply line • Installation of a heating substation in the Sports Hall building • Overhauling of the existing heating and ventilation system • Installation of solar thermal panels for heating domestic hot water • Replacement of windows and doors • Replacement of a part of the roof covering • Installation of Monitoring and Verification system • Thermal Insulation of the façade
Economic viability (availability of subsidies)	**Overall Pilot Project Value**: 167,000EUR **Contributions:** USAID 3E: 85,560EUR UNDP BiH: 3,500EUR GIZ Energy Efficiency Project in BiH: 2,500EUR City of Livno: 75,266EUR
Barriers	N/A
Challenges	N/A
Manageability	Representatives of the Sports Hall will manage the new system.
Replicability	Yes
Ecological relevance (qualitative climate change mitigation potential)	CO_2 emissions reduced by 70t CO_2/year
Links for further information	https://pdf.usaid.gov/pdf_docs/PA00K5JZ.pdf

Legal national status of data management, exchange and ownership

Law on Electricity in the Federation of Bosnia and Herzegovina (FBiH, 2017)

The Law regulates the functioning of the electric power sector, electric power industry activities, development of the electricity market, regulating of the market, general conditions for electricity delivery, planning and development, construction, reconstruction and maintenance of electric power facilities, supervision over the compliance with the Law and other issues significant for conducting electric power industry activities in the Federation of Bosnia and Herzegovina (hereinafter: FBiH). In Article 17 in order to achieve regulating the electricity market in FBiH it is established the Regulatory Commission for Electricity in FBiH. In the aspect of cross-border trade in electricity, consumer participation, including demand response, the Regulatory Commission for Electricity in FBiH shall be obligated to:

- ensure gradual introduction, regulation and development of the electricity market and also to ensure transparent and equal relations between all participants on the market, in accordance with the international norms and standards of the European Union, Electric Power Policy, reform of the energy sector, implementing regulations and acts of DERK;
- protect the rights of the participants in the energy sector (customers, operators of the distribution system, producers, suppliers and traders),
- regulate quality of service at all levels as well as tariffs and fees, which are paid for regulated services in distribution, taking into consideration the interests and needs of all users for electricity supply;
- supervise the efficiency of mechanisms and processes due to the insurance of balance between the **demand and supply** of electricity;
- encourage the participants in electric power sector on the activities related to safety of people and environment protection.

Energy regulatory bodies must stimulate demand-side resources, such as demand response, to participate in energy wholesale and retail markets together with supply-side actors such as electricity producers. In meeting the requirements for balancing and ancillary services, transmission and distribution system operators must treat demand response actors, including aggregators, in a non-discriminatory manner (MVTEO, 2017).

Distribution System Operators (DSO)

Distribution system must be available to all users in an objective, transparent and nondiscriminatory manner. The power utility that owns the license to perform distribution activity – DSO is responsible for the operation, management, maintenance, construction and development of the distribution system. DSO is obliged to connect all interested customers/producers to its facilities, in and objective, transparent and non-discriminatory way. Operation and management of distribution network is regulated by Network Rules for Distribution that are proposed by DSO and adopted by SERC. Electricity Law also stipulates the DSO, that is part of vertically integrated company, functions independently in terms of legal form, organization and decision-making.

BiH DSOs are currently in the second phase of the DSO development. Focus in on the infrastructure digitalization, smart meter/grid roll-out, technical and IT integration activities, and adjustment of fieldwork processes, predominantly in the operations (dispatching) and maintenance segments. Activities on the integration of sources of distributed energy are intensified in this phase, which requires adjustment of organization, processes and relationship with the key market stakeholders. On the other hand, an ever-increasing focus is placed on the construction of a modern asset management function which is tasked with allocating the investment budgets efficiently and with planning the network development (MVTEO, 2018). In BiH, prosumers may file a complaint to the DSO and supplier as any other customer and both operators have legal obligations to handle complaints. In all cases, the procedure for filing complaints is regulated by primary and secondary legislation. Prosumers may complain to the DSO on a connection offer if they do not agree with the solution given by the operator and to the supplier as regards to supply agreement-offtake electricity.

General Data Protection Regulation (GDPR)

Although not a member state of the European Union (EU), Bosnia and Herzegovina has applied the new EU law on the consumer data protection GDPR. The entry into force of the GDPR in May 2018 was immediately recognized by business entities in Bosnia & Herzegovina who process data of data holders from the EU in accordance with Article 3 of the GDPR, i.e. through activities related to offering goods or services to data holders in the EU, or monitoring their behaviour as long as it takes place within the EU. In addition, another reason for the increased interest of BIH business entities for GDPR and effort to comply with its requirements, are the extremely high fines imposed in cases of abuse of data. It is clear that the entry into force of the GDPR definitely had a positive effect on BIH, considering that many business entities, being controllers or data processors, began to devote much more attention to data protection and adjust their businesses to the demands of the GDPR, having in mind that it is not enough for them to be aligned only with local legislation but also with the requirements of the GDPR. Bosnia and Herzegovina signed the Stabilization and Association Agreement with the EU, obliging itself to harmonize its own with the legislation of the European Union (OTE, 2020).

1. Short national summary on existing/possible implementation fields, challenges and barriers and potential outlook

The Law on Renewable Energy Sources and Efficient Cogeneration was adopted by the FBiH Parliament in July 2013 and published in the Official Gazette of FBiH no. 70/13 in September 2013. As incentives measures, the Law provides for number of benefits for producers of electricity from RES, such as:

- priority in the connection to the electricity grid;
- priority in the delivery of electricity produced from RES&EC to the grid;
- the right of a certificate of origin;
- the right to repurchase produced electricity by the reference price.

This piece of legislation also regulates the obligation for end consumers to pay incentives compensation for the production of electricity derived from RES&EC, which will be further established by the Decree on Incentives for Production of Electricity from RES&EC and for Determining Incentives Compensation. Considering the existing incentive system, certain subsidies should be secured to stimulate production from renewable energy sources. In the Federation of Bosnia and Herzegovina, total planned funds for RES subsidies consist of funds for incentive part, balancing costs and operating costs of operator.

In BiH from the aspect of international obligations which affect the energy sector, the Energy Community Treaty (Official Gazette of Bosnia and Herzegovina – International Treaties), No. 9/06 (BiH, 2015) is most important. Energy Community Treaty was signed on October 25th 2005 and took effect on July 1st 2006. The Energy Community has been tasked with organising the relations between contracting and with establishing the rules and economic framework in relation to network energy in order to:

- create a stable legal and market framework capable of attracting investment in order to ensure a stable and continuous energy supply,
- to create a single regulatory space for trade in network energy,
- to enhance security of supply in this space and develop cross-border relations,

- to improve energy efficiency and the environmental situation related to network energy and develop renewable energy sources,
- to develop network energy market competition.

In order to complete these tasks, the contracting parties are obliged to gradually adopt the parts of the acquis, by transposing into their respective legislations the requirements and rules of the relevant EU directives and regulations governing the fields of electricity, gas, environmental protection, renewable energy sources, energy efficiency, oil, statistics and infrastructure. With regard to the electricity and heating segment, BiH already has a sufficient RES share in gross final consumption relative to the EU countries. This is the result of the hydro energy potentials in the electricity segment, as well as utilisation of biomass in the heating segment. Harmonization of BiH legislation with the European Union acquis is a complex assignment, considering that it implies the comprehensive and essential changes to the energy sector, as well as and overall sector reform. The basic strategic goal of BiH is to speed up harmonization of its legislation with the acquis, that is, to transpose and implement the obligations assumed under the Energy Community Treaty (MVTEO, 2018).

3.4.3 DR actions existing in Bulgaria

Two examples from Bulgaria show how in existing DH networks implement demand response actions. In one example, a DH network is used as storage, and in another one, the PV electricity supply peak is used for producing domestic hot water.

Demand Response (DR) action BG1	
Use of the district heating (DH) network as a storage	
Place	Bulgaria – most of the licensed DH companies
Description of action	Most DH companies in Bulgaria typically operate combined heat and power (CHP) units covering the average or slightly more than the average heat load during the non-heating season. During that period, the heat is used for domestic hot water (DHW) supply only. The energy production in the non-heating season is kept constant, regardless the hourly fluctuations of the heat demand. The district heating network is used as a heat storage during the hours of low heat demand, using temperature-flow control.
Actors	DH companies
Targets of action	• Additional income coming from electricity sale at high preferential prices, set by the Regulator; • more efficient operation of the energy production capacities; • longer life of the energy technology by avoiding to switch them off and on.
Impact on the energy system	• More efficient energy production • Higher heat losses in the network.

Economic viability (availability of subsidies)	High economic viability, mainly due to the high preferential price of electricity from highly efficient CHP. The price is set by the Regulator and it is typically much higher than the actual cost. The efficient operation, longer equipment life, and higher heat losses have moderate effect on the economic viability
Barriers	N/A
Challenges	A large share of the district heating network has very low energy efficiency. The average losses are 23.7 %
Manageability	The process is automated.
Replicability	Highly replicable.
Ecological relevance (qualitative climate change mitigation potential)	(+) higher heat and electricity generation efficiency; (+) more electricity from gas-fuelled CHP, which is more environment-friendly than the country average; (-) higher heat network losses – depending on the particular network, they may exceed 50 % in summer. The net effect may be either positive or negative, depending on the specific situation.
Links for further information	N/A

Demand Response (DR) action BG2	
PV electricity supply peak shaving by producing domestic hot water	
Place	Sofia
Description of action	A house is heated and cooled by a heat pump, as a primary heating / cooling source. Additionally it has a roof-top solar PV, not connected to the electricity grid, used to cover (part of) the own electricity consumption of the household. When the electricity generation from the PV exceeds the household consumption, the excess electricity is used to produce domestic hot water via heating rods installed in the heat pump buffer tank.
Actors	Households
Targets of action	The target is to build highly energy efficient house, applying modern energy technologies.
Impact on the energy system	Reduction of the heat pump operation (energy saving)
Economic viability (availability of	Not economically viable. No public support (e.g. through grants). The technological scheme is used only until the PV installation is connected to the grid by the local DSO. Sometimes the administrative procedures for the

subsidies)	connection take long. The preferential prices of roof-top PV electricity (set by the regulator) are high and make the electricity sale to the grid economically viable.
Barriers	No public support.
Challenges	N/A
Manageability	The process is automated.
Replicability	The replicability is hampered mainly by the lack of economic feasibility.
Ecological relevance (qualitative climate change mitigation potential)	Lower GHG and other emissions, due to the use of clean RES.
Links for further information	N/A

Legal national status of data management, exchange and ownership

DR actions BG1 and BG2 (see above) are implemented respectively by the DH company and by the consumer, without any involvement of other parties, so they have no data management, exchange, and ownership implications.

In DR field, the Regulator is guided by the principle that electricity transmission and distribution prices should allow increased end-user involvement in the improvement of efficiency of the power system by optimising consumption. The Regulator puts efforts to encourage transmission and distribution system operators to offer system services for electricity demand response, demand management and distributed generation on organised electricity markets and improve the efficiency in networks design and operation, in particular (NEEAP, 2017):

- the shifting of the load from peak to off-peak times by end users taking into account RES availability, energy from cogeneration and distributed generation;
- energy savings by demand response from decentralised sources of production through a combination of supply of energy efficiency services and participation in the balancing electricity market;
- reducing consumption by means of energy efficiency measures implemented by providers of energy efficiency services;
- connection and dispatchability of energy facilities for the production of electricity of medium and low voltage levels;
- connection of energy facilities for the production of electricity location closer to consumption;
- allowing access to networks of energy storage facilities.
- introduction of dynamic tariffs as a measure for electricity demand response by end users through: time-of-use tariffs; critical peak pricing; real time pricing; and peak time rebates.

In general, the regulatory system concerning DR is settled. Some large energy consuming industries offer such services. However, the electricity system operator normally does not take advantage of such offers, because it has available own pumped storage hydro power plants, used for that purpose at lower cost. In case of crisis, DR opportunities offered by the industry remain an option.

In Bulgaria, the residential sector still purchases electricity on the regulated market, where fixed rates apply (a fixed day rate and a fixed night rate). DR is practically non-existent in that sector.

Short national summary on existing/possible implementation fields, challenges and barriers and potential outlook

The electricity market in Bulgaria is gradually liberalized. It was planned that households connected at 50 kW or more, corresponding to 3,100 households, would move to the free market on 1 September 2020 (Sotirova-Delcheva, 2020). Smaller residential consumers will follow later. According to the National Energy and Climate Plan 2021-2030, the electricity regulated price will be fully abolished by the end of 2025 (NECP, 2020).

Bulgaria plans to establish favourable conditions for prosumers, opportunities for collaboration through project aggregation or energy cooperatives, as well as for their role in DR (NECP, 2020).

Several DH companies made pre-feasibility studies for the development of a dedicated storage – a large hot water tank at the DH site. The studies showed that the storage would be economically viable in three cases listed below, starting from the most profitable to the least profitable:

- CHP capacity is higher than the base load during the heating season and the sale price of electricity from CHP is variable, market-based. In that case, the DH operator would be able to increase the production during the hours when the price is higher.
- The maximum heat production capacity is insufficient and either additional peak capacity or storage is needed; storage is then the more viable option.
- A new heat production capacity is needed anyway and the choice is between a larger one without storage and a smaller one with storage. Then the storage option would be more feasible, only if the difference between the two production capacities is at least several tens of MW.

In Bulgaria, none of these three cases is available. First, the sale price of electricity from CHP is constant, set by the Regulator. Second, the maximum heating capacity in all DH plants is more than sufficient, as the heat consumption has seriously dropped during the last years and decades. Third, no new capacities have been installed recently, because DH business is not attractive in general.

3.4.4 DR actions existing in Croatia

In Croatia, the only currently existing action trying to influence consumers' behaviour in heating is the differentiation of electricity price in higher period (each day from 7 am to 9 pm) and lower period (each day from 9 pm to 7 am). Consumers using heating devices with a storage possibility (electric water heaters or storage heaters) use electricity during periods of lower prices and utilise stored thermal energy throughout a day. The precondition is a double tariff electricity meter and a contract for a two-tariff model offered by all suppliers active in the electricity market. Among 2.4 million customers at a low voltage level, approximately 1.6 million is utilising any of the two-tariff models.

Legal national status of data management, exchange and ownership

N/A

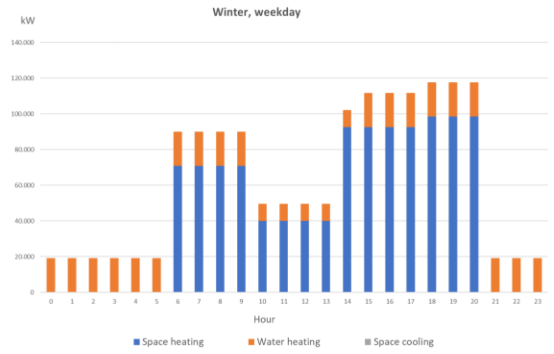
Short national summary on existing/possible implementation fields, challenges and barriers and potential outlook

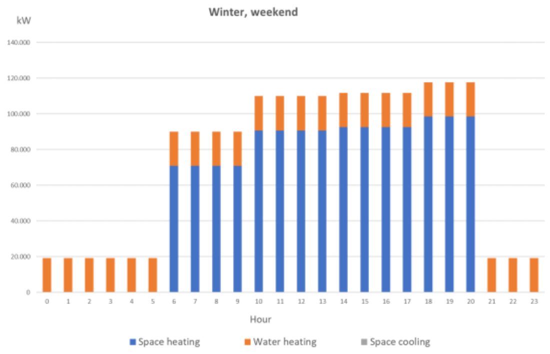
With a growing share of variable RES in electricity production, periods of excess electricity supply are expected to happen, e.g. in summer midday when PV production is high or during the night throughout a year when wind power production can be high and total electricity consumption is low.

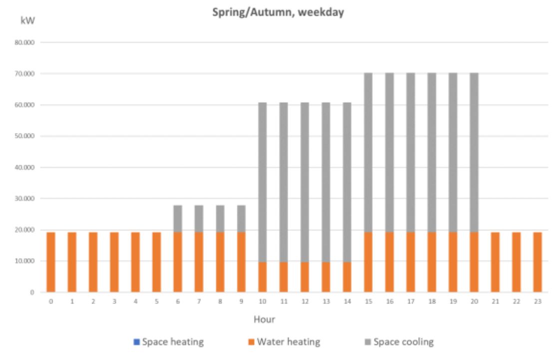
Therefore, the potential of heating and cooling devices used in households and the service sector to support the electricity system operation through RES supply peak shaving has been assessed (Assessment is not conducted within the REPLACE project; The presented results were obtained through the implementation of other projects at national level in which EIHP has participated). In the commercial sector, a database of energy efficiency certificates and conducted energy audits has been used as a basis for the assessment, while for the household sector energy consumption volume and habits in daily use have been investigated via a questionnaire answered by a representative sample of Croatian households and extrapolated to all Croatian households.

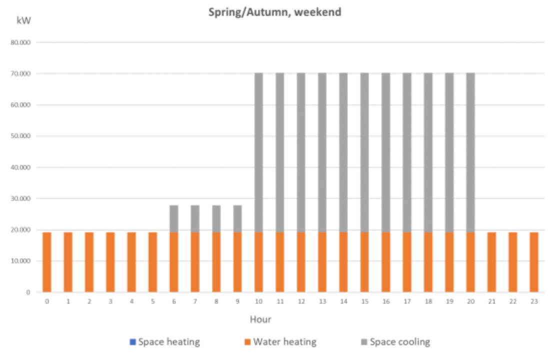
Electricity peak supply can be balanced by increasing electricity consumption. For this purpose, the following electric devices have been analysed: electric water heaters, electric space heaters and air-conditioning units, both in the household and service sector, together with the centralized HVAC systems in services.

The potential for increasing consumption differs across the year and depends on the time of the day. The potential of increasing electricity consumption for household sector thermal needs, in winter, summer and spring/autumn is given in the charts below, differentiating between a weekday and a weekend.









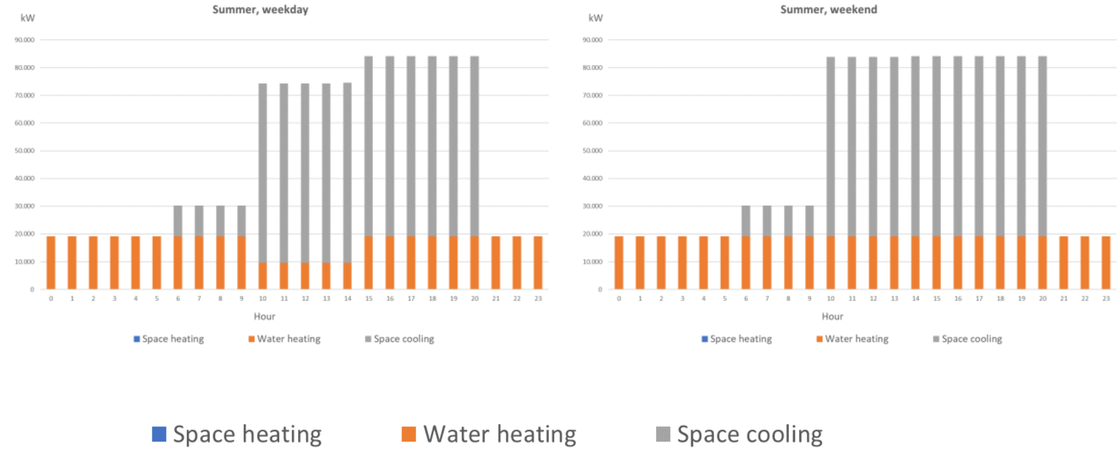
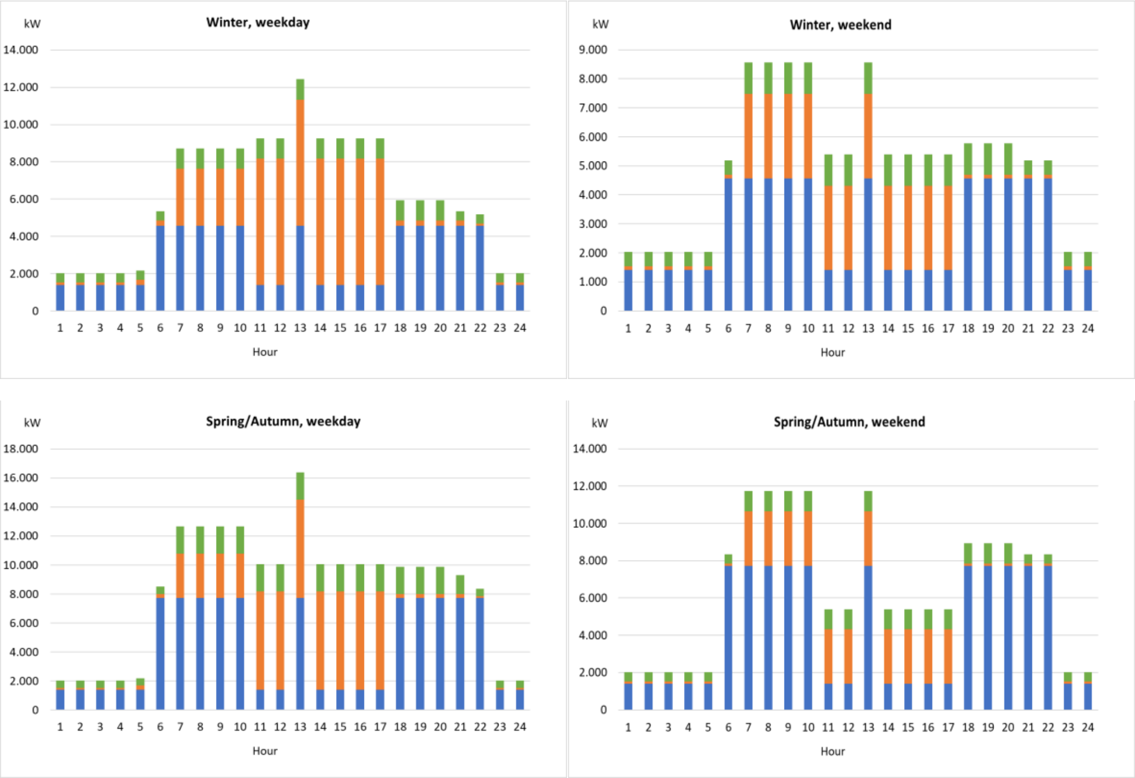


Figure 10: Croatia - potential of increasing electricity consumption for household sector thermal needs

It can be seen that the potential of peak shaving in households is higher during weekends than during weekdays and that the highest potential is in winter, more than 120 MW in the afternoon. In summer, the potential is estimated at more than 90 MW, also in the period between midday and early evening, which is favourable in terms of PV electricity oversupply adoption. Potential for excessive RES electricity occurring during the night, from wind power plants, is much lower and amounts to approximately 20 MW.

The potential of increasing electricity consumption for thermal needs of the commercial sector, in winter, summer and spring/autumn is given in the charts below, differed between a weekday and a weekend. The potential in all types of commercial buildings is shown.



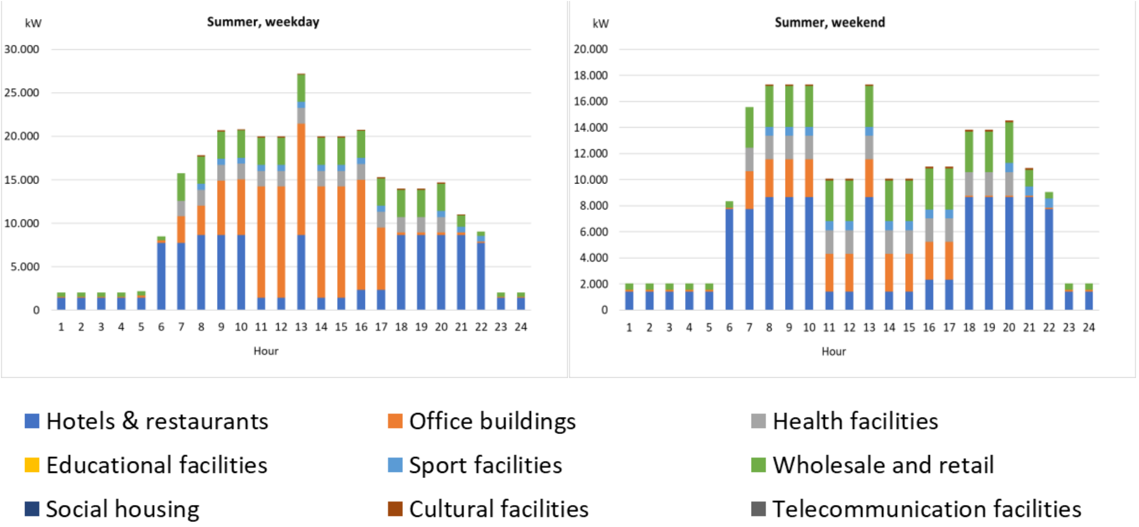


Figure 11: Croatia - potential of increasing electricity consumption for commercial sector thermal needs

It can be seen that the potential of peak shaving in the commercial sector is the highest in the summer weekday, which is suitable for PV electricity oversupply (up to 35 MW). The potential of peak shaving in periods of low consumption, in the night-time, is considerably lower and is around 2 MW.

It must be noted that this is a preliminary assessment and further research is needed. Also, the potential has been assessed based on energy efficiency certificates and the questionnaires with a number of qualitative instead of quantitative values, which highlights the importance of further research and field measurements.

3.4.5 DR actions existing in Germany

For Germany, two promising examples for DR actions in the HC sector are given. One shows an example about load shifting, in combination with more economic decentralized storages. The other one is an example about the sector coupling in the German tenenats' power model, where PV modules were comnbined with heat pumps in a residential building.

Demand Response (DR) action GER No. 1	
Decentral thermal storage in combination with forced charging of connected storage tanks	
Place	Bavaria, Germany
Description of action	Small DH networks use decentralized thermals storage tanks (in region Oberland already since 2013) that include sanitary exchangers (600 to 1,000 litres capacity) for being able to use a smaller dimensioning of the pipe works. Peak loads in the morning are avoided by forced charging of the connected storage tanks during the night hours.
Actors	Several DH network operators (e.g. in Lenggries, Buch a. Erlbach; under construction in Steingaden), customers
Targets of action	Reduction of peak loads and reduction of heat losses in summer
Impact on the energy system	Fewer heatings of biomass boilers during summer (only once a day or one time in several days) can lead to 40 % reduction of heat losses.

Economic viability (availability of subsidies)	Operating cost reduction as consequence of fewer heatings and reduction of peak load
Barriers	n.a.
Challenges	Not in the operation phase, yet before the realisation of a DH network
Manageability	Remote controlling and monitoring
Replicability	Highly replicable
Ecological relevance (qualitative climate change mitigation potential)	Depending on size of the network, thousands of tons of CO_2 reduction compared with fossil fueled heatings.
Links for further information	https://portal.enerpipe.de/de/blog/79/waermenetz-in-lenggries/?backTo=27&page=14 https://www.enerpipe.de/de/produkte/13647/nahwaermepufferspeicher

Demand Response (DR) action GER No. 2	
Tenant's power model – Combination (sector coupling) of PV modules with heat pumps in residential building	
Place	Munich, Bavaria, Germany
Description of action	In a new residential building, a PV system was combined with two (different sized) heat pumps (brine-water heat pumps). For the coupling between the systems, the heat pumps are equipped with SG (smart grid) interfaces to the energy management system, where the required primary data of the generating system (i.e. PV system) are collected via smart meters or directly from the inverters of the PV system. In summer months, the heat pumps prevent the mandatory active power reduction of the PV system, which would result in the loss of renewable energy. The heat pumps thus play the role of energy storages. The smaller heat pump is in operation all year round for hot water supply, while the larger heat pump only runs for heating on cold days. System information: Usable floor space: 5,584 m^2 KFW 40+ apartment building with 59 apartments and one commercial unit Domestic hot water demand: 69,797 kWh/year Heating heat demand: 95,277 kWh/year 2 brine-water heat pumps PV system: 100 kWp battery storage: 120 kWh Generation PV: 110,000 kWh/year Electricity consumption of residents: 140,000 kWh

	Electricity consumption of heat pumps: 40,000 kWh Self supply PV: 80,000 kWh Degree of self-sufficiency of buildings: 44%.
Actors	Renewable Energy Provider Polarstern, building owners, tenants
Targets of action	Reduction of (grid) energy demand of the heat pumps and reduction of forced power reduction of the pv system
Impact on the energy system	Provision of RE for the community without having a negative impact on grid stability. Avoidance of lost renewable electricity.
Economic viability (availability of subsidies)	Operating cost reduction for heat pumps (self generated electricity is cheaper than from the main grid).
Barriers	Availability of efficiently usable heat source and accessibility - e.g: brine vs. air.
Challenges	Conviction of building owners. Higher investment costs needed than for conventional heating.
Manageability	Remote controlling and monitoring, technical interfaces
Replicability	Highly replicable
Ecological relevance (qualitative climate change mitigation potential)	CO_2-eq reduction compared with fossil fueled heating and conventional elecricity from the national grid. Based on the German energy mix (0.474 kg CO_2-eq/kWh as of 2017), a reduction of 52.14 t CO_2-eq/year is achieved.
Links for further information	https://www.polarstern-energie.de/magazin/artikel/mieterstrom-waermepumpe-pv-sektorenkopplung/ https://www.umweltbundesamt.de/themen/klima-energie/energieversorgung/strom-waermeversorgung-in-zahlen?sprungmarke=Strommix#Strommix https://rechneronline.de/photovoltaik/co2-einsparung.php

Legal national status of data management, exchange and ownership

For operating a DH network or implementing demand response actions, many personal data from consumers (clients' names, addresses and heat consumptions and time of heat consumption) are required. The data are automatically collected and stored at the operator and maintenance provider for practical (opereational) reasons.

The requirements of the EU General Data Protection Regulation need to be respected in all operating and maintanance activities. All legal details need to be laid down in contracts covering all measures of the DH network operating and DR actions.

Short national summary on existing/possible implementation fields, challenges and barriers and potential outlook

Presently, highly motivated drivers and stakeholders together are the most important success factor for a realization of DH networks in Germany. Without public acceptance, the sustainable potential will remain unused although there is still a large potential for the realisation of DH networks. As of 2017, 13.6 % of German households were connected to DH, while a potential DH connection of more tha 60 % is estimated (IFEU, 2017: 22).

The existing German market incentive programme (Marktanreizprogramm) supports DH financially, however without excluding fossil solutions. The fossil fuel taxation will most probably have a supporting effect for renewable heating solutions. While DR actions for the electricity sector have gained political interest and support (e.g. the project DSM Bayern – DR Bavaria, http://www.dsm-bayern.de/pilotprojekt/das-projekt/), dedicated DR action support for the HC sector still needs to be put on the political agenda.

3.4.6 DR actions existing in North Macedonia

Five examples were identified in North Macedonia. Three different solutions for hot water generation, one tariff scheme and an example for dedicated eco loans.

Demand Response (DR) action NM No. 1	
Connecting water heaters to the District Heating System	
Place	North Macedonia
Description of action	BEG Distribution, the heat distribution company in Skopje, facilitates the installation of combined water heaters that are connected both to the electricity and district heating system. Furthermore, it encourages designers of heat installations systems in buildings to consider the possibility of installing combined water heaters. To assess the technical potential, the district heating distribution company BEG Distribution installed 3 combined water heaters in administrative buildings back in 2015.
Actors	• Balkan Energy Group, BEG Distribution (district heating distribution company) • End-consumers • Installers and technicians
Targets of action	• Improved consumer comfort • Cost savings • Increased reliability of hot water supply
Impact on the energy system	• Efficient use of the district heating system; • Reducing the peak load on the power system;
Economic viability (availability of subsidies)	According to data from the test systems at the administrative buildings of BEG Distribution, for a period of 5 months of the year, about 70 % of the hot water needs come from the district heating system. No subsidies are available for the implementation of this measure.
Barriers	• Lack of awareness; • Lack of information on the payback period

	• Lack of technicians' experience with the required automation systems that need to be installed
Challenges	• Avoiding unauthorized connection of combined water heaters to the district heating system • Improving the visibility of the demand response action to consumers
Manageability	High manageability due to simple installation of the water heaters. Additionally, existing hot water tanks with electric heaters can be modified so as to operate as combined water heaters.
Replicability	The DR action is replicable only in households that are connected to the district heating system and have hot water tanks.
Ecological relevance (qualitative climate change mitigation potential)	The power sector in North Macedonia has a high emissions grid factor of the electricity sector. Hence, heating the water via the natural gas fed district heating system should yield emissions reduction.
Links for further information	Connecting water heaters to the district heating system

Demand Response (DR) action NM No. 2	
Deployment of combined solar thermal / district heating / electrical water heaters	
Place	North Macedonia
Description of action	BEG Distribution, the heat distribution company in Skopje, facilitates the installation of solar thermal collectors in buildings in combination with combined water heaters that are connected both to the electricity and district heating system. Furthermore, it encourages designers of heat installations systems in buildings to consider the possibility of installing combined water heaters. The utilisation of the solar energy is defined by both the old and the new Energy Law and the Rulebook on Energy Performance of Buildings by which all public buildings from 2015 should have solar thermal systems (which does not exclude the possibility of combined heating systems as well). In the municipality of Karposh, 35 such systems have been installed. The subsidy started in 2015 supported by the Ministry of Economy (with different approaches and models to date). The combined heating systems offered by BEG are a good initiative for further development of the company by expending their business. At the time "Heat Distribution Balkan Energy" and "Golden Art" have implemented a pilot project for installing a combined system for providing hot water in collective residential buildings in Skopje. The first such system was implemented in the new residential-business building being built by Golden Art Company. It is a state-of-the-art technology solution that will enable the tenants of the building to fully meet the needs of hot water throughout the year, by

	combining and harnessing energy from three different sources: central city heating, solar collectors and from the mains. The system is designed to use solar energy as a primary source of energy, while for the winter season, i.e. during the heating season - from October 15th to April 15th, it will use heat from central heating. In the summer, as well as outside of the heating season, or when downtown electricity will not be sufficient, the combined system will use electricity. This combined model is also included in the EE development plans for the municipality of Karposh. Due to the lack of finance, their implementation is being postponed. This system is great if combined with all types of heat pumps with buffer storage in terms of increasing the EE of the system.
Actors	• Balkan Energy Group, BEG Distribution (district heating distribution company); • End-consumers; • Installers and technicians.
Targets of action	• Integration of renewable energy sources; • Improved consumer comfort; • Cost savings; • Increased reliability of hot water supply.
Impact on the energy system	• Increased share of renewable energy; • Efficient use of the district heating system; • Reducing the peak load on the power system.
Economic viability (availability of subsidies)	The Programme for promotion of renewable energy and energy efficiency in the households offers subsidies for purchased and installed solar thermal collector systems in households (up to 30 % of the cost, but not more than 15,000 MKD per household). The Programme has a total budget of 5 mill. MKD.
Barriers	• Most buildings connected to the district heating system are multi-apartment buildings that lack adequate rooftop area availability.
Challenges	• Consumers' perception of the high complexity of the system; • Improving the visibility of the demand response action to consumers.
Manageability	High manageability for detached houses with available rooftop area.
Replicability	The DR action is replicable only in households that are connected to the district heating system and have available rooftop area. The DR action is more difficult to implement in multi-apartment buildings due to a lack of transposition of the renewable/citizen energy community regulation.
Ecological relevance (qualitative climate	North Macedonia has a high solar potential. Solar thermal collectors provide an effective mechanism for integrating larger shares of renewable energy

change mitigation potential)	and for reducing primary energy use in households.
Links for further information	[Combined solar thermal/district heating/electric water heaters]()

Demand Response (DR) action NM No. 3	
Installation of rooftop PV generators & self consumption based net billing scheme	
Place	North Macedonia
Description of action	Prosumers and the ability to install rooftop PV generators was granted to consumers with the Energy Law and the Rulebook on Renewable Energy Sources. EVN Generation, the energy generation company of EVN Macedonia, offers turnkey solutions for rooftop PV generators in residential and commercial buildings. The default net-billing scheme imposed on prosumers with rooftop PVs by the Rulebook on Renewable Energy Sources stimulates self-consumption. It does so by remunerating the excess PV generation at a lower tariff, proportional to the amount of PV generation exports to the grid. The tariff for the exported electricity C is therefore calculated as: C = PCE * 0.9, if during the calculated period $E_i >= E_p$ C = PCE * 0.9 * E_i/E_p, if during the calculation period $E_i < E_p$, where: • E_i = total electricity supplied by the supplier and received from prosumer within the billing period and expressed in kWh, • E_p = total electricity supplied to the electricity grid of prosumer within the billing period and expressed in kWh, PCE = average cost of electricity that the prosumer pays to the supplier of electricity, without the grid tariff (MKD/kWh), and other taxes, within the billing period and expressed in MKD / kWh. One of the actions that is planned by the Government Action Plan is a grant of 500 EUR for all installed capacities in the households for own needs up to 4 kW. In the social sector as a measure against the energy poverty, instead of the current financial assistance, 4kW capacity will be installed onsite. Another action which is in line with the installation of rooftop PV systems is the installation of hybrid solar power systems and sanitary hot water on public facilities under the jurisdiction of the municipalities. Hybrid PV technology delivers 20 % more electricity than standard PV panels and 600 kWh of thermal energy per 1 m^2 of panel area. This reduces the return period to 50 % of standard systems. According to the new Rulebook on RES and the new legal solutions in the Laws on Energy and EE a pilot project and study of the most favorable facility (school, kindergarten) will be implemented to install such a system that will meet at least 80 % of the

	electricity needs of the grid and 100 % of the needs for sanitary hot water.
Actors	• EVN Generation; • End-consumers; • Government; • Municipalities.
Targets of action	• Integration of renewable energy sources; • Improve self-consumption/load matching capabilities of consumers; • Stimulate load shifting; • Cost savings; • Higher rooftop PV penetration.
Impact on the energy system	• Increased share of renewable energy; • Reducing the peak load on the power system; • Possibility of overvoltage in the electricity distribution system.
Economic viability (availability of subsidies)	No subsidies are available for this measure. Sparkasse Bank and EVN generation have signed a contract in order to provide a stimulating finance mechanism. Consumers are offered an ECO loan with a 15 % grant of the installation costs. There is a lack of experience with regards to the actual payback period. Calculations estimate a payback period of 8-10 years. Economic viability improves in case of better load matching, which is the case in buildings with heat pumps and/or air conditioning systems.
Barriers	• Lack of transparency of the details related to the net-billing scheme; • Consumers need to split the contract with the regulated Universal electricity supplier and take part in the deregulated market to install a rooftop PV. This, in turn, would introduce higher electricity tariffs. • Current regulation does not guarantee that the suppler must "buy" the excess PV generated energy. This is because it is cheaper for the supplier to buy the energy from the market, and not from the prosumer.
Challenges	• High investment costs; • Lack of best practise examples; • Lack of information on the payback period.
Manageability	High manageability for detached houses with available rooftop area.
Replicability	The DR action is easily replicable in buildings that have access to a suitable rooftop area. The DR action is more difficult to implement in multi-apartment buildings due to a lack of transposition of the renewable/citizen

	energy community regulation.
Ecological relevance (qualitative climate change mitigation potential)	Solar photovoltaic generators can offset about 30-40 % of the on-site electricity consumption. This share is higher for buildings with heat pumps and air-conditioning systems as they have better load matching capabilities. As buildings improve their self-sufficiency via rooftop PVs, they avoid consuming carbon intensive electricity from the national fossil fuel-based system.
Links for further information	EVN generation turnkey solar generation Rulebook on renewable energy sources

Demand Response (DR) action NM No. 4	
Time-of-Use Electricity Tariff Scheme	
Place	North Macedonia
Description of action	Residential consumers supplied by the regulated Universal electricity supplier are billed according to a time-of-use tariff. For the households the following tariff apply: • high tariff: 0,052 EUR/kWh, active from 07:00-14:00 and 16:00-22:00 (Monday – Saturday); • low tariff: 0,0099 EUR/kWh, active from 14:00-16:00 and 22:00-07:00 (Monday – Saturday) and during the whole day on Sunday. The low electricity tariff is especially useful for shifting the heating demand during daytime and using the building envelope or a dedicated buffer tank as a thermal storage. Hence, the time-of-use tariff is convenient for buildings with legacy equipment such as storage heaters. Storage heaters in households are often turned on to accumulate heat during the nighttime low tariff which can later be used during the daytime.
Actors	• EVN Supply; • End-consumers;
Targets of action	• Stimulate consumers' price responsiveness; • Load shifting; • Energy poverty reduction (low tariff during daytime).
Impact on the energy system	• Shifts a portion of the peak during daytime; • Reducing the peak load on the power system;
Economic viability (availability of subsidies)	N.A.
Barriers	No barriers have been acknowledged for the implementation of this DR

	action, since it has been applied to all residential consumers.
Challenges	• The tariff is only applicable to consumers supplied by the regulated Universal supplier; • Night time low tariff coincides with peak consumption; does not incentive substitution of old inefficient storage heaters.
Manageability	Currently applied to all residential consumers. This incentivises load shifting and is useful for heating or cooling systems that include thermal storage.
Replicability	Similar and more customized time-of-use tariffs can be applied by deregulated electricity suppliers.
Ecological relevance (qualitative climate change mitigation potential)	Consuming electricity during the daytime entails consuming less carbon intensive electricity generation (higher PV generation in the electricity mix, off-peak period).
Links for further information	Residential electricity time-of-use tariff

Demand Response (DR) action NM No. 5	
Eco Loans	
Place	N. Macedonia
Description of action	Sparkasse Bank provides consumer loans for EE within the EBRD Western Balkans Green Economy Investments Project (GEFF). This collaboration results with ECO loans for enhancing EE in the households. Successfully implemented and approved projects are eligible for investment grants between 15 % and 20 % of the investment value. The following categories of technology are included: windows, doors, isolation, biomass and gas boilers, solar water heaters, PV, heat pumps, lighting, balanced mechanical ventilation, hot water storage tanks. The GEF (Global environment facility) credit line for households ensures EUR 12 million of which 5 million are currently realized. The financing is available through several banks in the country for all the above measures listed. World Bank launches call for EE measures for heating facilities and systems through the Ministry of Finance - EUR 5 million grants for health facilities in the country - EUR 20 million in loans that will be repaid with savings from measures implemented for public buildings (schools, kindergartens, administrative buildings in municipalities).
Actors	• Banks;

	• GEFF; • Municipalties; • Consumers.
Targets of action	• Improving EE, • Integration of RES, • Substitution of old heating systems in the households.
Impact on the energy system	• Reduction in primary energy use; • Integration of renewable energy sources; • Improvement of energy efficiency.
Economic viability (availability of subsidies)	Investment grants between 15 % and 20 % of the investment value. Improved financing conditions if complementary technologies are implemented (e.g. substitution of windows and improving building insulation; solar thermal collector and heat pumps etc.)
Barriers	Insufficient acquaintance for various financing support
Challenges	• Lack of information on payback period;
Manageability	Easy manageability
Replicability	Replicable when investment and development banks offer credit lines.
Ecological relevance (qualitative climate change mitigation potential)	The measures implemented via the ECO loans contribute to the reduction of primary energy use and to the integration of renewable energy sources. Bot contribute greatly to the reduction of local emissions (PM particles) and GHG emissions.
Links for further information	https://sparkasse.mk/Физички_лица/Кредити/Наменски_кредити/ЕКО_-_кредит.aspx

Legal national status of data management, exchange and ownership

This Law on Personal Data Protection regulates the protection of personal data and the right to privacy related to the processing of personal data, and in particular the principles related to the processing of personal data, the rights of the data subject, the position of the data controller and data processors, the transfer of personal data to other countries, the status and competencies of the Agency for Personal Data Protection, special operations of processing of personal data, judicial remedies and responsibility for the processing of personal data, supervision over personal data protection as well as misdemeanour in proceedings in this area. This Law is in compliance with the European legislation in the field of personal data protection, as follows: Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data, the free movement of such data and the repeal of Directive 95/46 / EC (General Data Protection Regulation) CELEX number 32016R0679.

No particular information is available regarding the data collection procedures of individual electricity and heat suppliers, or other companies dealing with demand response activities. In the case e-payment of EVN Macedonia, the processing of personal data is carried out in accordance with the Law on Personal Data Protection and EVN's internal acts, for specific and clearly defined processing purposes - to enable online use of the services EVN offers. By selecting the service registration option, consumers consent to EVN collecting, processing and storing your personal information. Shared personal information will not be used for any other purpose and will not be shared with third parties without consumers' consent, except as provided for by law. Consumers' personal data may be transferred to EU member states on the basis of an EVN approval issued by the Agency for Personal Data Protection.

Short national summary on existing/possible implementation fields, challenges and barriers and potential outlook

Currently, the national electricity producer ESM Macedonia provides incentives for the substitution of old and inefficient wood/oil boilers with inverter heat pumps. This action is applicable to consumers that live in the cities with the higher national air pollution (5,200 households in Skopje, 2,500 in Bitola, 1,500 in Tetovo and 800 in Kichevo). The action provides consumers with 1,000 EUR and has a total budget of 10 mil. EUR. Based on the budget offered by the ESM Macedonia, the 10,000 households would install heat pumps with a total capacity of about 20-30 MW. A possible improvement of this action would be to consider the integration of smart grid ready (SG Ready) heat pumps so as to equip consumers with the ability to respond to DR signals in the future. This would make use of the integration of the heat and electricity sector. Having direct load control over a portion of this capacity would provide an efficient use of the power and heat sector coupling. Nevertheless, numerous examples are available related to the use of the hot water tank or the building envelope as a heat storage for individual heating solutions. Moreover, the abundance of groundwater in Skopje has been widely used for the installation of ground source heat pumps. Further DR potential in North Macedonia, can be utilized through the integration of solar-thermal collectors for solar assisted heat pumps.

With regards to the electricity sector, incentive-based DR, such as direct load control (DLC) has not had notable penetration in the case on North Macedonia. The lack of physical and institutional infrastructure, along with the cheap electricity have been the main barriers for the low deployment of DLC. On the other hand, time-based DR has had a certain success on a national level. As a result, this subsection focuses on the time-based DR related to the electricity system. More specifically, time-based DR has been implemented via the time-of-use (TOU) tariff applicable to residential consumers. This is a legacy tariff which dates back to time when the electricity sector was vertically integrated. Currently, the TOU tariff is applicable only to residential consumers that are supplied by the regulated electricity supplied (EVN Universal supplier). In case residential consumers choose another electricity supplier, other tariffs should apply. However, the main barrier with regards to selecting other electricity suppliers is that, as of the time of this writing, there are no other available offers for residential consumers, other than the Universal electricity supplier. Hence, residential consumers can access the open electricity market only *de jure*, while *de facto* they are bound to the regulated market. This barrier has a spillover effect on penetration of rooftop PV generators. Consumers that consider the installation of rooftop PV are required to choose a supplier other than the regulated Universal supplier. As there are no specific offers available, they are effectively not able to install rooftop PVs.

Neither the Energy Law nor the Energy Efficiency Law contain a specific definition of demand response, demand side measurement or direct load control. Nevertheless, the national legislation does not hamper the existence of demand response. Namely, the Energy Efficiency Law provides a number of mechanisms for DR action to be offered. For instance, the Energy Efficiency law permits the existence of *aggregators* as well as their participation in the electricity market. Aggregators can therefore make use of the consumers' flexible load from heating/hot water and offer that flexibility to the market, or stimulate consumers to shift their demand by providing dynamic tariffs. Moreover, the Energy Efficiency Law also enables the formation of *ESCO companies* which can provide *contracts for energy services* or *guarantee energy use reduction*. Nevertheless, the modalities of organizing more advances DR actions which require coordination between the heat and electricity market operators are not clear and need to be further examined.

Finally, a complete harmonization of the national legislation with the EU Clean energy for all Europeans package should be conducted. This package of measures focuses on making the energy sector more consumer centered. In such a system, demand response will play a vital role in improving the energy system's flexibility. Hence, hourly (and later 15 minute) tariffs will made available to consumers by electricity suppliers. These dynamics in the electricity tariffs should, in turn, result in higher responsiveness on the demand side. Proper integration of the power and the heat sector will be an important consideration for policy makers if these dynamics are to be fully utilized. Whether or not DR measures succeed, is highly determined by the taxing system imposed. Hence, the issue of how taxes are imposed should be comprehensively addressed by regulators and policy makers in the future.

3.4.7 DR actions existing in Serbia

The examples from Serbia include the use of smart software for remote heating operation mode depending on the outside temperature and for optimizing the DH network performance. Also, an example of buffers as heat accumulators is given and the use of electricity in the period of reduced consumption in combination with heat pumps is presented, representing the only example of a systematically implemented DR action in Serbia.

Demand Response (DR) action SER No. 1	
Remote heating operation mode depending on the outside temperature	
Place	City of Šabac, Serbia
Description of action	The energy company has introduced the use of the SCADA package, which includes software for the technical management of the operation of the thermal energy production and distribution system. The work of the heat sources is managed by Noeberger Weishaupt SCADA and the work of the heat substations is an application based on Wonderware SCADA. Both packages are integrated through Danfoss Mentor Planner software that uses weather data and, taking into account the behavior of the system (learned by analyzing archived data over the past few years), predicts operating conditions and optimizes the operation of the DH network.
Actors	Local energy company – PUC "Toplana-Šabac"
Targets of action	Eliminate peaks in the heat supply
Impact on the energy system	The thermal load of the network is reduced, the factor of heat supply (the coefficient of simultaneous demand for energy) is increased. It is possible to operate the system from a remote center and work with a significantly reduced number of contractors, which in times of emergency provides increased security in the supply of thermal energy.

Economic viability (availability of subsidies)	In the specific example of the DH system in Sabac, optimization has achieved savings of up to 4 %, which makes the use of “smart solutions” a good investment with an extremely short payback period.
Barriers	Less than 10 % of users have the ability to manage energy consumption due to technologically outdated heating installations, without TS valves installed.
Challenges	Search for the option of sustainable financing for the modernization of heating installations is ongoing. There is a problem in communication with users, which is one of reasons they are unable to make an informed decision.
Manageability	The local energy company has introduced an “open door” term to inform customers about the sustainability of the measures. A local energy company has taken on the role of ESCO to fund the installation of TS valves and cost allocators.
Replicability	All energy companies in Serbia could apply this model in the same way. Municipalities are the founders of local energy companies in their territory and define rules of operation and act as regulators. For the system to function in the same way in other municipalities, it is necessary to apply the model developed in Sabac.
Ecological relevance (qualitative climate change mitigation potential)	Reducing the consumption of produced and delivered energy reduces the consumption of fossil fuels and pollutant emissions. The DH system in Sabac uses natural gas as fuel, so CO_2 emissions would be reduced, which contributes to the fight against climate change.
Links for further information	www.toplanasabac.rs

Demand Response (DR) action SER No. 2	
Using smart solutions to optimize DH network performance	
Place	City of Šabac, Serbia
Description of action	Installation of SCADA software for remote monitoring and operation of district heating network (TekonWare for optimization of hydraulics and strategic development planning, Wonderer Scada for remote monitoring and operation of thermal substations, Noeberger Weishaupt SCADA for management of operation of thermal sources and Mentor Planner Danfoss for optimization of system operation using weather data to predict operating parameters).
Actors	Local energy company – PUC “Toplana-Šabac”
Targets of action	Optimize the operation of the district heating system, eliminate the heat energy consumption peaks
Impact on the energy system	Reduction of energy consumption, reduction of DH heat losses
Economic viability (availability of	The savings achieved through optimization have the effect of reducing the operating costs of the local energy company and reducing the energy

subsidies)	consumption of users of heating services, which means reducing heating costs.
Barriers	Mentor Planner software takes into account the costs of operating heat sources, and above all the technology of cogeneration of electrical and heat energy and the use of renewable fuels. The current DH system in Sabac has neither cogeneration machines nor uses renewable energy sources (except for a small district heating network in the village of Letnjikovac where wood chips are used).
Challenges	Renewable energy projects are under development so that smart solutions will be implemented at full capacity only after these projects are completed.
Manageability	DH regulatory and development issues are addressed to the city government because it is both the founder of a local energy company and a district heating regulator. Technical support is an obligation of the energy company management. Good coordination between the local administration and the energy company is founded by the city's energy policy.
Replicability	There are 60 local energy companies operating in Serbia that operate on the same principles as PUC "Toplana-Sabac". This means that smart solutions implemented in Sabac are equally applicable in other municipalities in Serbia.
Ecological relevance (qualitative climate change mitigation potential)	Optimization of work reduces primary energy consumption, heat losses in the grid, but also takes into account the use of renewable energy. Smart solutions are based on the principle of using renewable fuels as a base source of energy and using fossil fuels only to cover peak needs. In heating systems where there are more implemented renewable energy technologies, priority is given to more efficient and sustainable technologies.
Links for further information	www.toplanasabac.rs

Demand Response (DR) action SER No. 3	
Use of buffers - heat accumulators	
Place	City of Šabac, Serbia
Description of action	A small district heating network in the village of Letnjikovac on the outskirts of Sabac (500 kW wood pellet boiler and 2 x 400 kW fuel oil boilers) was built in 2018. A tank capacity of 6,000 liters was installed as part of the equipment. The built-in buffer crew is tasked with burning the peak of heat demand in the morning when the heat demand is highest and increasing the working hours of the wood chipper to make the technology implemented as sustainable as possible. During the 2019/2020 heating season, thanks to the built-in buffer tank and optimization of the operation of this plant, the oil-fired boilers were not used.
Actors	Local energy company – PUC "Toplana-Šabac"
Targets of action	Optimize the operation of the district heating system, eliminate peaks of

	heat demand.
Impact on the energy system	Reduces stress in the district heating network, reduces energy consumption, reduces heat losses in the DH network.
Economic viability (availability of subsidies)	The savings achieved through optimization have the effect of reducing the operating costs of the local energy company and reducing the energy consumption of users of heating services, which means reducing heating costs.
Barriers	There are no technical recommendations for the use of buffer containers in heating / cooling installations. Few engineers design such systems, relying on personal experience and good practice information gained from periodic trainings organized by equipment manufacturers.
Challenges	The installation of buffer containers increases the investment costs of heating installations, so subsidies should also cover other equipment installed in HC installations such as buffer containers, frequency controlled circulation pumps and automation for optimizing the operation of HC installations.
Manageability	The implementation of such solutions should be imposed through technical regulations and should be initiated by professional associations of designers and contractors, as well as professional associations of installers and equipment manufacturers. Implementation in DHC systems should be promoted by the Energy Business Association (in Serbia, association is called “District Heating Companies of Serbia”).
Replicability	HC installations using renewable energy should have a buffer tank installed, reducing the installed power of individual systems and reducing operating costs to an optimal extent.
Ecological relevance (qualitative climate change mitigation potential)	By optimizing the work, heat losses in the grid are reduced as well as primary energy consumption and pollutant emissions.
Links for further information	

Demand Response (DR) action SER No. 4	
Use of electricity in the period of reduced consumption	
Place	Serbia
Description of action	The Energy Agency of the Republic of Serbia (AERS, 2020), on the basis of the Law on Energy (Paragraf, 2020a), has established the Tariff System for the Calculation of Electricity for Tariff Customers (AERS, 2017). It recognizes three tariff regimes for the household group - tariff rate for rational consumption (“green” up to 300 kWh$_e$/month), tariff rate for moderate consumption (“blue” 350 kWh$_e$/month – 1600 kWh$_e$/month) and tariff rate for high consumption ("Red" over 1,600 kWh$_e$/month), as well as two

	daytime modes (otherwise called "daytime" and "nighttime" electricity).
Actors	Energy companies involved in the public supply of electricity
Targets of action	The tariff system favors low electricity consumption in times of least use (up to 300 kWh_e/month and between 22:00 and 6:00).
Impact on the energy system	The demand of electricity buyers is shifting towards the period of the lowest load of the generating plants and the electricity distribution networks, thus achieving savings in peak demand periods.
Economic viability (availability of subsidies)	Customers provide themselves with electricity at the lowest possible cost, which reduces the operating costs of heating/cooling and reduces the payback time of investment in modern technologies (if applied).
Barriers	Incentives for the production of electricity from renewable sources are not sufficient to make renewable technologies sustainable. The emissions trading scheme has not been put in place, so the owners of (electricity) generation plants and owners of energy plants in the HC sector have no motivation to invest in either renewable technologies or cogeneration plants using fossil fuels (primarily the use of natural gas).
Challenges	Too low electricity prices discourage investment in the implementation of biomass and solar technologies, as in DHC, and on the other hand, the use of heat pump technology is favored. The challenge we face is the use of heat pumps with built-in electric compressors that use electricity generated from coal (the energy mix for electricity production in Serbia is very unfavorable and heat pumps with COP < 4.6 are not acceptable in terms of CO_2 emissions).
Manageability	A financially viable solution would be to implement smart systems with buffer containers that incorporate electric heaters that are part of the HC installation. This solution involves the use of software to remotely control the operation of heat sources and optimize charging, i.e. heat accumulation at a time when the heat demand is lowest.
Replicability	This is the only example of a systematically implemented DR action in Serbia. A large number of families in older multi-family buildings where no heating installation is implemented utilizes storage heaters with electrical resistance coils for heat generation where energy stores in clay bricks during low demand periods (overnight). Stored energy is used overday when required. It should be noted that these devices use three-phase electrical installations, which is the standard in the construction sector in Serbia.
Ecological relevance (qualitative climate change mitigation potential)	The lack of subsidies and motivation for investors to invest in renewable technologies and cogeneration machines primarily for the production of electricity and heat from biomass does not give much importance to the implementation of this DR action in Serbia.
Links for further information	http://www.ems-undp.rs/en-US/Blog/Post?id=104

Comparison with the situation in the EU energy market

By the adoption of the new Energy Law in the end of 2014, the energy field in the local legislation was harmonised with the provisions of the Third Energy Legislation Package of the European Union and, thereby, the process of introduction of competition in the energy sector in Serbia was continued in order to increase the efficiency of the sector via market mechanisms in electricity production and supply, while economic regulation of electricity transmission and distribution as natural monopolies still remained (AERS, 2011).

The Energy Law (Paragraf, 2020a) introduced an obligation to license energy companies depending on the energy activity they perform. According to information from the AERS (2017) web portal, 19 energy companies are listed in the list of licensed electricity supply companies as of 2017. Companies in Serbia (including the public sector) can buy electricity on the market from licensed companies or on the electricity exchange (SEEPEX, 2020). Households and small businesses buy electricity from the public supplier (EPS, 2020), but are free to find a supplier in the market as well. In this case, the price is regulated and is based on the following principles (AERS, 2011):

- Coverage of justified costs,
- Economic and energy efficiency,
- Non-discrimination,
- Regulation efficiency,
- Transparency.

The Energy Act provides for incentives (GoRS, 2020) for electricity generated from renewable sources. Incentive procedures are too complicated and the financial sector does not recognize small businesses and nature persons as potential investors in renewable energy. Small producers who are unable to provide incentives are free to build electricity generation systems, most commonly PV systems, and in order to be connected to the public grid, they need to meet the relevant technical requirements and in that case sell surpluses at market prices. The current purchase price of "green" electricity paid by the state-owned supply company is 40 EUR/MWh$_e$ and private energy companies are willing to pay a few percent more.

The electricity price for the household category, tariff item “rational consumption” and tariff item “low consumption” is too low to pay households for investments in PV installations within a reasonable time. On the other hand, the price for the “high consumption” tariff item may be sustainable, but the amount of energy to be produced is too large for the surface area of PV installations available to households, so it is a barrier that cannot be overcome.

Natural gas legislation has been harmonized with the Third Energy Legislation Package. The Energy Law recognizes three energy activities: transportation, distribution and supply of natural gas. Although the market is free, the state-owned JP Srbijagas is at the same time the owner of the transport pipelines, the operator of the natural gas transportation system, in several municipalities simultaneously the owner of the natural gas distribution pipeline, the system operator and the natural gas supplier, as well as the supplier of public suppliers at the level of States. The second largest company, JugoRosGaz, is engaged in transport, distribution and supply of natural gas in a small part of the territory of Serbia (Niš). In addition to these two companies, there are a number of smaller companies involved in the distribution and supply of natural gas, but as in the case of the two large companies mentioned above, they are all simultaneously the owners of distribution networks, system operators on those networks and suppliers. The conclusion that is easy to draw is that all companies in the natural gas sector are in conflict of interest and that the market is essentially not open.

The business of supplying natural gas can be seen as a supply for large customers operating on market principles (if the unfair competition of PE "Srbijagas" whose position is described in the previous paragraph is neglected) and as a public supply. Public supply is regulated and is intended for small customers (AERS Natural Gas, n.d.) i.e. customers who take up not more than 100,000 m^3/year. For customers in the public supply category (households and other small customers) the price of natural gas is US $ 293/1,000 Sm^3 (as of April 2020), while prices for customers in the other supply category it is US $ 337/1,000 Sm^3 (Q3 2019) plus system access costs to the system amounting to approximately US $ 80/1,000 Sm^3 (according to data taken from PUC "Toplana-Sabac").

DH companies in Serbia buy from a state-owned company natural gas for the price that applies to the supply category. This anomaly that households pay for natural gas is significantly less than the DH energy companies discourage efforts to develop DH networks and discourage households from connecting to DH systems. The unfair competition of the state-owned Srbijagas with respect to local energy companies is a threat to the DH sector and threatens sustainable operation of local energy companies and favoring the use of natural gas.

There are no examples of DR actions in the gas sector.

The Energy Law is harmonized with the Third Energy Legislation Package and in the DH sector. However, the situation is similar to that in the gas sector. Local energy companies are at the same time owners of heat sources and heat distribution systems, as well as distribution system operators and heat energy suppliers. Local administrations are DH regulators, and at the same time the founders of local energy companies and users of heating services for the needs of public buildings are therefore in conflict of interest. The law provides for competition in the performance of all three energy activities in the DH sector: generation, distribution and supply of heat.

Introducing competition in the field of heat production and heat supply does not pose a particular challenge. However, the distribution of heat is a challenge because it is possible to have only one operator of the distribution system, but the problem is solved by regulatory acts issued by the local administration.

There are 60 local energy companies in Serbia and only 15 companies pay for the delivered heat according to the measured consumption. Other companies charge a lump sum for the estimated cost and share of the heated area of the attached buildings). In 2011, Sabac implemented metering in thermal substations and belongs to a group of 15 cities where consumption is charged.

Users of district heating services are stimulated to rationally consume thermal energy, but for the time being, there is no possibility for independent owners of heat sources to deliver thermal energy to the DH network. Using Mentor Planner (Danfoss) software, which takes into account the cost of generating heat in different heat sources and optimizing the operation of the DH network, will create the conditions for DR actions.

Personal data protection

In Serbia, the Law on Personal Data Protection (Paragraf, 2020b) is in force since 22/08/2019. It is compliant with the GDPR in force in EU countries. The Law on Personal Data Protection is not fully applicable and is not in compliance with the Serbian legislation. Certain omissions that represent a barrier to its full capacity implementation are vague provisions and mechanisms that do not exist in the Serbian legal system, and these solutions have been taken over without change from the GDPR (Krivokapić, 2019).

DHC energy companies are substantially exposed to the requirements and obligations arising from the implementation of the provisions of this law. In the ordinary course of business, energy companies and customers enter into written contracts. An essential element of this contract is customer information, as follows: first and last name, address of residence, address at which the apartment is occupied or rented by the buyer (if applicable), then the personal identification number required as an element of identification in the event of a dispute between the energy company and the buyer.

The address of the actual place of residence is necessary for the purpose of supplying information potentially exchanged by the buyer and the energy company during the validity of the contract. All other information is not relevant, and it is not necessary for the customer to supply it. An e-mail and telephone number is desirable to facilitate communication with the customer.

On the other hand, the development of information technologies improves the business of energy companies, and one of the services offered is the delivery of energy bills electronically (e-mail, texting or mobile application). In this sense, the information on the e-mail address or mobile phone number are necessary information that the energy company must obtain from the user. This information is archived in the energy billing software and the preparation and distribution of bills, and in this respect every energy company is obliged to adopt a procedure for protecting the data on users of its services. Companies are required to adopt a data protection risk assessment act and to perform data processing and data archiving in accordance with that act and the procedures adopted.

A particular challenge is surveys and analyzes related to the efficiency of systems that help energy companies improve their functioning and develop strategic development plans.

Activities of DH operator on personal data protection

The energy company in Sabac (PUC “Toplana-Sabac”) has adopted the Risk Assessment Act, which prescribes procedures for the protection of data on service users. The purpose of the data collection is to conclude heat supply contracts, consumption billing and invoicing. Only necessary information is collected such as (in addition to the names and surnames of the service user) address, the address of the building/apartment where electricity is delivered and the unified identification number. As of 2018, the company has offered the option of providing invoices electronically only to users who accept this service, with the written consent of the user. The request can be downloaded from the company website (JKP Toplana Šabac, 2020).

Preparation of individual contracts is underway with all users of the Company's services, where, among other things, relevant to the energy company/service user relationship, notes will also be entered on the user's rights to the confidentiality of personal data and the company's obligations to ensure this. In the course of 2020, 11,000 individual contracts will be replaced.

During 2018 and 2019, two surveys were conducted that examined the interest of citizens in connection to small district heating networks in the suburban settlement Letnjikovac and the suburban settlement Bogosavac. The surveys were anonymous. The survey results will be used to plan the development of district heating networks in suburban settlements that will use renewable energy.

The City of Sabac and the Energy Company (PUC “Toplana-Sabac”) are participants in the OPEN DATA project (launched by the UNDP office in Serbia). The aim of the project is to open energy consumption data. Energy consumption data at the level of thermal substations and buildings would be available in machine-readable code. The freedom to create mobile applications on energy consumption for use by those interested in such as homeowners and occupants, real estate dealers, engineering analysts and designers dealing with energy efficiency and more has been left. Open data will not contain the personal information of the homeowners and tenants. The project is ongoi ng and the planned realization is at the end of 2020.

A similar project is planned for 2020/2021 year and refers to the assessment of the availability of roof surfaces to accommodate PV panels. The method of data collection and the presentation of results are subject to planning and compliance with GDPR and the Law on Personal Data Protection. The project is under preparation.

3.4.8 DR actions existing in Slovenia

In Slovenia, the main existing action trying to influence consumers' behaviour in heating is the differentiation of electricity price in higher period (each day from 6 am to 10 pm) and lower period (each day from 6 pm to 10 am) during:

- winter time:
  - high tariff from 6 am to 10 pm
  - low tariff from 10 pm to 6 am
- summer time:
  - high tariff from 7 am to 11 pm
  - low tariff from 11 pm to 7 am

Consumers using heating devices with a storage possibility (electric water heaters or storage heaters) use electricity during periods of lower prices and utilise stored thermal energy throughout a day. The precondition is a double tariff electricity meter and a contract for a two-tariff model offered by all suppliers active in the electricity market.

An example of a DR action is therfore given for the electrical sector, and a knowledge transfer for DR actions in the HC sector is carried out in the conclusions.

Demand Response DR action SI No.1	
Demand Response (DR) action NEDO	
Place	Slovenia
Description of action	Increasing the share of renewable energy sources, electric charging stations, battery systems, flexible end-users of the grid and other diffused electricity sources brings both, technological and business challenges and ultimately represents an opportunity for development for all players in the electricity system. Due to the development of new technologies, the main goal is also to provide an electricity system that will enable safe, reliable and quality electricity supply at all times. The NEDO project represents Slovenian-Japanese cooperation in the field of so-called smart grids, which began in November 2016 and will run through April 2020.
Actors	Japan's NEDO Development Agency, Hitachi, ELES, Solvera Lynx
Targets of action	It is one of the first energy consumption management projects for households in Slovenia and is aimed at acquiring knowledge and experience

	with household users and their behavior in case of different ways of managing consumption at a time when there is a period of high energy consumption in the network. The goal is also to identify the requirements and ways of integrating a wide variety of information systems for the purposes of managing the electricity distribution network, and to examine how different types of consumption management devices can be integrated into the entire energy management system of a distribution company.
Impact on the energy system	In 2018, the pilot phase of the Move Consumption project was being implemented, with savings of 8,419 EUR for all active customers resulting from the savings of being included in the customer management scheme or the new KKT tariff group. The savings from electricity consumption represented 115 MWh compared to the previous year, which represents a 2.4 % decrease in electricity consumption. The savings of each active customer thus amounted to 10.2 EUR per measuring point for the whole year.
Challenges	It was found out that users are not familiar with tariff models and a large proportion of them are still on the classic single-tariff network charging model, even though they already have the option of using two-tariff billing, which can represent a more rational use of electricity. In addition, the development of new dynamic tariffs will enable even more rational use of electricity by end-users of the network, or in particular it will have an impact on regional areas where the supply of electricity is lower due to high loads and thus improved through consumption management.
Links for further information	https://www.solvera-lynx.com/sl/study/demand-response-in-residential-buildings-households/#wpcf7-f2925-o1

Legal national status of data management, exchange and ownership

DR activities improving the electricity system operation: The regulatory framework of Demand Response (and consequently tariffs) is based on the *Act on the methodology determining the regulatory framework and the methodology for charging the network charge for the electricity system operators (Uradni List, 2020)*. The following measures are introduced:

- Demand Response measures,
- Quality of Service regulation,
- Incentives for smart grid projects,
- Supporting of pilot projects from a field of Demand Response and demand side management, renewable energy management and storage of energy.

These measures ensure the cost-savings in networks according to criteria mentioned under paragraph 1 of the Annex XI. of EED. Shifting of the load from peak to off-peak by final costumers taking into account the availability of renewables is not prevented by the regulation (for retailers), and not explicitly supported either (for network operators). Time of use tariffs and critical peak pricing are applied in Slovenia, and they are established under Article 98 of the Act.

There are two market participants on the electricity market – TSO and PMO. The public company Electricity Transmission System Operator (TSO ELES Ltd.) has the exclusive right to perform the public service of the transmission network system operator in Slovenia. The founder and the sole owner of the company is the Republic of Slovenia. PMO Borzen on the other hand provides and facilitates coordinated operation of the Slovenian electricity system. It executes the activities of balance scheme management, recording of closed contracts, elaboration of indicative operating schedule, imbalance settlement and financial settlement of transactions, all connected with the aforementioned activities.

ELES publishes tenders and/or auctions for the ancillary services and purchase of electricity for covering losses on the transmission network annually (ELES, n.d.). Network regulation enables participation of aggregated distributed consumers in ancillary services, according to Article 31, paragraph 4 of the "Act on the methodology determining the regulatory framework and the methodology for charging the network charge for the electricity system operators" (JRC 2015). At the same time, Demand Response providers are required to ensure 24/7 availability which is a major obstacle, and excludes a large number of potential (small) participants, thus limits the size of the load (SEDC 2015). The response time is 15 minutes, and it must be possible to deliver the service for a maximum 2 hours. The time between two activations must be at least 10 hours, with a maximum number of 2 activations per day. The minimum aggregated bid size is 5 MW.

Main market barriers: The key barriers are related to the specificities of the country. The size of the electricity market is small with small volumes, and the number of accessible programmes is limited. In effect, there is not really a business case for Demand Response. For the moment, there are no programmes aimed at the network management.

A significant chunk of the market has not been available, namely the wholesale market and the Balancing market is more fit for large consumers due to the limitation on aggregators. The requirement of 24/7 availability is too difficult for participants that are potentially interested in the Tertiary Reserve.

Conclusions: Response is allowed in the Balancing Market in Slovenia, but not in the Wholesale market. The capacity market does not exist in Slovenia. To the contrary of most countries which opened their product requirements to DR, Slovenia did not allow aggregated load in a wide scale, and limited aggregation to the Tertiary reserve, which now seems to open up in the Secondary reserve, too. This has resulted in the limitation of participants because small consumers are excluded, while large industrial consumers are the sole participants that can access the markets. There is only one aggregator in the market.

The business case is not evident in Slovenia for Demand Response, primarily because it is a small market. Both the TSO and the Demand Response providers need to improve their products in the future in order to compete with the conventional supply units.

DR improving an economic and ecological operation of (renewable) district heating and micro grids

Demand response activities in district heating networks in Slovenia are not possible. Very often, it is complicated and costly to lower connection power. The customer must inform the distributor of the change in connection power due to:

- changes in the thermal protection of the building,
- changes in the purpose and use of the building or part of the building,
- changes in the purpose and use of thermal devices,
- extensions of thermal installations,
- modernization of thermal installations resulting in a more economical use of heat,

- termination or partial termination of heat installations,
- calculation errors in determining the connection power or the differences between the calculations in each phase of construction.

The changes identified affect:

- contractual power,
- maximum flow,

accuracy of measurement and regulation of heat supply.

3.4.9 DR actions existing in Spain

In the HC sector, presently no DR actions are carried out in Spain. The given example about Smart Meters, energy consumption and hourly price control to modify consumption patterns, could however also be regarded as potential starting base for DR actions in the HC sector when the use of heat pumps is assumed.

Demand Response (DR) action ES No. 1	
Smart Meters, energy consumption and hourly price control to modify consumption patterns	
Place	Spain
Description of action	By installing Smart Meters, consumers have access to both hourly prices and their own consumption: energy consumption hourly data, power demand, emissions and benchmarks in the different categories with similar consumers. With this information consumers can take different demand response actions: -Consumption reduction: Increase in the level of awareness, equipment renovation… -Adaptation to hourly prices: Increasing or lowering consumption depending on the hourly energy price, provided by the DSO the day before. -Adjustment of tariff to consumption needs and peak power demand.
Actors	DSOs– provide Smart Meters and online platform to analyse measurement and compare them to the hired conditions. National Grid Technical Operator - provides hourly price information for the next day and historical price data. Natural persons/consumers: Responsible to show interest and use resources and information at their hand to reach full saving potential.
Targets of action	- Energy saving and changing consumption pattern. - Lowering emissions. - Lowering demand in high-demand periods of time (peak cut).

	- Increasing level of awareness.
Impact on the energy system	- Adjustment of consumption patterns and flattening of national and regional electricity demand curves. - Increase on replacement of inefficient equipment by knowing which ones have larger consumption. - Changes in hired tariffs and power.
Economic viability (availability of subsidies)	The cost is included in the fixed part of the energy tariff, as indirect cost (meter hiring cost); IT system needs of a cost of 80 to 150 €/meter installed, considering the meter and infrastructure.
Barriers	- Need of advanced software to manage individual consumption and patterns. - Consumers don't know about the possibility to use the platforms provided the DSOs which frequently are free.
Challenges	- Reaching consumers, informing them and increasing their level of awareness to use this system
Manageability	- Big data analysis and management, need of personnel and technology
Replicability	- The use of the smart meter data is replicable by any other DSO or any building or infrastructure where data could be obtained at low cost
Ecological relevance (qualitative climate change mitigation potential)	- A reduction in the energy demand has a direct proportional impact in the reduction of CO_2 emmissions.
Links for further information	https://www.ree.es/es/actividades/operacion-del-sistema-electrico/precio-voluntario-pequeno-consumidor-pvpc https://www.ree.es/es/actividades/operacion-del-sistema-electrico/gestion-de-demanda

Legal national status of data management, exchange and ownership

This demand response action involve a large collection of personal data, such as: clients´ names, addresses, occupation, number of residents per household, energy consumptions and time of it and hired tariff and power. The requirements of the EU General Data Protection Regulation need to be respected in all operating activities. All legal details need to be laid down in the supply contract.

In the specific situation of Spain, the DSO smart meters rollout is done under national regulations, thus mandatory for the consumers. Other countries, as The Netherlands, have options for consumers regarding the use of smart meters connected or not to the advanced monitoring system.

Short national summary on existing/possible implementation fields, challenges and barriers and potential outlook

DR actions in Spain are very limited and mainly found in the electric sector, such as time discrimination rates or adapting consumption to times of the day with lower demand.

To develop and promote these actions the Ecological Transition Ministry has included it as a topic of interest in the Energy Efficiency National Plan, under the name: “facilitation and promotion of demand response” but is yet to be a reality in the heating and cooling sector (IDAE, 2020).

4 | Legal Collective Actions (CAs), Renewable Energy Communities (RECs) and Citizens' Energy Communities (CECs)

Following, information about Collective Actions (CAs), Renewable Energy Communities (RECs) and Citizens' Energy Communities (CECs) is given. Starting, general definitions are presented, followed by examples about the scope of these actions. For all REPLACE target countries, legal issues of relevance and existing examples are furthermore shown.

4.1 General definitions

CAs - Collective Actions (defined for the purposes of this paper/project, is based on various definitions of Bottom-up processes & Social innovation)

There are three general types/approaches to community development efforts:

- “Top-down”: the government/authorities actively initiate community development activities, while the community/ general public remains passive.
- “Bottom-up”: the community plays the active role in initiating and managing development activities, while the government plays a more supportive role, enhancing the skills and knowledge of the local community actors.
- “Partnership”: a combined effort between the government and the community to carry out community development activities

Social innovations are “bottom-up” innovations from civil society intended to address the failure of “top-down” private market and political approaches in solving complex modern societal problems

In order to turn questions tackled by theories regarding Bottom-up processes and Social innovation into an analysis design facilitating REPLACE’s project implementation, the terms "Bottom-up" and "Social innovation" need to be defined adequately.

In the REPLACE project, **Social innovation** means Novelty, Intentionality of the social benefit and Social interaction:

- Novelty: At the time of its creation, it is a new solution for the context in question, e.g. for a specific target audience, organisation, topic, or region.
- Intentionality of the social benefit: The declared goal is a positive social impact for an underserved target group or a socially neglected topic. Added value for the target groups or society will be created.
- Social interaction: In the course of implementation, there is a minimum of social interaction.

Bottom-up innovation can be defined as the decisive civil society engagement of communities to solve problems, address societal challenges and create opportunities. Ideas and evolutions originating from civil society, and/or a high degree of civil society participation or self-organisation are characteristic of Bottom-up processes.

Contributors of Bottom-up processes, considered in REPLACE, are:

- Civil society, self-organised groups
- NPOs (non-profit organizations) and social enterprises as initiators and actors of civil society
- Municipal actors in community-based processes

It should be noted that Bottom-up approaches are rarely applied in initiatives directly related to energy, as the topics are very complex, on the one hand, and on the other hand, people are notably risk-averse with regard to the topic of energy. It is not an issue where people like to experiment.

This is also supported by the results of the project "PLAISIR – Planning Innovation: Learning from Socio-Innovative Energy Projects". To overcome the barrier of high complexity, the approaches recommended in REPLACE are defined as **Bottom-linked**.

This means that initiatives are embedded in local communities and implemented in cooperation with local networks (e.g. public municipal actors).

Renewable Energy Communities (RECs) and **Citizens' Energy Communities (CECs)** are two forms of civil engagement that will play a role in the near future. These forms are further described in chapter 4.

4.2 Scope of already implemented CA, or “REC and CEC like” activities considered

Regarding the scope and examples of CA, the definition for CAs stated above will be used to screen existing (preferably bottom-linked) CA initiatives and/or related projects in the partner countries.

Examples for CAs in the field of heat supply and room air conditioning for the housing sector could be:

- Collective wood pellet purchase
- Collective thermal insulation of the uppermost ceiling of single-family houses (e.g. based on trained self-assembly groups)
- Collective purchase of boilers/equipment for renewable heating systems (by both, end consumers or installers)
- Collective implementation of low-cost measures recommended by public energy advisors at boiler inspections
- Collective purchase of PV systems with domestic hot water (boilers equipped/ upgradable with) power-to-heat heating rods
- Collective purchase of PV systems together with efficient household mono- and multi-split room air conditioning systems (e.g. listed on www.topten.ch)
- Collective purchase and implementation of solar thermal systems (e.g. via trained self-assembly groups)
- Biomass micro grids supplying more than at least two buildings (e.g. based on farmers cooperatives, even operated as a kind of plant energy contracting completely for third parties)
- (larger) Biomass district heating grids based on energy cooperatives

Examples for any already existing "RECs like" activities could be

- Community PV production plant – e.g. via tenant electricity supply models
- Communities/settlement of houses running PV plants for electricity self-consumption having only one connection point to the public electricity grid (with self-organized billing and metering)
- Any kind of energy community with the target of high self-supply with heat and/or electricity

Examples for any already existing "CECs like" activities could be

- Like RECs, but focus on electricity; fossil fuel energy conversion is a relevant part of the story or the community owns and operates the electricity grid too

Heat might play a role in REC and CEC too already, via using electric heating rods or heat pumps for example.

4.3 European level REC, CEC and CA issues of relevance for this report

As shown above, the framework conditions for Renewable Energy Communities and for Citizens' Energy Communities are defined in RED II and in ED II. Collective actions occur in the framework of civil law and are thus in most of the cases subject to national law.

In the REPLACE project, aspects like data availability and management helping to identify existing inefficient heating systems, possibilities to access owners of such systems (via direct communication means) and access to facilities of owners of such systems can be treated.

In terms of the legal status of data management, exchange and ownership, the regulations as of GDPR need to be respected and the publications of the Council of European Energy Regulators (CEER) can be considered for future laws. More information about the GDPR and the CEER statements are available in chapter 2.3.

Following, examples about legal issues from Europe with reference to the report scope are given:

- The first aspect serves the question where inefficient heating systems are existing and what is knowledgeable about them. An example of an advanced data availability and management is the case of Denmark. Here, according to EBPD data about the thermal quality of buildings and about the heating system were collected and benchmarked systematically and accessible for the whole public. The database even includes technology neutral recommendations for thermal improvements of the building and heating system and the investment and energy savings achievable. The database (SparEnergi, 2020) is accessible for everybody, results are obtained after providing postal code, street and street number. The data are geo-referenced, so that the quality of the neighbouring buildings can also be seen, which can be a stimulus to become active and better related to one's own home (EPBD-CA, 2016).
- The second aspect relates to communication possibilities that public entities have to approach owners of inefficient heating systems directly (on public initiative). From a legal aspect this is not easy to perform (GDPR). In Austria, state government bodies (including independent energy advisors) are not allowed to mail end consumers (as long as they have not given signed permission to do so). This is a problem, as end consumers, e.g. after a first on-site energy advice, cannot be asked by the advisors whether or how they want to proceed with their actions. In

Austria, only municipalities or mayors respectively are allowed to approach end consumers directly, e.g. via mailing or phone for various matters.

- The third aspect relates to access to facilities of owners of inefficient heating systems. This can be of relevance for establishing the database mentioned in the first under point or to actions like a recurrent labelling of the age of existing boilers, increasing awareness towards an informed replacement. In Austria for example, due to a corresponding legal basis, currently only chimney sweepers have access to (the greatest part of) inefficient existing heating systems. A further question is whether information (that for example chimney sweepers (may) have about inefficient systems) is documented systematically and is available for public bodies or not. It could also be highlighted, how partner countries perform the boiler inspection, which they are obliged to by the EBPD, and what data, if any, are collected systematically.

4.3.1 Legal status quo in Austria

Data availability and management about inefficient heating systems: In Austria, according to the Clean Air Act municipalities are obliged to license, monitor (and withdraw non-compliant) heating systems (from service). Chimney Sweepers are the agents that practically and regularly assess heating systems and related building infrastructures, allowing municipalities to carry out those tasks. Therefore the chimney sweepers also establish databases that are deemed for municipal control activities. Data gathering and documentation is not always made systematically and electronically, however. And some municipalities do not have sufficient recources to fulfil those tasks as desireable.

The provincial government of Salzburg has access to most of the municipal/chimney sweepers boiler data bases describe above, where among other data, a large share of the existing fuel oil and natural gas boilers and some specifications about them (e.g. address, owner, primary and secondary heating systems, technology, nominal power, installation year, partly fuel consumption, decommissioning year, age of the house etc.) are recorded. The data are continuously reconciled and extended with information from the constantly arriving building energy certificates. The boiler database does not cover all existing boilers and is not fully accurate. It is however statistically valuable and helps to make appropriate policy decisions.

Communication possibilities: In Austria, state government bodies (including independent energy advisors) are not allowed to mail end consumers (as long as they have not given signed permission to do so). This is a problem, as end consumers, e.g. after a first on-site energy advice, cannot be asked by the advisors whether or how they want to proceed with their actions. In Austria, only municipalities or mayors respectively are allowed to approach end consumers directly, e.g. via mailing or phone for various matters. It is also a problem for local authorities to forward messages that at first glance do not appear pleasing to end consumers. They would prefere that news that might become costly to end consumers originate from State or Federal offices who are responsible for this.

Access to facilities of owners: In Austria, due to a corresponding legal basis (e.g. fire investigation), currently only chimney sweepers have access to (the greatest part of) inefficient existing heating systems situated in residential buildings. Installers have access to boiler rooms only if owners ask for or allow so. Information that chimney sweepers or installers may have about inefficient systems in general is not automatically available for public bodies (e.g. the federal or provincial governments), however. Information can be shared on a voluntary basis, when GDPR stipulations are fulfilled.

4.3.2 Legal status quo in Bosnia and Herzegovina

Data availability and management: In order to provide a mechanism for monitoring and verification of energy efficiency action plan, BiH was introduced an integrated energy efficiency information system (EEIS). At the level of the state of Bosnia and Herzegovina, a decision on the establishment of an energy management system and an information system on energy efficiency was adopted by the Council for Ministers in June 2019, in order to implement Article 8 of Directive 2012/27/EU and improve monitoring system on energy efficiency. The Rulebook on an energy efficiency information system (EEIS) was already adopted in FBIH in January 2019 (FBiH, 2019).

Intensive activities have recently been carried out on the establishment of EEIS in BIH, made up of entity information systems. Based on the entity energy efficiency laws, the content, structure and responsibilities for data provision and processing in the EEIS were defined in the rulebooks on the Information system. The EEIS is made of the following modules:

a) Inventory of buildings

b) Energy efficiency action plans

c) Energy savings

d) Energy consumption

e) Energy certificates of buildings

f) Technical systems in buildings

Communication possibilities to approach owners of inefficient heating system directly: According to the Consumer Protection Law of FBiH, in Article 51 is prescribed that without the permission of the consumer, the trader (district heating company) are not allowed to use mail or telephone for communication with end consumers.

In addition, according to the Law on the Protection of Personal Data of BiH, the controller may process personal data only with the consent of a data subject and this Law shall apply to personal data that are processed by all public authorities, natural and legal persons, unless otherwise stipulated by other legislation.

Also, as described above although not a member state of the European Union (EU), Bosnia and Herzegovina has applied the new EU law on the consumer data protection GDPR which among other things prescribes that state government bodies (including independent energy advisors) are not allowed to mail end consumers (as long as they have not given signed permission to do so). In addition, it is important to emphasize that GDPR is not yet implemented in most of state government bodies in BIH.

4.3.3 Legal status quo in Bulgaria

Data availability and management about inefficient heating systems: In Bulgaria, there is a national geo-referenced database of the buildings with an energy efficiency certificate, managed by the Sustainable Energy Development Agency (SEDA). However, due to the low number of certified residential buildings, as of April 2020 the database contained only 1,865 such buildings (SEEA, 2020), representing only 0.1% of all residential buildings in the country.

SEDA manages databases about the condition of the air conditioning systems with nominal electric capacity of over 12 kW and boiler-based heating systems with capacity of each boiler over 20 kW. However, systems with such high capacity are highly uncommon in the residential sector.

Statistical data is collected during the census for all dwellings. These include the type of fuel used for heating - electricity, wood, coal, district heating, gas. However, no data is collected about the particular heating systems. Additionally, during the census, data is collected about the availability of basic energy efficiency improvements of the dwelling, namely energy efficient windows and external insulation of the building envelope.

Communication possibilities that public entities have to directly approach owners: Due to the GDPR requirements, it is not possible for public entities to approach specific persons, unless these persons explicitly express their consent about it.

Access to facilities of owners: In Bulgaria, the consumers are obliged to grant access to the district heating and gas supply companies to record the heat / gas consumption and inspect the integrity of the heating system. Additionally, there is a legal obligation for inspection of the abovementioned large air conditioning and boiler systems, but such large systems are extremely rare in the residential sector.

4.3.4 Legal status quo in Croatia

Regarding the data availability and management, the main legal concern is identifying the inefficient heating and cooling systems, as well as the households experiencing energy poverty. Currently, data about the thermal quality of buildings and heating systems used is not publicly available. Databases, heat mapping and geo-referencing are usually developed for scientific and research purposes or the energy planning purposes in the city area. However, these databases remain unavailable to the public.

Communication possibilities to approach owners of the inefficient heating system directly are reduced due to the GDPR provisions and the owners of such systems have to provide signed permission for contacting them in the future.

Access to facilities of owners of inefficient heating systems is limited in cases when the buildings are using district heating (DH) and substations for the heat supply. In such cases, heat suppliers and heat buyers are not allowed to access substations without signing the contract with the building's residents. Households with individual boilers and furnaces have to provide all necessary information for the chimney sweepers' regular yearly inspection, as they are the ones with access to these heating systems.

4.3.5 Legal status in Germany

Data availability and management about inefficient heating systems: In Germany there is no centralized database. However, chimney sweepers possess all relevant data (nominal power, installation year, address, emissions, energy source). Gas suppliers also possess relevant information (nominal power, installation year, address, consumption) with regards to inefficient heating systems. Both, chimney sweepers and gas suppliers, are not obliged to hand out their information in order to create an anonymized data set.

Publicly available information with regards to renewable energy used in heating systems is provided by "Biomasse-Atlas" (biomass atlas). This database includes information (nominal power, energy source, installation year) only of subsidized heating systems by the Federal Office of Economics and Export Control (Bundesamt für Wirtschaft und Ausfuhrkontrolle) for heating systems up to 100 kW nominal power.

Communication possibilities: In Germany, due to a lack of a centralized database and data privacy regulation, public authorities are not able and not allowed to directly address owners of inefficient heating systems. However, municipalities, which have declared the sustainable energy as a part of public services (Daseinsvorsorge), are able to address their citizens in specific quarters of their municipality, where there is a high probability of inefficient heating systems, e.g. on the basis of similar years when houses were built.

Access to facilities of owners: Only chimney sweepers and gas suppliers possess the right to access facilities of owners. Chimney sweepers receive access in order to check emissions of the heating system and adherence of fire safety regulations. Gas suppliers receive access in order to read the gas meter of the facility.

4.3.6 Legal status quo in North Macedonia

Data availability and management: For the time being, N. Macedonia has only the national geoportal (RoNM, 2020) and maps from the cadastre (AREC, 2020) for buildings which is solid ground to upgrade with data for the heating systems and thermal quality of the buildings. Very few municipalities like Karposh, Gjorche Petrov and Aerodrom in collaboration with HABITAT (2020) have done questionnaires regarding conditions (of doors, windows, façade and roof) of the buildings and houses, the heating system installed and used. The additional data was also aimed at amending the Housing Law so that tenant communities would have an additional obligation regarding the electricity bills for common areas which must be submitted in monthly balances for energy consumption. This should be done by the state and the competent ministry for all public buildings, industrial and residential sectors. The data will also be used in the municipalities to subsidize EE measures. The above mentioned could be simply combined and the results would be heat atlas and better data availability and management. The process simultaneously is time consuming and it solves many opened questions. Thus, it will create opportunities for accelerated heating system replacement.

One step further was done with a survey on the topic: How are the households in Skopje heated? (Anon, 2020). The map is the result of a survey conducted in 2017 on a representative sample of 5,044 households in Skopje. The survey was carried out by the United Nations Development program in collaboration with multiple institutions. The map provides information on heating systems such as pellet boiler (based on subsidies), electricity, residual fuel oil, wood stoves, coal and district heating (DH). However, this is the only bottom-up heat mapping carried out on national level.

Moreover, another heat mapping in Skopje using the top-down approach has been conducted within a study for the potential of DH in Skopje (FMEM, 2017). The study gives an overview on the share of heating systems used in the city of Skopje and provides a heating model suggesting DH, heat pumps and inverters.

Communication possibilities to approach owners of inefficient heating system directly: Regarding the communication possibilities to approach owners of inefficient heating systems there is no distinctive measures who have rights to approach, whether it is public entity, municipality or mayor. This aspect has not been tackled in the laws or any regulation document, as it is the case for Austria. Thereby, information for this legal issue is not provided in the country.

Access to facilities of owners of inefficient heating systems: As mentioned in the first point, some municipalities have upgraded their surveys and applied questions concerning the heating systems. The surveys were performed by external interviewers. Heating systems were surveyed throughout the municipality of Karposh in 20,500 households in individual and collective housing. The control of the heating systems is defined by the Rulebook on Energy Control according to the power of the system.

Another way to access to facilities of owners of inefficient heating systems is through the State Statistical Office (SSO) during the census. So far beside other population questions, they have included basic questions on the type of the heating system for each household.

Notary offices could also help to systematically collect data on the inefficient heating systems. When making a lease, the lessor should answer the questions about the cadastral statement regarding the real estate subject to the lease (in terms of insulation, age of the building and heating systems). By these means, they could collect the data regarding the heating systems and improve the data availability and management.

In N. Macedonia, chimney sweepers are not collecting the data for inefficient heating systems. This issue might be resolved with the help of installers, as they have access to the newest and existing heating systems. To this end, there is lack of age data of existing boilers and consequently it is not available for the public bodies.

4.3.7 Legal status quo in Serbia

Data availability and management about inefficient heating systems: There is no database on energy inefficient heating systems in Serbia. Data on the type of heating is collected only during the general inventory (census) when the summary report is published, but no data processing is carried out up to the household level. The Ministry of Mines and Energy has issued the obligation to periodically inspect boilers with a heat capacity exceeding 50 kW and refrigeration units with a capacity exceeding 12 kW. Periodic reviews are performed by legal entities that obtain a license from the Ministry. Although the regulation exists in practice it does not apply. The reports are not made public.

Since November 2016, the Ministry of Construction has introduced the obligation to issue energy certificates for buildings. The obligation applies to new buildings and buildings where facades and installations are being upgraded or reconstructed. Energy class and basic information about the owner/investor are publicly available. Installation information is not publicly available.

Communication possibilities: The Personal Data Protection Law has been in force since 2019, so only communication with owners of inefficient devices is possible through anonymous surveys and provided that the interviewed persons consent to participate in the survey. Data on individual fireboxes are not publicly available except for aggregate data that is collected to develop development plans.

The Energy Law (Paragraf, 2020a) recognizes an “energy-protected customer”. These are persons who are considered to be energy poor, according to the criterion of monthly and annual income per household member. All persons classified in this category will voluntarily apply to the municipal administration to exercise the right to subsidize the cost of district heating or to the state administration to exercise the right to subsidize the cost of electricity. Data on these persons are not publicly available. The only possible way of communication is to invite persons belonging to this group through public calls with the aim of exercising their rights that are legally theirs.

Access to facilities of owners: Up-to-date databases are available for district heating utilities and natural gas distribution companies. Considering that energy and fuel consumption measurements are carried out on a regular basis for individual facilities and that these companies are obliged to provide the Ministry of Mines and Energy with data on the efficiency of their systems, this means that these companies have data on each facility individually connected to DH distribution network or gas network. Local administrations and the Ministry of Mines and Energy can request information from fuel trading companies (coal, wood, liquid and gaseous fuels for heating) to produce energy balances. On the basis of these data it is possible to evaluate the efficiency of individual furnaces in the households (which are not connected to the natural gas distribution network) but it is not possible to process data on individual facilities.

The Housing and Building Maintenance Act (Paragraf, 2020f) recognizes the need to inform facility owners. Local governments under this law are obliged to organize counseling for persons who intend to implement energy efficiency measures and replace inefficient devices. This means that each owner of the facility can, but only with his or her own will, talk to a person from the municipal administration (or local energy company) about the measures that are applicable to his facility. Data and analysis generated from these communication channels are not publicly available.

Chimneys and installers have access to heating and cooling devices in facilities not connected to the district heating network. However, as mentioned earlier, there is no obligation to report to the competent institutions on the efficiency and condition of heaters below 50 kW or cooling units below 12 kW, which means that these data are not processed.

4.3.8 Legal status quo in Slovenia

Data availability and management about inefficient heating systems: The main insight into the area of household's technical system for heating offers Register of small combustion plants, which enlists over 280,000 combustion plants. It was established and is still operated by chimney sweepers through annual boiler inspection. Regarding the building's thermal envelope conditions, it's possible to model the envelope of each household by merging the database from Register of Real Estates (includes data e.g. year of construction, year of energy renovation of façade, roof and window replacement) and Eco fund, who gives subsidies for energy efficiency measures. The main issue is then to identify households that deal with energy poverty. The inefficient thermal envelope or heating system itself does not necessarily indicate that household is experiencing energy poverty.

By merging several databases (Register of Real Estates, Register of small combustion plants, Energy Performance Certificate, Eco fund) it's possible to model the condition of the building stock for the purpose of heat mapping. This was already done on the national and local level for the purpose of demonstration (IJS, 2018). This presents a tool where it's possible to identify and access the owners of inefficient heating systems and/or households.

One of the main issues is getting the access to district heating (DH)-related data. The database of households that's connected to either DH or gas pipeline is not public, thus presenting an obstacle where it's possible to straightforwardly identify DH with big potential for new DH connections to the grid. The main method that can be used is by using the heat map and identify buildings with inefficient heating systems (combustion plant) that lies on the DH grid. Through communication channels such households could be informed for possible HC replacements. Since the DH are located exclusively in the cities, the main communication channel for reaching such owners would be local newspapers and through energy advisory network.

Communication possibilities: Government bodies are not allowed to mail end consumers as long as they have not given signed permission to do so. End consumers could contact the energy advisory offices once the see the dissemination materials (i.e. posters, press notes dissemination, etc) and also multiplication agents (as consumer organizations, installer associations, private companies with registered databases, etc.) contact them due to the Local Working Group and dissemination events or actions.

Access to facilities of owners: Chimney sweepers, DH and gas suppliers possess the right to access facilities of owners. Chimney sweepers receive access in order to check emissions of the heating system and adherence of fire safety regulations. DH and gas suppliers receive access in order to read the gas meter of the facility.

4.3.9 Legal status quo in Spain

Data availability and management about inefficient heating systems: In Spain, there General Direction of Industry in each Region (depending on the Regional Government) is responsible for the Certification of Approval of any Boiler installation. There is no national or regional electronic register of all boilers. In Castilla y León the documents, hard copy papers, are stored in provincial offices.

Communication possibilities: In Spain, national or regional government bodies (including independent energy advisors) are not allowed to mail end consumers (as long as they have not given signed permission to do so). End consumers could contact the information offices or helpdesk of the regional energy agency (EREN) once the see the dissemination materials (i.e. posters, press notes dissemination, etc) and also multiplication agents (as consumer organizations, installer associations, private companies with registered databases, etc.) contact them due to the Local Working Group and dissemination events or actions.

Access to facilities of owners: Boilers over 70 kW should be installed in the so-called “boiler rooms”, as indicated in the RITE (Thermal Installations for Buildings Regulation). Lower powers are not included in this concept.

Lower power (<70 kW) boilers or heaters can be monitored easier by any user, but without manipulation (not dismounting, not removing parts, etc.). For over 70 kW equipment only registered installer/maintainers are allowed to manipulate.

To access to any home, explicit permission is needed from the owner, which is the final responsible to fulfil any legal requirement (i.e. mandatory inspections).

4.4 Collective actions (and other examples) existing in partner countries

In the following section, different examples for collective actions in the REPLACE target countries can be found.

4.4.1 Collective actions (and other examples) existing in Austria

As representative collective actions in the case of Austria three examples are shown here: collective wood pellets purchase, thermal insulation of the uppermost ceiling (preferably with renewable insulation materials and combined with an energy efficiency improvement of existing heating system of residential houses) and a non-profit umbrella organization servicing farmers’ collective biomass micro grids supplying more than at least two buildings.

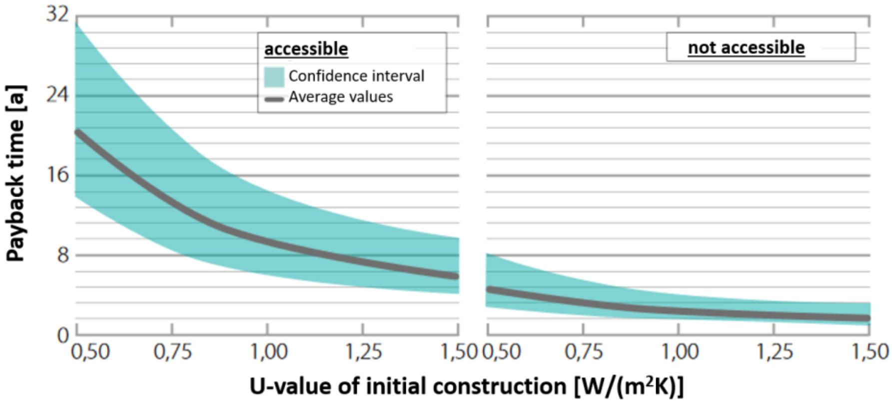
Furthermore two “RECs like” activities are presented: classical “community PV electricity generation plants”, based on the Austrian tenant electricity supply model and a community/settlement of houses running PV plants for electricity self-consumption having only one connection point to the public electricity grid (with self-organized billing and metering).

Collective actions (CA) actions AT No 1	
Collective Wood Pellets Purchase	
Place	Austria
Description of action	A non-profit or public supporting organisation procures wood pellets for a target group (e.g. several dozen to several hundred households, commercial enterprises etc.) for their existing pellet heating systems. The initiative can be local or supra-regional at the community level. The initiative aims to make heating with pellets more attractive. This should also make the changeover from e.g. heating oil to pellets more attractive.
Actors	Superordinate coordination team: Public-Private-Partnership (PPP); e.g. consisting of the federal state, independent energy advisors, local climate and energy region managers, e5 municipality advisers, local caretakers (public or private non-profit), consumer interest organisations, association of cities and municipalities, pellets industry (boiler manufacturers, pellets suppliers) and banks (financing). Regional & local actors develop a joint implementation plan; defining quality criteria and putting together a package of standardized offers (negotiation with pellet manufacturers and traders); solving barriers regarding implementation and financing, dissemination for replication in other regions Local caretakers (e.g. community officials) act as a One-Stop-Shop for implementation, perform local advertising, shall be assisted by independent public energy advisors Consumers: cheaper pellet procurement (albeit modest); ensures greater investment security, i.e. shorter payback periods, can be accompanied by further measures to make pellets more attractive, which can lead to new pellets customers Pellet manufacturers and suppliers: sales markets that can be controlled in terms of delivery times (currently incentivised by spring discounts of 5-10 %) to make better use of existing truck fleets and avoid delivery bottlenecks. Plant manufacturers: a good domestic sales market helps to become more competitive internationally.
Targets of action	Decarbonisation of the space heating market, conversion to a regional recycling economy: wood pellet heating systems are an interesting alternative to oil heating systems (phase-out oil), as there is a pellet-compatible storage room with access suitable for trucks.
Impact on the energy system	Oil must be replaced by alternatives by 2035. 22 % of all households in Salzburg still heat with oil. Currently, oil heating systems are still in operation for more than 50,000 households in the province of

	Salzburg. In addition (those are out of scope of Replace), oil-fired hotels, commercial, service, trade and industrial companies as well as horticultural businesses are also interesting target markets for a replacement of fuel oil by wood pellets or wood chips.
Economic viability (availability of subsidies)	Representative example: Climate and Energy Model Region Nature Park Pöllauer Tal (Model Region Managers Andreas Kröpfl and Thomas Weiglhofer); The project goal of a minimum order quantity of 150 tons was exceeded by far. Costs: approx. 350 € for the direct mail. Savings: between 55 € and 110 € per participant*in (depending on order quantity, compared to the target price).
Barriers	Pellet manufacturers and suppliers fear a loss of sales if the markets grow too slowly, especially if the campaign is only noticed by existing customers.
Challenges	Potential new pellets customers will probably not buy a new boiler on their own. High complexity of the technology and high up-front investment when switching to a new pellets heating system discourages potential new customers, further measures and incentives would be necessary.
Manageability	The campaign mentioned above was launched with community news, an information evening and a mailshot to all households. Subsequently, the order quantities were received by telephone or e-mail, negotiated with several suppliers and a collective order was placed.
Replicability	Replicability is relatively high, if a professional "care taker" takes initiative. According to Propellets Austria, there are already about 10 to 20 pellet purchase communities throughout Austria, from about 100 to 2,000 people per initiative.
Ecological relevance (qualitative climate change mitigation potential)	The action is particularly interesting for existing buildings outside conurbations, as otherwise health-endangering fine dust and NO_x limits are exceeded in the conurbation due to the permanently high volume of traffic. Salzburg's residential oil heaters cause about 260,000 tons of CO_2-equivalent annually. A relevant part of the oil will have to be replaced by wood pellets.
Links for further information	https://www.klimaundenergiemodellregionen.at/ausgewaehlte-projekte/best-practice-projekte/showbpp/207

Collective actions (CA) actions AT No 2
Collective thermal insulation of the uppermost ceiling (preferably with renewable insulation

materials) and energy efficiency improvement of existing heating system of residential houses	
Place	Austria, based on findings of the study (Hierzinger, et al., 2019)
Description of action	A group of public servants (e.g. municipal employees) or a non-profit organisation procures insulation materials (preferably based on renewable raw materials) and other materials for thermally insulating the uppermost ceiling (umc) of existing buildings for a target group (e.g. several dozen to several hundred households, commercial enterprises etc.). It would be ideal, if in parallel to the insulation of the umc, the heating system is also optimised. The initiative can be local or supra-regional at the municipal level. Initiatives can also include training for potential self-build multipliers and pooling of refurbishment objects for insulation by professionals. Best case: usage renewable insulation materials (rim). A usage of rim is doubly energy-efficient (IBO, 2017): On the one hand, they help to save heating energy, and on the other hand, less energy is usually required for production than for conventional products, where high process temperatures are required. Subsequent insulation of the umc is particularly easy with a perlite or expanded glass fill or alternatively with pressure-resistant and therefore directly accessible wood fibre insulation boards. If the attic is subsequently converted into living space, wood fibre, hemp or flax insulation materials as well as sheep wool or cellulose blow-in insulation are particularly suitable. Due to their high heat storage capacity, they also offer very good protection against summer overheating.
Actors	The set-up of actors and their tasks would be similar to that described in collective action No 1. Now a list of actors and how they benefit follows. Consumers: Energy and cost savings in heating; faster heating, less overheating of living spaces in summer; for single family houses the shortest payback time for individual component measures to improve the energy quality of the building envelope. Local businesses (such as plumbing companies, relevant specialist firms) receive additional income and employment opportunities, strengthening local structures and cohesion. Producers of renewable insulation materials (e.g. wood fibres, cellulose, flax, hemp, cork, straw, sheep's wool etc.): more/assured sales improve profitability/competitiveness compared to products made of fossil/synthetic raw materials (PU foams, EPS etc.) and mineral raw materials (mineral wool (glass wool, rock wool), expanded perlite etc.). Farmers in structurally weak areas, e.g. Waldviertel, Burgenland, are provided with additional income opportunities; the cultivation of NAWAROs often improves the soil and does not require artificial fertilizers or chemical sprays Agriculture and the timber industry can add further products and timber assortments to the material use and thus contribute to climate protection in several ways; binding CO_2 in buildings, avoiding material and energy-related CO_2 emissions from fossil raw materials or energy-intensively produced mineral insulation materials.
Targets of	Decarbonisation of the space heating market, energy savings in heating; faster

action	heating, less overheating of living spaces in summer. Especially in buildings with a poor surface/volume ratio (i.e. with high heat losses through the uppermost ceiling in relation to the total heat requirement, like single family and semi-detached houses), a thermal insulation of the umc saves approx. 15-25 % saving of total space heat demand (costs of about 1,500 – 2,500 Euro). In addition, an improvement of the summer heat protection is achieved. After insulation of the umc has been completed, the flow temperature of the boiler must be readjusted (adjustment of the heating curve) and a hydraulic balancing of the heating system must be carried out (costs of about 500 Euro). At the same time, heating valves on radiators and in the boiler room, pipes and fittings as well as hot water installations and circulation lines should be insulated and old heating pump should be replaced by a variable speed heating pump (costs of about 170 Euro), which additionally reduces electricity demand. In this way (with costs of 1,500 to 3,000 Euro), a further 5-10 % of the heating energy can be saved and the total efficiency gains (in total approx. 25 % less space heating requirement) can also be secured in the long term.
Impact on the energy system	87 % of heating oil on the space heating market in Austria is used in single family and semi-detached houses. Forcing the insulation of umc in those buildings, heated with fuel oil in combination with heating system optimisation could reduce the fuel oil demand as well as the demand of other energy sources in combination with heating system optimisation by approx. 25 %. According to the current governmental programme 2020-2024, the Austrian federal government plans to introduce a socially acceptable renovation requirement for measures that will quickly pay for themselves, such as the insulation of the top floor ceiling, accompanied by subsidised consultations and special subsidy offers, with exceptions and threshold values.
Economic viability (availability of subsidies)	A thermal insulation of the umc is one of the most economical measures for thermal improvements to the building envelope (payback within a few years). According to (Holm et al., 2015), typical payback periods, depending on the price of oil or energy, are around 8-12 years (walkable) or 2-6 years (non-walkable insulation).  As example, in Germany, the insulation of the uppermost ceiling (umc) in buildings is obligatory and had to be implemented until the end of 2015. Thus, it would be interesting to know about the costs for this measure. The insulation of a walkable ceiling is the more expensive choice, yet also the more useful one. On average, the

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<p>costs for such measure amount to 1.950 €.</p>
<table>
<tr><th>Construction</th><th>Costs per m^2</th></tr>
<tr><td>non-walkable uppermost ceiling (blow-in insulation)</td><td>15 - 25 € / m^2</td></tr>
<tr><td>blow-in insulation of existing cavities (walkable)</td><td>15 - 25 € / m^2</td></tr>
<tr><td>create and insulate walkable floor slab</td><td>40 - 50 € / m^2</td></tr>
</table>
<p>Figure 12: Range of costs for umc insulation (Energieheld, 2020)</p>
<p>Thus, the investment need for a umc insulation is relatively moderate.</p>
<p>If accompanied by an energy efficiency improvement of the existing heating system more space heat demand can be saved with a similar payback time.</p>
<p>Depending on the size of the building, at multi-family houses, approx. 10 - 15 % of the space heating demand can be saved by insulating the umc. The payback periods are longer than for single-family houses (in relation to the entire building, not related to the heating bill of the apartment on the top floor).</p>
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<td>Barriers</td>
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<p>End consumers might shy away from the effort (information procurement, funding procedures, planning, commissioning of trades, execution control, etc.). Difficulties in reaching/mobilizing end consumers, to get the necessary attention may occur. They also may want individual solutions that cannot be implemented by means of joint (pooled) procurement, or at least not at reasonable expense.</p>
<p>Up-front investment could be a particular obstacle for households at risk of poverty. When purchasing ecological insulation materials, additional costs are sometimes to be expected. Compared to conventional insulation materials such as XPS, EPS or mineral wool insulation board, additional costs per m^2 are incurred. However, there are no disposal costs and a subsidy can further reduce the additional costs.</p>
<p>Lack of motivated care takers who could coordinate a scale-up (executing agency): lack of funding for the community-oriented activity for "caretakers" (supply push), fear of lack of trust that end consumers are willing to take the offer – that the action is actively accepted (demand pull, i.e. insufficient motivation among consumers).</p>
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<td>Challenges</td>
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<p>The aim of the bottom-linked initiative should be that end consumers find a low-risk, strongly service-oriented all-round carefree package, with attractive fixed prices for partial areas and variants (regarding insulation of the cms with rim, optimization of the heating system) from a one-stop shop; in cooperation with relevant, local companies that the citizens know and who, unless self-assembly groups become active, i.e. implement these solutions.</p>
<p>The citizens should clearly recognize the advantages of the collective action. This also means that the whole process is made much easier for citizens from the moment they decide to take part in the action than if they did it on their own.</p>
<p>This means that the local one-stop-shop should be responsible for consulting, stock-taking, preparation of the basis for decision-making, concrete planning, acceptance of all formalities and administrative procedures (e.g. application for funding or building permission, if required), monitoring of the implementation, and right up to commissioning. Citizens should find a central contact person in the one-stop-shop for all their questions, from the expression of interest in an independent consultation, to the submission of offers, to the completion of the project.</p>
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	The campaign could be made even more attractive with additional financing offers, insurance packages (with regard to possible risks and liability issues) as well as supplementary incentives (e.g. further funding opportunities).
Manageability	Bottom-up is the approach in that although top-down support is required, the activities in the initiation and implementation are carried out by actors anchored in the region. The project is innovative in that it brings actors together in a one-stop shop, so that a large number of existing barriers are minimised for the actual target group, i.e. households. This initiative is also a good example of how top-down and bottom-up approaches can have the best impact. If politics remains limited to top-down approaches, central obstacles to the market penetration of renewable raw materials for insulation measures cannot be overcome.
Replicability	Good replicability expected.
Ecological relevance (qualitative climate change mitigation potential)	With the measures described (combined with subsidies graduated according to income), comparatively large quantities of heating oil can be saved in a socially acceptable manner within a short period of time – without any "renovation roadmap related", i.e. technical conflict – parallel to the phase-out of oil by replacing old boilers. A wide-spread thermal insulation of umc in single family and semi-detached houses could deliver a significant contribution to the EU energy efficiency target in 2030 (-32.5 % absolute energy savings compared to a reference scenario in 2030).
Links for further information	https://energytransition.klimafonds.gv.at/basisstudien/ebu/

Collective actions (CA) actions AT No 3	
Non-profit umbrella organizations servicing farmers' collective biomass micro grids supplying more than at least two buildings – BENÖ *(Bioenergy Lower Austria): The success of Farmers' cooperatives*	
Place	Austria, Lower Austria (processor concept in Styria, see blow)
Description of action	Generally speaking, there are numerous business-models in place in Austria, which is a consequence of – or a pre-requisite for – the successful market-diffusion of biomass district heating and in-house big biomass boilers. Currently there are more than 1,400 biomass district heating plants (small and large scale; Austria has ca. 2,400 villages). The business-model of BENÖ is specific to small scale district heating, micro grids, in-house heat production and supply (e.g. at residential buildings, commerce and service buildings, public buildings, agricultural-forestry facilities, industries), as long as the power-output does not exceed the range of several 100 kW. BENÖ is a "roof-cooperative" for rural cooperatives. Its offer is a ready to use legal entity based on an existing infrastructure. It allows farmers to specialize on the

	tasks they are easily able to, and used to, carry out (supply of boilers with biomass/woodchips, operation and simple maintenance of boilers, …), while work the farmers are unfamiliar with (bookkeeping, detailed planning, benchmarking,…) can be delegated to the peak-cooperative which has this expertise. The cooperation of cooperatives allows cost-reduction via common procurement, exchange of experience etc.
Actors	BENÖ was founded in 2003 in the Federal State of Lower Austria by six bodies which were then active in bioenergy: • The Lower-Austria federal state government-agency for energy economics, • The chamber of agriculture (timber department), • The Lower-Austria-heating plant alliance, • The Lower-Austria-timber alliance (70 forest managing communities), • AGRAR PLUS as the legal entity • Raiffeisen revisal alliance Lower-Austria - Vienna Members of BENÖ in general farmers cooperatives own the whole biomass heating system (the whole chain of raw material, energy conversion and heat transport and supply installations). Either the local members of the cooperative or the “headquarter” of BENÖ would take care for daily business (e.g. O&M, billing, customer acquisition etc.), depending on the complexity of the challenge. During the operation of the plant, BENÖ would take care for accounting of heat and biomass, it would support the operators of the cooperative in accounting, describe and benchmark the costs for staff and business management, and it would periodically revise the balance sheet through the revision alliance.
Targets of action	As a first step to start a project, the farmers get first information and consulting. To compensate for their lack of information and know how, the farmers can use the pool of experts and information of BENÖ. They can collect basic data and the key benchmarks, they get advice which data are necessary to get. As a result, cooperation between the farmers and BENÖ occurs, which would later on result in the official establishment of the cooperative. The farmers would be embedded in the information circle of BENÖ, but they take the decisions themselves. They would be informed about which subsidy they can get for the plant and which for the consumer. They would be supported in information-work for the consumers and the municipality, in the formulation of a feasibility study and a business plan. BENÖ is a ready to use legal entity for small plants; when the plant appears to become too big for BENÖ, the company Agrar Plus (as the mother-entity of BENÖ) would take over and continue the consulting-process. BENÖ knows the necessary authorizations for the plant and where to get them, it helps to identify, select and supervise the technical planer and the technical equipment.
Impact on the energy system	Regional farmers will be enabled to work for heat supply based on regional resources without the need to elaborate all necessary details of the know-how for the construction and operation of the plant by themselves. They will supply heat consumers, based on raw material on short closed regional circles. As of 2015, there have been 367 members of the cooperative BENÖ operating roughly 60 district heating plants, among them mainly farmers and timber owners, and 791 heat consumers (private consumers, residential buildings, public buildings,

	business enterprises, confessional buildings etc.) would be supplied with heat. The total power connected amounted to 17.3 MW, the length of the grids was 17.6 km. The regional value added generated through the sale of forest wood-chips amounted to 380,000 €/a.
Economic viability (availability of subsidies)	Within BENÖ, the members of the cooperative would usually themselves supply the raw material to their heating plant. The price is set according to other biomass district heating plants and based on a system of indices comprising costs of heating oil, costs of a typical labour hour etc. This setting of the price is common among all types of business models. The price for district heat in Austria is not regulated. The price for the energy supplied is usually comprised of three parts: • a basic price [€/month, which would cover fixed costs on the side of the plant like investment, plant management, maintenance, all independently form energy consumption], • an energy-rate [€ per kilowatt-hour, which would cover variable costs like fuel costs, ash disposal costs, and others], and • a meter rent [€ per year, which covers fixed costs on the side of the customer]. All projects fulfilling funding criteria have access to the Federal UFI – Environmental Subsidy Scheme. Biomass district heating plants with a grid length of > 1,000 m and a net heat capacity above 400 kW, applying for UFI subsidies, have to take part at the Quality Assurance Program. The subsidy amounts to up to 35 % of the eligible costs depending on the type of plant.
Barriers	While in Austria big biomass district plants with an average power of 5.4 MW are usually being operated by power-companies, the preferred power-range of boilers which are operated by cooperatives is below 750 kW, moreover, the average boiler size of new plants operated by cooperatives has decreased to below 400 kW. So the operating cooperatives are usually small too. The "weakness" of BENÖ could be referred to as the fact that cooperatives are not used to operate complex big industrial biomass plants but have their natural power-threshold below 1,000 kW.
Challenges	**Starting point:** The general problems farmers face when they want to start a bioenergy-project (like a district heating supply for a village) are manifold: • Lack of information and know how • Need for collection of basic data, key benchmarks • Missing knowledge about support-schemes (investment) subsidies • Need to produce feasibility study and business plan • Decision: which legal entity, which formation process offers which legal capacity and legal security? • Complex technical planning of the plant • Authorizations needed for the plant • Accounting during building phase and during operation of the plant • Accounting of heat and biomass: costs for accountant, staff, and business management. **Solution**: BENÖ was founded to provide a simple answer to these problems. To avoid a complex formation process, BENÖ works as a ready-to-use legal entity for

	farmers, as a „cooperative for rural cooperatives“. A cooperative is open at any time for new members: It is no problem when a member contracts out and leaves the cooperative, as well when it enters the cooperative. In another legal entity or construction (limited, for example), for any leave from and entry into the entity, a notary would be needed, an inscription in the companies-register, etc.… This causes additional costs and consumes time. Further advantages of cooperatives are: • it takes care of the members benefit, • the business purpose is to get a good price for the agricultural/forestry product biomass/wood chips • it is open for new members at any time • it reduces costs for each member and for each plant • common actions can be performed, for example marketing • restricted liability for members • direct influence of the members on the management BENÖ is based on existing infrastructure. To become a member of BENÖ, the one-time entry flat rate amounts to only € 600.- reducing the costs for the foundation of a legal entity. As a member of BENÖ, the farmers-cooperatives are supported during pre-feasibility and call for tenders, and during all steps of investment, the financing process, and the construction of the district-heating-plant. A benchmark-system allows comparing plants to each other, as related to construction- and operation. During operation, heat meters can be calibrated in common. Risks of operation can be reduced through uniform insurance.
Manageability	Is given, as described.
Replicability	Is given, as described. There are in fact organisations that offer similar “collective” services to their members or clients, respectively. Examples are **Regionalenergie Styria and nahwaerme.at Energiecontracting GmbH,** which has regional partners in Styria, Salzburg, Carinthia, Lower Austria and Tyrol. **nahwaerme.at Energiecontracting GmbH is an energy service provider** which, **in cooperation with local partners, erects and operates biomass DH plants** and other RES plants. In a nationwide network with around 90 partners, nahwaerme.at currently operates 46 locations for energy generation and several locations for raw materials management in Austria. A example is the business model of **Regionalenergie Styria.** Regionalenergie, a planning office situated in Styria. For more than 25 years it has facilitated farmer’s community based plant contracting or “**rural wood-based energy-contracting”**, respectively. By December 2018, Regionalenergie had commissioned 293 projects with a capacity of approx. 35 MW and an investment volume of € 34 million excluding VAT. The plants consume 105,000 m³ of wood chips, which replace 7.9 million litres of extra light fuel oil annually. So far, these projects have created 264 jobs in trade and industry and 65 jobs in forestry.
Ecological relevance	BENÖ has annual heat sales of some 20 GWh in 2015 compensated for fuel oil sales of 2.4 million liters per year and a calculated reduction of CO_2 emissions of 7,800 t/a.
Links for	https://bioenergie-noe.at/startseite.html

further information	www.regionalenergie.at or http://www.biomasstradecentre2.eu/data/intranet/D4.1_Technical %20paper %20energy %20contracting_Lk-Stmk.pdf www.nahwaerme.net https://www.umweltfoerderung.at/betriebe/nahwaermeversorgung-auf-basis-erneuerbarer-energietraeger.html

Existing "RECs like" activities, AT No 1	
Community PV electricity generation plant – Austrian tenant electricity supply model	
Place	Austria
Description of action	The, since 2017 legally in the Electricity Act (ELWOG) anchored, concept of "collective power generation plant" makes it possible for end consumers to jointly use renewable electricity generated by a plant physically connected with their electricity supply system, e.g. PV electricity. At least two or more parties must participate in the PV system. For example, one person (legal/natural, e.g. a contractor) can operate the plant and use the generated PV electricity, while at least one other person participates in the plant by using only the PV electricity.
Actors	The regulation is applicable to tenants or owners of apartments in multiple dwellings; but also in office buildings or shopping centers can join together to operate collectively a renewable power generation system. The predominantly business model is that everything is offered by one project champion, who takes care of planning, implementation, lease of the roof area, operation including maintenance and repair and allocation of electricity quantities and billing. Often those champions are electricity suppliers (who then are full service electricity suppliers) or specialized PV plant developers (some of them offer citizenship or workforce-ownership models, e.g. by sale-and lease back contracts) who then allow consumers to choose their own electricity suppliers or choose one for them. The building owner (at least) benefits from an annual lease payment for the use of the roof area. Alternative business models are e.g. a PV plant investment by the building owner (e.g. electricity for free because of marketing or increase of property value) or a residential community association, which leases a roof area for the PV plant.
Targets of action	Use of the shared green electricity generation system for the benefit of the tenants in the form of energy cost savings.

	The new rules create more flexibility for households and businesses. Passive "energy users" can thus become active stakeholders (keyword: "prosumers"), for example by covering their own consumption with a photovoltaic system that can now be installed and operated jointly with others. In addition, existing systems can be better integrated by incorporating storage technologies. This ensures security of supply in a more decentralised energy system.
Impact on the energy system	The scope of the new regulation is limited to the local distribution grid, low voltage level (grid level 7). Previously pure electricity consumers can jointly generate electricity and thus to a certain extent supply themselves. In this way, the participating parties save energy costs, grid fees and taxes that would be incurred if they were to purchase electricity from the grid. The regulation should enable an increasing decentralized generation of green electricity. The supply to community participants is limited to the grid part “behind” the same network connection. Surplus energy is returned (sold) to the public grid. In the event of a shortfall in coverage, electricity is supplied (purchased) by the public grid. More practically the generating plant is connected to the common main line (riser(s)) owned by the owner of the building in the building. The participating beneficiaries (one or more parties) participate in the operation of the generation plant. The parties make an agreement on the distribution of the self-consumed generation of electricity among each other (static or dynamic). In addition, the parties have the choice to participate in the joint generation plant at participate. A separate metering point is set up for the generation plant – there are 2 virtual metering points: one for supply and one for generation. It is important that only one business partner is allocated to these points of delivery. Smart meters or load profile meters measure generation and consumption at the generation plant and at the participating parties.
Economic viability (availability of subsidies)	The first projects that were realized end of 2018 offered a guaranteed electricity price saving of about 20 % for duration of 10 years to participating parties (most frequently tenants living in large building blocks that had to be renovated comprehensively). Participating parties do not have any additional costs and can withdraw from the community any time. The Austrian electricity supplier Wien Energie published in a consumer brochure that the prerequisite for a community PV production plant are 30 residential units or 50 with a pitched roof.
Barriers	The business model is not really a business case, as it is quite time consuming for the project champion to acquire participants. To show this the steps of a pilot sales process conducted in reality is

	described: - Tenants' meeting incl. handover of the information package/contract to the persons present. - Transmission of minutes of the tenants' meeting incl. information package/contract to all tenants. - Follow-up by telephone and arrangement of on-site appointments. - Personal appointments on site. In that concrete case 75 % of all tenants become participants, this pilot project was realized at high costs however. The economic advantage for end consumers is about 10 to 20 % cost saving on the annual electricity bill. For the project champion administrative costs are significant. Such projects therefore seem to be economically feasible only from 2-3 plants onwards.
Challenges	There is a high effort for project developers to get as many end consumers on board (to participate) so that projects can become economic feasible. The return on investment is rather limited however. It can be assumed that some projects are realised also due to their marketing value. A challenge was also the introduction and operation of smart meters for an appropriate billing and metering. Theoretically smart meters would allow end users to opt out and select a new energy supplier at any time (as it is required by EU law) as long as bilateral contracts allow that flexibility. Energy suppliers developing such projects see a benefit, if they can establish long term contracts with end consumers, allowing them to deliver electricity via the public electricity grid when PV power is not sufficient to deliver the demand.
Manageability	The organisation effort for developers entering the market for the first time is high. From a technical view appropriate solutions exist. While it can be assumed that classical energy utilities entering that market take into account also the marketing value of such projects, more idealistic project developers (e.g. non-profit organisations) also are active in that field. The website pv-gemeinschaft.at, dedicated to Austrian collective power generation plants, gives a good overview of the issues of relevance and how to handle them. Furthermore many early market movers shared their experiences at various branch related conferences.
Replicability	On the website pv-gemeinschaft.at, dedicated to Austrian collective power generation plants, 25 realised best practice examples are

	listed. It can be assumed that more plants have been realized. Due to limited profit margins market growth with existing framework conditions is rather limited.
Ecological relevance (qualitative climate change mitigation potential)	According to (OIB, 2019) the mix of electricity supplied in Austria has an emission factor of 227 g CO_2 equivalent per kWh electricity. The cited OIB directive 6 defines the format of the Energy Performance Certificates (EPC) and the requirements for the thermal performance of the building envelope, domestic hot water and parts of the technical heating and cooling systems. State of the art PV plants (with an energy yield equivalent to average German conditions) are reported to have an emission factor of 50 to 67 g CO_2-eq per kWh (Wirth, 2020). Because of the higher power yields in Austria these numbers in Austria are even about 20 % lower, i.e. around 40 g CO_2-eq per kWh. So, a kWh PV electricity in Austria saves around 160 to 170 g CO_2-eq per kWh. The model also makes sense from an energy-economic perspective: after all, around half of the 236,000 households in Salzburg are in multi-party residential buildings. If all the roof surfaces of these residential complexes were fitted with photovoltaic panels, this would generate around 150 GWh (Salzburg AG, 2020).
Links for further information	http://pv-gemeinschaft.at https://www.vorarlbergnetz.at/gemeinschaftliche-erzeugungsanlage.htm

Existing "RECs like" activities, AT No 2	
Communities/settlement of houses running PV plants for electricity self-consumption having only one connection point to the public electricity grid (with self-organized billing and metering)	
Place	Austria, Lower Austria (near Vienna)
Description of action	Community housing project with 11 houses and 37 flats having (a) a biomass based heating grid with solar thermal support, (b) a shared PV plant for electricity production, and (c) only one grid connection point (self-organized billing and metering).
Actors	Community Members
Targets of action	Reducing ecological Footprint of housing according to the statutes of the community. CO_2 neutral heating with local biomass (avoiding additional electricity consumption from heat pumps in winter)
Impact on the energy system	Overall the 100 kWp PV system produces as much electricity as is consumed over the year. However, self-consumption is about 35 %. 65 % is fed into the public electricity distribution grid.

Economic viability (availability of subsidies)	The biomass micro-grid was subsidized, but remains more expensive than gas or heat pumps (at current energy prices). The PV system was also subsidized, but would have paid off even without subsidy due to reduced electricity consumption from the grid.
Barriers	Biomass microgrid: planning was sub-optimal (buffer too small for optimal use of solar thermal system). PV: the development has only one central grid connection point for the whole community. This has the main advantage that (1) the community can negotiate a better electricity price because they are a large consumer and (2) all households automatically help to increase the self-consumption share of the PV system. The downside of this is that the individual community member cannot freely choose its electricity supplier, but a supplier change can only be decided in a common decision – thereby possibly creating “locked customers” (counteracting the main idea behind the electricity market liberalization, free choice of supplier at any time to increase competition).
Challenges	Biomass: not all domestic engineering offices are capable of planning a heating grid efficiently. PV: even if the system pays off for itself, at the beginning of the project community members were skeptical (it was still perceived as an “expensive add-on”). The system was built anyway because of a good financing opportunity which required no additional own capital (besides the 25 % invest subsidy).
Manageability	Biomass: increased maintenance (compared to gas or heat pump) PV: certain additional effort for self-organized metering and billing in course of the general accounting of operation cost
Replicability	Biomass: yes, certainly PV: the biggest challenge could be the realization of a common, single grid connection point. This will eventually require some negotiation with the distribution grid operator and/or the electricity regulation authority.
Ecological relevance (qualitative climate change mitigation potential)	Completely CO2 neutral housing.
Links for further information	brot-pressbaum.at

Legal national status of data management, exchange and ownership

As described for Germany also in Austria identified purchasing groups have in common to be private interest groups without legal forms. Thus, civil law applies. It is important to know that also in private groups data protection (i.e. GDPR) needs to be respected.

The downside of the community/settlement having only one access point to the public electricity grid is that the individual community member cannot freely choose its electricity supplier. A supplier change can only be decided based on a common decision – thereby possibly creating “locked customers”. This in general is counteracting the main idea behind the electricity market liberalization, free choice of supplier at any time to increase competition. Nevertheless such settlements do exist in Austria and are common in Switzerland too, for example.

Short national summary on existing/possible implementation fields, challenges and barriers and potential outlook

A collective wood pellets purchase, as any other collective action needs professional “care taker” that take initiative. Real grass route actions (as by now) probably won’t deliver the impact required for climate change. According to Propellets Austria, there are already about 10 to 20 pellet purchase communities throughout Austria, from about 100 to 2,000 people per initiative. The action is particularly interesting for existing buildings outside conurbations. In the REPLACE target region Salzburg residential oil heaters cause about 260,000 tons of CO_2-equivalent annually. A relevant part of the oil will have to be replaced by wood pellets.

With the collective action “thermal insulation of the uppermost ceiling (preferably with renewable insulation materials and combined with an energy efficiency improvement of existing heating system of residential houses)” (combined with subsidies graduated according to income), comparatively large quantities of heating oil can be saved in a socially acceptable manner within a short period of time – without any “renovation roadmap related”, i.e. technical conflict – parallel to the phase-out of oil by replacing old boilers. A wide-spread thermal insulation of the uppermost ceiling in single family and semi-detached houses could deliver a significant contribution to the EU energy efficiency target in 2030 (-32.5 % absolute energy savings compared to a reference scenario in 2030).

If RECs - Renewable Energy Communities and CECs - Citizens' Energy Communities (see below) find an enabling environment “community PV electricity generation plants”, based on the Austrian tenant electricity supply model would be boosted. Such kind of collective action will become even more relevant as the current Austrian Government plans that 1 million PV plants shall be realized by 2030.

4.4.2 Collective actions (and other examples) existing in Bosnia and Herzegovina

For Bosnia and Herzegovina, two collective actions about crowdfunding for solar thermal installations are provided.

Collective actions (CA) actions BiH No. 1	
Solar collector at the roof of the Public Health Care centre for persons with Mental Disabilities „Drin“ Fojnica	
Place	**Fojnica, Bosnia and Herzegovina**

	
Description of action	The first crowdfunding campaign of finance citizen energy projects in order to increase the number of similar initiatives in the future was conducted. The aim of this campaign is to invest in solar energy for the needs of the Public Institution for Placement of Persons with Mental Disabilities „Drin", Fojnica. During the campaign, the citizens financed the renewable energy sources through group financing. This institution needs hot water 24 hours a day and for 365 days a year. Part of this energy can be obtained by using solar energy, and that is exactly what we can achieve with this campaign. In this way the energy costs of this institution will reduce, which will directly help its users.
Actors	REIC (the Regional Education and Information Center for Sustainable Development in South-East Europe)
Targets of action	The target was to invest money for solar hot water collectors that will be installed on the roof of this institution.
Impact on the energy system	By installing solar collectors, it is possible to **save up to 60 %** for the preparation of hot water, which will also have a positive effect on the environment. Drin, which has about 500 inmates and 250 staff, needs hot water 365/24/7, and it currently spends some BAM 250,000 (EUR 127,823) a year on electricity bills.
Economic viability (availability of subsidies)	**15.000 USD**
Barriers	N/A
Challenges	Possibility to collect financial resources through campaign and subsidies.
Manageability	Public Institution for Placement of Persons with Mental Disabilities „Drin", Fojnica
Replicability	Yes
Ecological relevance (qualitative climate change	Solar energy, unlike fossil fuels, is available to an unlimited extent and does not produce harmful emissions.

mitigation potential)	
Links for further information	https://balkangreenenergynews.com/reic-launches-first-ever-renewables-crowdfunding-campaign-in-bih/

Collective actions (CA) actions BiH No. 2	
The Crowdfunding Campaign „Solarna Pecka“	
Place	**Mrkonjic Grad – Village Pecka, Bosnia and Herzegovina** 
Description of action	**The Solar Pecka crowdfunding campaign „Solarna Pecka“, started by organizations „Greenways“, in charge of Visitor center Pecka management, and „Center for Environment (CZZS)/Friends of the Earth Bosnia Herzegovina“ has been successfully completed, managing to raise up to USD 6,687.** This amount is enough to install solar thermal collectors for 300 liters of water and part of the photovoltaic (PV) panels for power generation in Visitor Center Pecka‘s roof, what was the campaign goal. The capacity of PV system is 5.4kW. The “Solarna Pecka” campaign has lasted 26 days, during which **226 individuals and organizations** have contributed to it. Besides, part of the contributions have been made directly to “Greenways” organization’s bank account, and several socially responsible companies and organizations have supported the campaign.„Solarna Pecka“ is now the country’s first citizen initiative to bring solar energy to the rural area.
Actors	**„Greenways“, „Center for Environment (CZZS) / Friends of the Earth Bosnia Herzegovina“**
Targets of action	The country’s first citizen initiative to bring solar energy to the rural area.
Impact on the energy system	Solar thermal collectors for 300 liters of water and part of the photovoltaic (PV) panels for power generation in Visitor Center Pecka‘s roof.
Economic viability (availability of subsidies)	For the installation of the entire 5.4 kW PV system on the visitor center’s roof and implementation of the whole presuming idea in the center USD 13,000 are needed, which is actually the main goal. Through the campaign was collected USD 6,687, further 5.6

	thousand euros are still needed to complete the project, with the support of other organizations and companies.
Barriers	N/A
Challenges	Lack of financial resources with the inability to predict the resources (USD) that will be raised through the campaign.
Manageability	Visitor Centre Pecka
Replicability	Yes
Ecological relevance (qualitative climate change mitigation potential)	Production of electricity from renewable energy that results in positive effect to climate change.
Links for further information	https://czzs.org/uspjesno-zavrsena-kampanja-solarna-pecka-obezbjedjeno-6-687-usd/?lang=en

Legal national status of data management, exchange and ownership

In BiH, participants in the crowdfunding campaign are interest groups without legal forms. All activities are implemented on the voluntary basis and the ownership of the installation have the public institution/place which is subject of the campaign.

Basic legislation on ownership rights in FBiH have been adopted and are generally mutually harmonized. Acquiring ownership and construction rights is regulated by the FBiH Law on Property Rights, while the FBiH Law on Construction Land (FBiH, 2003) provides for the additional possibility of acquiring the right to use construction land for the purpose of construction.

Short national summary on existing/possible implementation fields, challenges and barriers and potential outlook

In the context of civil energy and energy transformation, in the EU, energy cooperatives have proved to be a good form of local community organization. Energy cooperatives develop the RES projects, which are wholly or partly owned by the community that lives in the area where the project is being built. The community participates in investment that will use local RES potential such as biomass, manure, wind, geothermal energy, roofs of buildings for the construction of solar systems, etc. **At BiH state level** there is a General Law on cooperatives that defines the cooperative as a form of organization of voluntarily affiliated members - cooperatives to meet their common economic, social and cultural needs and aspirations, through shared ownership and democratically controlled business. Resources that the cooperative receives as subsidies of the state, NGOs and other resources can be used only for the material investments or for permanent working capital. Further, in BiH there is no energy cooperative yet.

Therefore, in BiH, it is necessary, at the strategic level, to express the commitment to introduction of new business models in the energy sector, as are energy cooperatives, public-private partnership (PPP). Energy cooperatives are one of ways to support these initiatives, and they are not mentioned in the Framework Energy Strategy of Bosnia and Herzegovina until 2035. Also, according to the Third Annual Report under the Energy Efficiency Directive, Bosnia and Herzegovina presently do not have the conditions in place for the creation of an ESCO market (Energy Service Company) and energy performance contracting.

Key barriers for development of energy cooperatives and collective actions are:

- insufficient political support and possible resistance from the public,
- lack of appropriate support framework and lack of financing,
- lack of knowledge and cooperative pilots,
- available data on energy citizen projects in BiH is rather limited.

4.4.3 Collective actions (and other examples) existing in Bulgaria

For Bulgaria, the collective action of common heating in multi-family buildings is following presented.

Collective actions (CA) actions BG No. 1	
Common heating in multi-family buildings	
Place	Sofia, Bulgaria
Description of action	Apartment owners in multi-family building initiate and realize a project for heating and hot-water supply in the building through a common wood chips or natural gas boiler.
Actors	Apartment owners in multi-family buildings Professional property manager hired by the owners (not obligatory) Equipment supply and installation companies
Targets of action	Cost saving - economy of scale, sometimes (e.g. in the case of wood chips) fuel price Easy servicing of one boiler compared to boilers in each apartment
Impact on the energy system	Depends on the replaced energy carrier
Economic viability (availability of subsidies)	The initiative is generally economically viable, depending on the replaced previous heating solution. No grants are available.
Barriers	The law requires agreement of 100 % of the owners. The association of apartment owners cannot attract third party financing.
Challenges	To convince all apartment owners that the solution is beneficial.
Manageability	The installation is typically managed by an energy service company, contracted by the apartment owners.
Replicability	High replicability potential.
Ecological relevance (qualitative climate change mitigation potential)	The solution is generally environmentally friendly, but it depends on the previous heating source.
Links for further information	

Legal national status of data management, exchange and ownership

The self-consumption concept in Bulgaria is underdeveloped. The legal definition regarding the scope of residential prosumer and collective self-consumption schemes is missing (Trifonova, 2018).

Short national summary on existing/possible implementation fields, challenges and barriers and potential outlook

Only single pilot projects for collective self-consumption are existent due to exclusive conditions for their operation (funding, property rights). A major barrier are property rights. For instance, in the multi-family housing case, the owners of the shared RES installation must be 100 % of the owners of the property and all 100 % need to be willing to participate in it (Trifonova, 2018).

Another important barrier for the realization of community projects is the difficulty to obtain financing from private banks by the association of owners in multi-family buildings - the association has no legal right to do so. Furthermore, there are no financial incentives for energy cooperatives available in the country.

The organizational form (special purpose vehicle) under which the project should be created in order to be granted a network access is also linked to a number of legal problems. Above all, the financial benefits from self-consumption in the form of savings of the variable part of the electricity bill are limited because of the inequality of the individual apartment owners that consume the energy and the owner of the self-consumption project (SPV, association of owners, or another). This refers also to energy cooperatives and other forms of collective self-consumption (Trifonova, 2018).

The other main barrier is the heavy procedure to get a permit for integrating a small scale renewable energy capacity to the grid and even greater challenge for integrating small renewable heat into an existing district heating network (Community Power, 2016).

The way ahead is small decentralized renewable energy owned by people and used by the people locally (Community Power, 2016).

The National Energy and Climate Plan 2021-2030 (NECP, 2020) specifies that a legal framework will be developed to guarantee that consumers can consume own electricity produced from renewables and sell the excess electricity without complicated administrative procedures. Unfortunately, no further details are provided in that document.

4.4.4 Collective actions (and other examples) existing in Croatia

Three collective actions are given for Croatia. The joint action for the first biomass fuelled heating plant in Croatia, a collective fund promoting the use of renewable energy sources for natural persons, and crowd lending for Solar Roofs.

Collective actions (CA) HR No. 1	
Pokupsko – first biomass fuelled heating plant in Croatia	
Place	Zagreb County, Croatia
Description of action	Pokupsko District Heating System is the first biomass powered district heating system in Croatia, commissioned in late 2015. With the capacity of 1 MW and 1,2 km long DH network, the system supplies thirty users through individual substations (public buildings including elementary school, municipality administrative building, church building, but also houses and local utilities). The plant is fuelled on locally available wood chips originating from the

	surrounding forests and residues from a local sawmill. This CA was financed by the EU's Instrument for Pre-Accession Assistance in Rural Development (IPARD) as well as the Croatian Environment Protection and Energy Efficiency Fund, and the total investment amounted to app. 1,6 million EUR.
Actors	The project was initiated by Pokupsko municipality in cooperation with REGEA.
Targets of action	To enable secure and constant heat supply for the municipality using locally available energy sources and to create new economic activity in the area.
Impact on the energy system	Annual heat generation of the plant is 1,000 – 1,200 MWh, supplying 30 connected end-users.
Economic viability (availability of subsidies)	Heat price is approx. 0.04 €/kWh for households (without VAT) and 0.053 €/kWh (without VAT) for public/commercial buildings. The project is economically and socially viable as it provides a cheaper and environmentally friendlier alternative to the previously used heat supply source – wood furnaces.
Barriers	Lengthy procurement procedure, which extended the project implementation.
Challenges	The main challenge for the implementation of this specific project, biomass DHS in Pokupsko, was related to securing the financing of the investment. Due to the high investment amount needed for the (then) new RES initiative, first of its kind in Croatia, the investors were not keen on investing. However, this challenge was resolved once the project got the green light from the IPARD Fund. However, the funding challenge remains for other similar projects, initiated in the local communities for the local communities. Current Operational Programme for Rural Development does not include incentives to stimulate the development of the new RES DH projects and the options to finance biomass DH projects are limited in the current setting.
Manageability	Municipality of Pokupsko owns and manages plant operation.
Replicability	Project is considered to be highly replicable and there were similar initiatives in other "bio villages" in Croatia but due to the lack of funding, such as grant funds, the initiatives were terminated.
Ecological relevance (qualitative climate change mitigation potential)	Commission of the new heat plant resulted in the CO_2 reduction, which amounts to approx. 230 t per year due to the fuel switch – from fuel oil to biomass.
Links for further information	http://biovill.eu/wp-project/uploads/2016/09/ BioVill_D2.1_Best_Practice_Examples_final_161102_subm-2.pdf

Collective actions (CA) HR No. 2	
Promoting the use of renewable energy sources for natural persons	
Place	Karlovac County, Krapina – Zagorje County, Primorje – Gorski Kotar County, Zagreb County
Description of action	Up until 2015 the Environmental Protection and Energy Efficiency Fund (EPEEF) provided grants to municipalities, cities and counties for programmes promoting and incentivising the use of RES in households, which could amount to 40 % of the investment costs. To obtain grant funds from EPEEF, local and regional governments had to contribute to the implementation of the programme with at least 10 % of eligible investment costs. Once the EPEEF allocated grant funds to local and regional governments, they could publish calls to promote the use of RES in households. Actions promoted with these calls included amongst others installation of solar thermal systems, heat pumps and biomass boilers. This action can be characterised as a partnership CA as the local and regional authorities had to apply for grant financing from a national body in order to support citizens to use RES in their households.
Actors	Environmental Protection and Energy Efficiency Fund and local and regional authorities.
Targets of action	Promote the use of RES in households by incentivising the households' owners to invest in RES systems and replace their less efficient heating systems.
Impact on the energy system	Impact on the energy system on the national level is not significant but it is a step towards gaining energy independence for individual households. However, from the data obtained for one of the counties (Krapina – Zagorje County), energy savings amounted to just under 4.000 MWh in the period from 2009 to 2015 for the usage of solar collectors for heating water procured using the subsidies.
Economic viability (availability of subsidies)	Minimum available subsidy amounted to 50 % of the total investment, with EPEEF contributing 40 % of the investment costs and the local/regional authority 10 % minimum.
Barriers	As the subsidies were available to homeowners only through local or regional authorities, citizens were dependant on the willingness of their local/regional authority to participate in the EPEEF programme, causing the inequality. Therefore, in 2015 it was decided that the Fund will publish calls for all citizens willing to invest in RES systems for their households, thus reducing the inequality.
Challenges	Local/regional government was responsible for evaluating submitted applications, checking and verifying the current energy status of the applied households and contracting the professional supervision to check the installed equipment and systems prior to the funds' disbursement. This can be seen as a major challenge and setback for the implementation of the programme as local governments tend

<table>
<tr><td></td><td>not to have a sufficient number of technical experts.</td></tr>
<tr><td>Manageability</td><td>Local/regional authorities applied for funding to the EPEEF and were responsible for the application process on the local/regional level, distribution of funds, controlling the implementation of the renewable systems and the expenditure of allocated funds.</td></tr>
<tr><td>Replicability</td><td>The action continued after the amendments in 2015 and it has proved successful, as the funds are allocated within a couple of weeks after publishing the call. The calls are published every year since 2015 and in the first year, after the amendments were made, the number of applications increased by 25 %.</td></tr>
<tr><td>Ecological relevance (qualitative climate change mitigation potential)</td><td>This collective action has a significant impact on the climate change mitigation potential due to the funds allocated for the promotion and installation of the RES in households. Below is data regarding CO_2 reduction per each year for Karlovac County triggered by the collective action.
<table>
<tr><th></th><th>2009</th><th>2010</th><th>2011</th><th>2012</th><th>2013</th><th>2014</th></tr>
<tr><td>CO_2 savings, t/year</td><td>55.33</td><td>77.52</td><td>254.18</td><td>324.09</td><td>240.3</td><td>196.11</td></tr>
</table></td></tr>
<tr><td>Links for further information</td><td>Public calls are currently closed, but all the relevant information can be found on the Environmental Protection and Energy Efficiency Fund website: http://www.fzoeu.hr/hr/nacionalni_javni_pozivi_i_natjecaji/</td></tr>
</table>

<table>
<tr><th colspan="2"><i>Collective actions (CA) HR No. 3</i></th></tr>
<tr><td colspan="2"><i>Križevci Solar Roofs</i></td></tr>
<tr><td>Place</td><td>Koprivnica – Križevci County, Croatia</td></tr>
<tr><td>Description of action</td><td>The first crowd-lending project in Croatia for the first citizen energy project - a solar power plant of 30 kW on the roof of Development Centre and Technology Park in Križevci. Crowd-lending campaign was launched to raise the amount of 230.000 HRK (30.000 EUR) to build the solar plant and the interest the citizens showed was beyond expectations. The necessary amount was collected in ten days by 53 small investors based on micro-loan model. The minimum investment chip was 1.000 HRK (130 EUR), the maximum was 10.000 HRK (1.300 EUR) and the average in this project was 4.000 HRK (500 EUR).</td></tr>
<tr><td>Actors</td><td>Green Energy Cooperative initiated the project but other participants, such as partners from the city of Križevci, Regional Energy Agency North, Greenpeace Croatia, Solvis and ACT Group were also included in the project development.</td></tr>
<tr><td>Targets of action</td><td>The solar plant was built to cover The Križevci Development Center and Technology Park energy demand, and surpluses will be</td></tr>
</table>

	delivered to the grid as agreed with the supplier, based on the supply model "customer with own production".
Impact on the energy system	During the project duration (10 years) expected reduction in CO_2 emissions amounts to 412.500 t, whereas the expected reduction in CO_2 emissions during the solar plant lifetime (25 years) amounts to 1.031.250 t.
Economic viability (availability of subsidies)	Although PV systems are eligible to be eligible energy producers and receive incentives for energy production in Croatia, this initiative is not funded through such a scheme. Initial investment and the loans will be returned to investors with 4.5 % of interest over 10 years, from the income generated by electricity production of the solar power plant on the roof.
Barriers	Researching the legal framework to determine legitimate contract stipulations for the crowdfunding campaign and the future legal relationship between Green Energy Cooperative, City of Križevci, PV manufacturer and energy supplier. Additionally, the cooperative was at the time developing their first crowdfunding platform, ZEZinvest, and it took a long time to design and eliminate technical problems.
Challenges	One of the challenges was establishing cooperation between the involved stakeholders, including the city mayor and the citizens (general public) and gaining the trust of the local stakeholders. However, the mayor was very proactive and involved in the whole project and energy cooperative started communication activities long before the project started to connect with potential investors.
Manageability	During the project and contract duration (10 years), Green Energy Cooperative is a sole owner of the solar plant and the Križevci Development Centre and Technology Park, i.e. City of Križevci will pay an annual fixed rent for the use of the power plant to the Cooperative. After the expiry of the contractual lease period of the solar power plant, the power plant becomes the property of the City of Križevci and continues to generate savings.
Replicability	The project has a large potential for replicability, and this is shown by the fact that shortly after the crowdfunding for the first CA project finished, second crowdfunding for the solar plant on the roof of the Križevci Town Library has started. A second crowdfunding campaign set a goal of collecting 23.000 EUR and this was also achieved in a matter of days.
Ecological relevance (qualitative climate change mitigation potential)	As stated earlier, the solar plant has a large impact on CO2 emission reduction.
Links for further information	https://www.zez.coop/ulaganja/

Legal national status of data management, exchange and ownership

From the data availability aspect, heat demand of individual houses and buildings (residential/commercial) is not publicly available and heat mapping is, at the moment, mostly used in scientific and research purposes, thus making it impossible to identify inefficient heating systems. However, as of 2008 all new houses and buildings are obliged to have Energy Performance Certificate (EPC), as well as houses, residential and commercial buildings which are being sold, rented or leased. EPC contains information about the energy properties of the building/house, including specific heat and primary energy demand and used energy sources. EPCs issued after the 1st of October 2017 (introduction of online energy certificate system) are publicly available in an online database, although not methodically organised but merely listed.

Considering the possibilities to access owners of existing inefficient heating systems, utility service representatives can only contact building's representative regarding the co-owned units in the building and not each tenant, i.e. co-owner of the building, separately.

Considering the access to facilities of heating systems' owners, two aspects are considered. First one is related to the substations in residential buildings and the second one to the chimney, boilers and furnaces in houses and buildings.

For the substations, it is essential to consider energy activities defined within the Croatian Heat Market Act (Official Gazette 80/13, 14/14). This act defines three heat energy activities – heat generation, heat distribution and heat supply and additional activity of heat energy buyer. The activity of the buyer is performed by a legal or a natural person who, on behalf of and for the account of the owner and/or co-owner of the building, which consists of several independent usable units (multi-apartment buildings), buys fuel for the heat production in a stand-alone heating system, or buys heat from a heat supplier in a closed or central heating system. This activity includes professional management, operation, maintenance of substations and other internal heat installations in joint ownership of the building co-owners and the supply of heat energy to the end customer in a building. Owners of residential and commercial premises, i.e. end customers connected to a common heat meter using substations, are obliged to select a heat energy buyer and sign a Heat Supply Contract with the selected heat energy buyer, who in turn will manage and maintain the substation and the internal installations. However, owners of private homes, business premises or industrial facilities, who have their separate metering point and who independently manage their internal heating installations, do not have to select heat energy buyer, but rather sign a contract directly with the heat energy supplier.

Maintenance of chimneys and furnaces is a legal obligation of all tenants. The co-owners of the building (tenants), as well as the house owners, have to allow the chimney sweeper to access each chimney and furnace used, inspect and clean the chimney and the furnace, as well as provide information on the number and type of chimney and furnace. In order to properly inspect and clean the chimney, it is necessary to allow access to the door, fittings, chimney cap and other parts.

The concessionaire i.e. authorised chimney sweeper must carry out regular and extraordinary inspections of the chimneys and to clean the chimneys. Regular chimney maintenance is carried out following the requirements of the building and at least once a year.

Providers of the heat energy activities, the heat energy buyer activity and chimney sweepers are obliged to follow relevant national and EU directives, including the General Data Protection Regulation (GDPR). End consumers are notified about which consumer data is collected, how it is processed, for what purposes it is used, and the customers' rights related to the disclosure of personal data.

Short national summary on existing/possible implementation fields, challenges and barriers and potential outlook

Based on the aforementioned aspects of the legal status of data management, exchange and ownership, possible implementation fields would be consolidating EPCs in a database, thus providing easy access to the information necessary to determine (heat) energy demand. However, several issues arise if this measure is implemented. First, privacy issues due to the address of each building listed on the EPC and secondary, EPCs are not obligatory for the buildings built before 2008 and this kind of database would not contain energy information for each existing building.

After the ownership of substations was transferred from heat energy companies responsible for the heat distribution (HEP Toplinarstvo in the City of Zagreb, City Heating Plant Karlovac in the City of Karlovac, Energo Rijeka in the City of Rijeka) to the tenants of the buildings, energy companies lost rights to access the substations, modify it or replace it without tenants' approval. Substations are an integral part of the heat distribution network and the heat losses in the substation and the building itself have a direct effect on the heat losses in the whole network. To improve the efficiency of the network and decrease heat losses, energy companies can either convince the tenants to replace the substation at their own expense or offer the replacement at energy company expense, although the substation is not owned by them. Both options put energy companies in an unfavourable position and present barrier for their business.

4.4.5 Collective actions (and other examples) existing in Germany

For Germany, three examples of collective actions to realize locally based, small DH networks are provided below.

Collective actions (CA) actions GER No. 1	
District Heating Steingaden	
Place	Germany
Description of action	Based on a sustainable energy action plan for the municipality of Steingaden, the high potential of a centralized bioenergy based heating supply became topic in the municipality. Together with local residents a cooperative approach was chosen to establish a heating supply based on bioenergy for 50 residential buildings.
Actors	Genossenschaft (cooperative)
Targets of action	Collective heating supply for 50 residential buildings
Impact on the energy system	Transformation from individual heating supply based on fossil fuels (oil) to central renewable source (wood chips)
Economic viability (availability of subsidies)	Subsidies through KFW bank: approximately 30 % of investment costs
Barriers	-
Challenges	• Variability of oil prices create challenge in economic prediction of collective action. • Uniting 50 individual home owners to create a system for collective heating supply

	• Creating business plan and business model • Finding appropriate people to run the cooperative • Project development based on volunteer work by convinced people
Manageability	Decision making through Board of Directors of cooperative. Quarterly assembly of members of cooperative during project beginning phase.
Replicability	High replicability once motivated volunteers are identified. Business model cooperative is relatively complicated to establish.
Ecological relevance (qualitative climate change mitigation potential)	Replacement of 180.000 litres of oil and an equivalent of 531.000 tonnes of CO_2 yearly.
Links for further information	https://energiewende-oberland.de/hp10333/Gruendung-einer-Energiegenossenschaft-in-Steingaden.htm

Collective actions (CA) actions GER No. 2	
District Heating Warngau	
Place	Germany
Description of action	A municipality established a central heating supply for public and residential buildings and produces additional 171.000 kWh renewable electricity from biomass through wood gas process.
Actors	Municipality, local volunteers
Targets of action	Collective heating supply for 10 residential and 5 public buildings
Impact on the energy system	Transformation from individual heating supply based on fossil fuels (gas) to central renewable source (wood chips) plus production of renewable electricity through additional usage of wood gas.
Economic viability (availability of subsidies)	Subsidies through KFW bank: approximately 35 % of investment costs
Barriers	Financing through municipality relatively complicated due to regulation that does not support economic activity by municipalities
Challenges	• Convincing local parliament to engage in economic activity to supply heat for private households • Long project development only possible through externally funded federal program (Bioenergieregion Oberland) • Establishment of economic activity within public administration
Manageability	Once established, this business model is completely run by the

	municipality.
Replicability	Low replicability due to reduced feed-in tariff by German renewable energy act.
Ecological relevance (qualitative climate change mitigation potential)	Replacement of 110.000 cubic metres of gas and an equivalent of 248 tonnes of CO_2 yearly.
Links for further information	https://www.merkur.de/lokales/region-holzkirchen/heizkraftwerk-warngau-alte-technik-birgt-neues-potenzial-4834225.html https://youtu.be/ousAE-LUFlc

Collective actions (CA) actions GER No. 3	
District Heating Habach	
Place	Germany
Description of action	A farmer established a wood chip centralized heating system for the neighbourhood
Actors	Farmer
Targets of action	Collective heating supply for 6 residential buildings
Impact on the energy system	Transformation from individual heating supply based on fossil fuels (oil) to central renewable source (wood chips)
Economic viability (availability of subsidies)	Subsidies through KFW bank: approximately 20 % of investment costs
Barriers	-
Challenges	• Convincing neighbourhood about collective heating supply • Restructuring of farm building due to new utilization of buildings • Contractual structure needed to be created and discussed
Manageability	Once established, this business model is completely run by the farmer.
Replicability	High replicability due to high potential of sustainable utilization of biomass for heat production especially in farm related field.
Ecological relevance (qualitative climate change mitigation potential)	Replacement of 30.000 litres of oil and an equivalent of 89 tonnes of CO_2 yearly.
Links for further information	-

Legal national status of data management, exchange and ownership

In Germany, identified purchasing groups have in common to be private interest groups without legal forms. Thus, civil law applies. It is important to know that also in private groups data protection (i.e. GDPR) needs to be respected.

Short national summary on existing/possible implementation fields, challenges and barriers and potential outlook

In the region Bavarian Oberland the heating sector is responsible for approximately 30 % of regional CO_2-emissions. In the year 2016 roughly 10 % of the heating demand was supplied by renewable sources. Due to the rural structure of municipalities the initial motives and chosen approaches vary from municipality to municipality and is highly depended on the main actor in the town or village.

The provided examples (see tables above) represent three methods on how to establish district heating systems. The subsidies provided by federal law are supportive, however the example of Warngau, which demonstrates an efficient way to combine heating and electricity production is not economically feasible anymore due to reduced feed-in tariffs for bioenergy within the German Renewable Energy Act (Erneuerbare Energien Gesetz).

In general, there is a high potential for further district heating systems based on bioenergy in the region Oberland. However, the project development and creation of a sound business model requires external expertise and can often times not be financed by the main actors themselves, which therefore depend on initiatives and assistance of regional energy agencies or coordinators.

Few larger towns in the region Oberland possess local energy utilities, which sometimes offer those services directly to their municipality and private households as well as enterprises.

A study carried out in the years 2015-2019 (INOLA) stated the potential of 36 district heating systems in the administrative districts of Bad Tölz-Wolfratshausen, Weilheim-Schongau and Miesbach. The region Oberland consists of the above named plus the administrative district of Garmisch-Partenkirchen. The district Garmisch-Partenkirchen has a comparable structure with regards to unused potentials of bioenergy. Therefore, the estimate for the region Oberland is a potential for district heating system higher than 40 – 45.

4.4.6 Collective actions (and other examples) existing in North Macedonia

Four examples for collective actions are given for North Macedonia, the joint organisation of summer pellets purchase (enhancing sustainable heating and leading to cost reduction), collective insulation, colective change of asbestos roofs, and financial support for rural development.

Collective actions (CA) actions NM No. 1	
Summer pellets cost reduction	
Place	City of Skopje, N. Macedonia
Description of action	During the summer period the companies that are selling pellets have the summer pellets cost reduction. The discount of 0.16-0.24 euro cent per bag (one bag cost approximately 3.25 euro) helps the users to buy pellets for the whole season and save money. Many pellet companies replicate this as a good practice and are offering different discounts and free delivery on orders above half tone of

	pellet.
Actors	Companies that are selling pellets
Targets of action	More affordable pellet price
Impact on the energy system	N.A.
Economic viability (availability of subsidies)	Price discount
Barriers	Storage space
Challenges	Large upfront costs
Manageability	Easy to manage
Replicability	High possibility to replicate
Ecological relevance (qualitative climate change mitigation potential)	N.A.
Links for further information	http://gran.mk/market/letna-ponuda-peleti/

Collective actions (CA) actions NM No. 2	
Collective insulation	
Place	Municipalities and Habitat (NGO), N. Macedonia
Description of action	In order to improve the EE, the living conditions and residents' comfort, municipalities (Karposh, Aerodrom, Gjorce Petrov) in collaboration with HABITAT provides financial support for insulation of buildings (façade and uppermost celling). Based on the percentage of tenants who agreed to contribute, the municipality partially covers the funding for the insulation (up to 30 %). Habitat provides low/no interest loans to tenant councils for this measure. The Municipality of Aerodrom facilitates the upgrade of façade insulation. So far, the facades of old buildings (22 in total) with energy efficient facades fully funded by the municipal budget. The project will continue in the coming years until the facades of all damaged buildings are replaced, not only improving their appearance, but also providing citizens with energy-efficient homes and heat saving. Municipality of Gjorce Petrov supports energy efficiency in the residential sector. As a first phase, a survey was carried out and a register of collective residential buildings was established which identified 283 residential units. The project involves supporting communities of owners of collective residential buildings. The Municipal Council adopted a Rulebook on the conditions, criteria, type and manner of subsidizing the project 'Energy Efficient Homes' of collective housing in the Municipality of Gjorce Petrov. Based on

	the Rulebook, a public call was issued where over 20 communities applied, 12 of which partially fulfilled the criteria. It is projected that in the period 2020-2024, over 30 buildings older than 40 years will be reconstructed, over 70 buildings older than 25 years, which would mean approximately EUR 5 million investment and savings of heating and cooling energy by approximately 40 % relative to existing consumption.
Actors	• Residents; • The municipalities; • Habitat (NGO)
Targets of action	Improving the insulation on the building envelope
Impact on the energy system	• Reduced heat demand; • Reduced electrical peak demand (when electricity is used for heating).
Economic viability (availability of subsidies)	• Partial financial support; • Low interest loans.
Barriers	• People's indifference; • Unorganized tenant communities and home councils; • BEG has no interest in adjusting the automation according to the changing conditions of the facility and reducing the excess energy through the calorimeters (up to 24 degrees). Thus the effect of reduced energy requirements is not visible.
Challenges	• Coordination and organization; • Logistics.
Manageability	Easy to manage
Replicability	High possibility to replicate
Ecological relevance (qualitative climate change mitigation potential)	Improvement of EE leads to lower specific heat demand (kWh/m^2). This, in turn, reduces the overall emissions related to the heating energy use, independent of the technology applied.
Links for further information	https://denar.mk/135981/ekonomija/ke-se-finansira-obnovata-na-fasadi-na-zgradi-vo-opshtina-aerodrom?utm_source=daily.mk&utm_medium=daily.mk

Collective actions (CA) actions NM No. 3
Asbestos roof change

Place	Municipality of Gjorche Petrov, N. Macedonia
Description of action	Group of residents of a building in the municipality singed for roof change. The asbestos roof was hazardous and unsafe for human's health. Their roof was changed free of charge by the municipality in order to increase the energy efficiency (EE) and improve people's comfort and living.
Actors	• Residents; • Municipality of Gjorce Petrov.
Targets of action	Roof change
Impact on the energy system	N.A.
Economic viability (availability of subsidies)	• The municipalities are offering subsides for asbestos roof change; • Subsidies of up to 30 % of the total investment for energy efficient facade and roofing.
Barriers	• People's indifference; • Unorganized tenant communities and home councils.
Challenges	• Large upfront costs; • Coordination and organization; • Logistics.
Manageability	Easy to manage; Difficult to implement
Replicability	High possibility to replicate
Ecological relevance (qualitative climate change mitigation potential)	• Improvement of EE • Improvement of human health
Links for further information	https://www.novamakedonija.com.mk/makedonija/skopje/никој-не-ги-изброил-опасните-азбестни/

Collective actions (CA) actions NM No. 4	
Financial support for rural development	
Place	N. Macedonia
Description of action	CeProSARD in collaboration with the World Bank in 2009 within the Program for Financial Support of Rural Development introduced a measure to support investments for construction and equipment for the production and use of renewable energy sources (RES) in rural areas in the amount of 18,000,000 denars.
Actors	• CeProSARD

	- World Bank
Targets of action	Improving EE and heating systems in the rural areas
Impact on the energy system	- Increased penetration of renewable energy; - Reduction of on-site energy consumption.
Economic viability (availability of subsidies)	Financial support
Barriers	Uninterested target group.
Challenges	N. A.
Manageability	Challenging manageability depending on the region resource availability.
Replicability	Challengeable replicability depending on the region characteristics.
Ecological relevance (qualitative climate change mitigation potential)	The purpose of this measure is to use RES in rural areas, to reduce electricity consumption, to protect forests from uncontrolled logging and to protect the environment, i.e. to reduce the greenhouse effects that contribute to the global climate warming.
Links for further information	http://ceprosard.org.mk/mk/PDF/PRIRACNIK_OBNOVLIVI%20IZVORI_mk.pdf

Legal national status of data management, exchange and ownership

In 2019 the National Portal of Electronic Services (Uslugi, 2020) was established and managed by the Ministry of Information Society and Administration (MISA). The platform provides quick and easy access to public service information by the competent authorities and state entities. The number of published services is 744 within 1,289 public institutions such as: The Public Enterprise Official Gazette of N. Macedonia, Ministry of Labor and Social Policy, Ministry of Economy, Ministry of Information Society and Administration, Ministry of Interior, Government of N. Macedonia, Agency for real estate cadaster, National hydrometeorological service of N. Macedonia, Employment Agency of N. Macedonia, Fund for innovations and technology development, etc. The platform offers joint data in several areas and it is base for further development with more detailed information on energy sector.

Furthermore, the State Statistical Office (2020) has abundance of data on energy balances and statistics, electricity and gas prices, RES share. Most of the data is accessible to the public. However, the data is collected from the supply companies and there is no disagreed data by individuals in terms of heating systems information.

Short national summary on existing/possible implementation fields, challenges and barriers and potential outlook

Efficiency is the first principle applied in energy policy making, planning and investment. It prioritizes investing in resources on the consumer side (including end-use EE and DR). Nationwide in the period 2011-2017, primary energy consumption decreased by 12.6 % mainly due to the increased import of electricity and petroleum products, as well as the implementation of EE measures and increased production of electricity from RES. Final energy consumption has remained stable with several variations, mainly due to fluctuations in industry and weather conditions. The indicative target in N. Macedonia is to reduce final energy consumption by at least 9 % by 2018 relative to reference consumption (BAU - Business as usual scenario), or the cumulative final energy savings to be 147.2 ktoe. This means that the country will keep primary energy consumption below the "individual per capita consumption" limit set for Energy Community Contracting Parties in the amount of 3,270 ktoe. Most of the energy savings are projected from the improvements in transport and industry, contributing 28.7 % and 27.8 % individually in 2018, but estimates show that households and the public sector are also important for energy saving, with a share of 19.6 % and 10.4 %, respectively.

The BAU scenario assumes insignificant changes in technology, economics or policy, which means that the usual circumstances can be expected to continue unchanged. This scenario is unlikely to happen because it implies, for example, that the efficiency of devices used in households in 2040 will be the same as the efficiency of devices used in 2017. However, such a scenario is crucial because it allows all policies and measures to be compared with the same reference option ('no action' case) and to assess their effect (such as energy savings, emissions and finances).

The BAU scenario develops several assumptions for which further propose measures for improvement.

- In 2040, final energy consumption is almost twice as high as in 2017
- In the household sector by 2040, it is projected that biomass for heating and electricity will account for ~ 93 %
- In the commercial sector by 2040, electricity is used by 64 %
- GDP growth increases the transport of goods and vice versa
- Non-investment in EE and RES will double primary energy consumption
- Exhaustion of domestic resources will increase energy dependency, reaching up to 75 % in 2040
- GHG emissions reach 15.4 Mt CO_2-eq in 2040, which is 66 % more than in 2017
- The RES share in gross final energy consumption is almost unchanged in the whole planning period
- In 2040, the annual costs for the entire power system will be ~ 2.5 times higher than in 2018

The intention is to show how these reference assumptions could be improved and what can be changed in order to utilize country potentials. The EE policies and measures follow the obligations of the new national EE legislation and ratified international agreements. All measures are evaluated against the BAU scenario. Following the requirements of the EE Directive, a total of 31 policies and measures have been identified which are grouped into seven relevant areas. Some of them affect few sectors and their total savings are reported separately (as horizontal measures). Four measures are realizing better than planned (promotional program for wider use of thermal solar collectors and heat pumps, street lighting, wider use of RES and promotion of greater use of railways). One third of the measures are partially implemented and only one measure is not implemented (local calorimeters).

- Horizontal measures
    - EE obligation schemes

  - Public awareness campaigns and network of EE info centers
- EE in the public sector
  - Retrofitting of existing of government and local self-government buildings
  - “Green procurements”
  - Improve street lighting in the municipalities
- EE in buildings
  - Solar rooftop power plants
  - Labelling of electrical appliances and equipment
  - Retrofitting of existing residential and commercial buildings
  - Construction of new buildings and passive buildings
  - Phasing out of incandescent lamps
- EE in industry
  - Energy management in manufacturing industries
  - Introduction of efficient electric motors
  - Introduction of more advanced technologies
- EE in transport
  - Renewing of the national car and other road vehicles fleet
  - Advanced mobility
  - Greater utilization of the railway
  - Electrification of transport
- Promotion of efficient heating and cooling
  - Solar thermal collectors
  - Greater utilization of heat pumps
  - Greater utilization of central heating systems
  - Biomass Thermal Power Plants (CHP optional)
- Energy transformation, transmission, distribution and demand response
  - Reduction of distribution losses
  - Large hydro power plants
  - Incentives feed-in tariff
  - Incentives feed-in premium
  - RES without incentives

The detailed description of each measure, the long-term goal, the assumptions for the reference scenario, moderate transition and green scenario, the results of the simulation and the estimation of the final and primary energy savings, benefits and budget are presented in the Strategy for Energy Development of the Republic of N. Macedonia by 2040 (PWC and MANU, 2019).

The government is also promoting the use of RES and EE in households under the annual National Program. The Program Implementer is the Ministry of Economy, which implements the following support schemes set out in the Program: up to 30 % compensation, but not exceeding EUR 300, from the costs of purchasing and installing solar thermal collectors; up to 50 % fee, but not more than 500 EUR from the cost of procurement and installation of PVC or aluminum windows. EE and RES support schemes are also implemented locally. An example is the Citizens' Subsidy Program on the territory of the City of Skopje for purchasing pellet boilers, which started in 2016 and provides up to 70 % of the value of the boiler, but not exceeding ~500 EUR. Each year, the Program is reviewed and considered to support some new technologies and the program budget is increased, as the number of applications each year is growing.

Under the new EE law all public procurement in different spheres must define a minimum energy class for the object. Leasing and renting premises cannot be done without an energy certificate (passport).

Subsidy for purchases of electric vehicles by 2021 is planned in order to initiate replacement of old fossil fuelled vehicles. Here we can mention the urban mobility and the transport and subsidies that municipalities provide for bicycles and electric trolleys.

4.4.7 Collective actions (and other examples) existing in Serbia

The four examples about collective actions from Serbia,include the thermal insulation of old buildings, the connection of buildings on small DH networks that use biomass, the installation of heat pumps for heating & cooling, and the joint investment in the construction of PV plants.

Collective actions (CA) actions SER No. 1	
Thermal insulation of old buildings	
Place	City of Šabac, Serbia
Description of action	Thermal insulation of old residential buildings. Financing model in period of 2010-2018 provided subsidies from the budget of the city of Sabac in the amount of 50 % of the funds. In 2020, the financing model changed. A local energy company plays the role of ESCO, secured funding by contract with the EBRD, and finances the thermal insulation of buildings and the installation of TS valves and cost allocators. Service users repay the investment over a period of 12 years from the savings achieved as a result of reduced energy consumption. There are no subsidies.
Actors	Local energy company for DH – PUC “Toplana-Šabac”
Targets of action	Reduction of heat and cooling consumption.
Impact on the energy system	Reduced heat requirement and as the result freed capacity in DH network to connect new users without additional investment costs.
Economic viability (availability	The effect analysis showed that energy savings range from 35 % to

of subsidies)	50 % depending on the condition of the building prior to the project and the behavior of the occupants.
Barriers	Obtaining a permit for energy rehabilitation of a building is conditioned by the volume of energy efficiency measures taken. After the renovation, the building needs to be classified for more than one class before the project. As a consequence, a building permit can only be obtained for larger scale energy efficiency measures, whereas it is not possible to obtain a building permit for measures that cannot secure the transition to a higher grade. The technical regulations do not envisage that the transition to renewable energy and the use of more efficient technologies are taken into account when assessing the effects of energy remediation.
Challenges	A qualified majority should be provided for the decision to join the project. There is no binding legislation for thermal insulation of buildings.
Manageability	The project is managed by ESCO (local energy company), which has the necessary technical capacity.
Replicability	There are 60 energy companies in Serbia that have the capacity to implement the project. It only takes the decision of the founder to launch the project in other municipalities in the same way as it was done in Sabac.
Ecological relevance (qualitative climate change mitigation potential)	Final energy consumption savings are 35 % to 50 %. The total heated area in the old multi-family residential buildings is 300,000 m^2, but so far the project has been implemented in the old multi-family buildings with about 100,000 m^2. There are 200,000 m^2 remaining to be covered by the thermal insulation project in the coming period. Expected savings are between 7,000 MWh/year and 10,000 MWh/year. Considering the heat losses and the efficiency of the heat source, the total savings in primary fuel energy would be between 8,600 MWh / year and 12,000 MWh/year. The energy company in Sabac uses natural gas to generate heat, and with this in mind, reducing CO_2 emissions would be between 1,720 t CO_2-eq and 2,400 t CO_2-eq annually after the project is completed. The Sabac City Energy Policy document provides for the use of renewable energy and the achievement of energy independence from fossil fuels, which means that by 2050 the share of renewable energy in DH should be up to 90 %, which would further correct the effects of this CA.
Links for further information	https://toplanasabac.rs/wp-content/uploads/2019/07/Sabac-RB-EE-SEP-22052019_ENG-FINAL.pdf

Collective actions (REC) actions SER No. 2
Connection of buildings on small DH networks that use biomass

Place	City of Šabac, Serbia
Description of action	The concept of district heating development envisages the construction of small DH networks in suburban and rural settlements. In the suburban settlement Letnjikovac, a boiler room with fuel oil boilers was reconstructed and a 500 kW wood-burning boiler was installed. The primary school building and the city administration building are connected to this small network. The technical and business model was developed as part of the CoolHeating (H2020) project. In 2020, activities on the project will continue with the construction of a 700 m DH network, which will connect 6 more buildings located at the site. Another 500 kW boiler on wood chips will be installed to meet the heat demand. The January 2020 city decision allowed the connection of households to the district heating network without any financial compensation. This is an incentive measure aimed at extinguishing small fireboxes that use coal and wood in an inefficient way and connecting to the DH network. In Letnjikovac, all households use individual fireboxes, so all households are the focus of this CA. On the roofs of public buildings, it is envisaged to install solar panels for the heating of sanitary water and PV plants of 15 kWe for the production of electricity, which will be used for outdoor and indoor lighting in public buildings on site.
Actors	Local energy company for DH – PUC “Toplana-Šabac”
Targets of action	Connection of 300 households and 8 public buildings onto renewable DH grid
Impact on the energy system	Renewable energy will be used to heat the buildings at this site with the idea that this site will become an energy island where only renewable technologies will be implemented.
Economic viability (availability of subsidies)	Replacing fossil fuels with locally available biomass and solar energy will help reduce the cost of building owners. During the 2019/2020 heating season, for the heating of the school building, the financial savings amounted to EUR 20,000 made on the difference between the price of wood chips and fuel oil used until 2018.
Barriers	Unclear provision of the tariff system for setting the price of heating. The tariff system focuses on energy companies and gives a framework to regulators regarding energy pricing. All the benefits of small renewable district heating networks are marginalized by the working conditions of large networks using fossil fuels. Heating costs are variable and fixed costs. Variable costs take into account the costs of fuel, electricity, working fluid and heat taken over, if applicable. All networks operated by an energy company shall be taken into account. The barrier is made up of a small share of renewable energy which is therefore marginalized and invisible. Specifically, in isolated locations such as Letnjikovac, energy buyers would not achieve the expected benefit because the variable part

	costs would be burdened with fossil fuel costs. The same problem is recognized when calculating fixed costs where incentives aimed at increasing the share of renewable energy become marginalized by existing costs of working with fossil fuels.
Challenges	During exploitation, renewable DHC grids will only have full effect if buildings connecting to these networks are also energy efficient. Choosing a financial model and securing the support of financial institutions is also a challenge. Financing the connection of multi-family residential buildings is a problem because residential communities (although organized as legal entities) are not visible to the banking sector due to problems with securing credit facilities. In response to this challenge, the promotion of ESCO participation is an acceptable option for the banking sector.
Manageability	The project must be managed by energy companies that have technical and human resources.
Replicability	There are no restrictions for use in rural and suburban areas. There are restrictions in urban areas due to space for the construction of new infrastructures.
Ecological relevance (qualitative climate change mitigation potential)	Building small grids that use renewable energy contributes to reducing fossil fuel use and reducing emissions. An example of a small DH grid that distributes the heat produced from a wood chips is the following: During the 2019 and 2020 heating season, 750 MWh of heat was produced. If it had not been for the project, this heat would have been produced from the heating oil, the CO_2 emission in that case would have been 262 t. Using wood chips, the CO_2 emissions were 28 t.
Links for further information	https://www.coolheating.eu/images/downloads/concepts/Report-D4.4-technical-concept-Sabac-Letnjikovac.pdf

Collective actions (REC) actions SER No. 3	
Installation of heat pump for heating & cooling	
Place	City of Šabac, Serbia
Description of action	The HC community in Šabac uses a 300 kW heat pump. The plant owner is the investor who built the building and the residential community pays for the cost of electricity and maintenance of the plant. Costs are divided into tenants in proportion to the energy taken up, which is measured by ultrasonic meters for each apartment individually.
Actors	The housing community and the SET company that owns the heat pump plant.

Targets of action	Use of efficient renewable technologies and reduction of HC costs.
Impact on the energy system	All the energy needed for HC space is produced by the use of a heat pump. The source/sink of renewable energy is well water. The heat pump uses SCOP = 5.5 electric compressors.
Economic viability (availability of subsidies)	Due to the low cost of electricity, energy costs are very low. The price of electricity and natural gas for the household category in Serbia is not regulated on the market, so a comparison with other HC technologies is not relevant.
Barriers	Complex procedures for obtaining permits and approvals for connection to infrastructure, as well as unclear provisions of the legislation for the use of well water as a source of renewable energy.
Challenges	The housing cooperative should be licensed to produce and supply energy for HC or hire a company that has the capacity to meet the license requirements. Licenses are issued by the city administration as a regulator of heating (and cooling).
Manageability	The city administration prescribes the business frameworks of energy entities engaged in HC.
Replicability	There are no restrictions except for the existence of natural renewable energy resources.
Ecological relevance (qualitative climate change mitigation potential)	The national emission factor for electricity is too high due to the excessive share of electricity produced in coal-fired power plants, which requires that heat pumps with high COPs be selected for installation to reduce emissions than using fossil fuels (natural gas).
Links for further information	SET Center 5

Collective actions (CEC) actions SER No. 4	
Investment in construction of PV plants	
Place	City of Šabac, Serbia
Description of action	In November 2019, the Sunny Roofs Energy Cooperative was established. In its first project to be completed in 2020, members of the cooperative will provide funding through a crowdfunding campaign and build a 16 kWe PV plant. The plant will be built on one of the public buildings (possibly the headquarters of PUC "Toplana-Sabac") and leased to the owner or user of the building. The user/owner of the building will produce electricity solely for their own needs and will repay the investment to the energy cooperative in the amount of the market price of electricity for a period not exceeding 10 years. After this period, the plant will become the property of the building owner/user.
Actors	Energy cooperative "Sunny Roofs" from Sabac

Targets of action	Use of electricity produced in a PV plant instead of electricity produced from fossil fuel power plants.
Impact on the energy system	It does not have a major impact on the operation of technical systems
Economic viability (availability of subsidies)	It does not have a big impact because the amount of energy in this case is very small.
Barriers	Low electricity costs that make the PV plant work at the limit of sustainability. Public companies are obliged to comply with the Law on Public Procurement, which does not allow the conclusion of contracts for a period longer than 3 years, which is not acceptable to investors because it does not provide certainty for the return of invested funds.
Challenges	The crowdfunding campaign needs to be high-level in order to attract enough citizens to participate in the financing of the project.
Manageability	The Energy Cooperative as the owner of the project ensures the management of the project realization in cooperation with the owner/user of the building.
Replicability	In the city territory without restriction. In an identical way, it is possible to invest in the construction of a large number of small PV plants on the roofs of houses whose owners have the choice to participate in the investment through a crownfunding campaign, or to just rent their own roof for the installation of PV plants.
Ecological relevance (qualitative climate change mitigation potential)	The construction of a large number of small PV plants would increase the share of green electricity.
Links for further information	https://balkangreenenergynews.com/sunny-roofs-serbias-first-energy-cooperative/

Legal national status of data management, exchange and ownership

With the entry into force of the Rulebook on the Energy Efficiency of Buildings (Paragraf, 2020c) and the Rulebook on the Conditions, Content and Method of Issuance of the Certificate of Energy Performance of Buildings (Paragraf, 2020d), the obligation has arisen that energy efficiency studies must be prepared for buildings as a condition for obtaining a building permit for new buildings or for energy rehabilitation and reconstruction of existing buildings and technical systems within existing buildings. After completion of the projected works, there is an obligation to produce energy passports that will document the situation after completion of the works.

Energy passports are archived in a database (CREP, 2020) managed by the Ministry of Construction, Transport and Infrastructure. Connection to the web portal (CREP) provides general information and graphic representation of passports. The basic information that is publicly available is the name of the investor (company name if investor), location of the building to which the energy passport relates, cadastral parcel, name of the contractor, and energy consumption data including energy class. Other information is not publicly available.

Both the Energy Efficiency Study and the Energy Passport contain data on energy consumption and efficiency of technical systems. But the energy class does not include the part related to energy consumption for space heating and cooling, DHW heating, or energy consumption data. The Energy Passport contains a non-binding recommendation page for improving energy performance, increasing the efficiency of technical systems and applying renewable energy.

The Energy Efficiency Act (Paragraf, 2020e) introduced the position of energy managers and energy advisers. Energy managers have competence in the public sector, industry and office and other buildings that consume large amounts of energy. Energy advisers are available to the public sector, companies and citizens, but without the obligation to be hired to solve specific problems.

The Law on Housing and Building Maintenance (Paragraf, 2020f) foresees the obligation of municipalities to provide once a week with advisory assistance to owners of buildings and estates related to improving the energy performance of buildings. In the general case, the implementation of energy efficiency measures and the use of renewable energy technologies.

Neither of the two last mentioned acts envisages the collection of data or the creation of a database which could in any way be used for further analysis in the energy sector.

Short national summary on existing/possible implementation fields, challanges and barriers and potential outlook

The activities carried out so far in Serbia were mainly aimed at increasing the share of renewable energy in the electricity generation sector. The environment in which renewable technologies are being implemented is suitable for large corporations and so far there is no room for civic initiatives and collective action to launch small communities locally. The reason is limited quotas when it comes to installed power and complicated procedures for obtaining permits and approvals.

There is no dramatic change in the H&C sector as the regulatory framework is shifted to municipalities whose local administrations lack the capacity to stimulate the implementation of renewable energy technologies through incentive schemes and support for collective action. The most common example of replacing old, inefficient appliances is the installation of new wood pellet boilers. The capacities of pellet manufacturers are higher than the requirements of the Serbian market and most of them are exported to EU countries. The wood chips market is not developed and except in a few examples in industry and the public sector (the cities of Sabac and Priboj) there are not many examples of boilers in exploitation (UNDP Serbia, 2018).

There is a shift in the field of energy efficiency. The Law on Housing and Building Maintenance has declared the public interest in the public interest and introduced the possibility for municipalities to create incentive schemes themselves using public funds. In addition to the obligation to classify buildings into energy classes, documenting the implementation of energy efficiency measures through the issuance of energy passports, a typology of residential buildings was implemented within which energy efficiency measures were proposed.

The National Typology of Residential Buildings of Serbia, created in 2013, is to support home and apartment owners to make an informed decision on the scope of work in the event of energy reconstruction. Unfortunately, renewables were not the focus of the authors. The proposed improvements related to DH grid connection with cogeneration networks without fuel indication, although given the ambience in Serbia, the author's intention was to promote the use of natural gas. An option was a heat pump for single-family dwellings, but without specifying the value of SCOP which, considering the energy mix in Serbia, is not a good enough solution, because from the aspect of environmental impact it only makes sense to implement a heat pump with SCOP > 4.6.

Professional associations (designers, installers, chimney sweepers) were not particularly interested in analyzes that would cover the owners of individual buildings and the structure and quality of devices used for HC. Local self-governments, on the other hand, are focused on district heating systems, but it cannot be said that development plans are based on examining citizens' habits and desires, but rely on the opinion of planners and experts without conducting surveys. These are the reasons why there was essentially no research involving a large number of citizens or even possible violations of the Law on Personal Data Protection.

Due to the nature of the business they do, local energy companies are in a situation every day to collect and process data from users of their services. For this reason, they are required to have a risk assessment act and to apply procedures that ensure data protection. The prospect of connecting citizens is the realization of CEC actions, the establishment of energy cooperative s and investments in small PV plants. Energy cooperatives are legal entities that are obliged to apply the provisions of the Law on Personal Data Protection, especially during campaigns to raise funds for the implementation of projects.

A good step forward in support of CEC actions would be to pass legislation that would exclusively concern energy cooperatives and define the status of prosumers. However, as long as the electricity price is too low, it is not realistic to expect the construction of a large number of small PV plants.

4.4.8 Collective actions (and other examples) existing in Slovenia

The three examples for colective actions from Slovenia include the collective purchase of electricity and natural gas in order to provide consumers with the best possible offer, a group purchase of pellet stoves, and a group purchase of air-conditioning devices.

Collective actions SI No. 1	
CA "Replace and save 1", "Replace and save 2", "Replace and save 3"	
Place	Slovenia
Description of action	The Consumers Association of Slovenia (CAS) organized three CA of purchase of electricity and natural gas in order to provide consumers with the best possible offer, without hidden costs and without bundling, with an upwardly limited price for one year. Replacing a supplier with a CAS was intended for all consumers and households in Slovenia. Basic info on CA (Y – year of CA, HCA - included households in CA, ESR – number of households that replaced energy supplier): "Replace and save 1": Y – 2014/2015, HCA – 40,849, ESR – 13,300 "Replace and save 2": Y – 2017, HCA – 25,900, ESR – 13,200 "Replace and save 3": Y – 2019, HCA – < 1000, ESR – < 500
Actors	Consumers Association of Slovenia
Targets of action	Ensuring the best possible price for electricity and natural gas

Impact on the energy system	The overall energy consumption remained the same, so the energy system was burdened equally as before.
Economic viability (availability of subsidies)	Basic info on CA (ASH - average saving in households, AS - aggregated savings): “Replace and save 1”: ASH – 164 EUR, AS – 1,0 mio EUR “Replace and save 2”: ASH – 211 EUR, AS – 1,2 mio EUR “Replace and save 3”: not possible to assess yet
Barriers	Long procedure.
Challenges	Auction bids, organization and managing the campaign and implementation in big number of households
Manageability	
Replicability	The project is considered to be highly replicable.
Ecological relevance (qualitative climate change mitigation potential)	
Links for further information	https://www.zps.si/index.php/zamenjaj-in-prihrani/1092-zamenjaj-in-prihrani-2014-2015/7388-vec-kot-14-tisoc-zamenjav-dobavitelja-skoraj-milijon-evrov-prihrankov https://www.zps.si/index.php/zamenjaj-in-prihrani/1093-zamenjaj-in-prihrani-2/8892-zamenjaj-in-prihrani-2-zelo-uspesno-zakljucen-ze-drugi-skupinski-nakup-energije

Collective actions SI No. 2	
CA Group purchase of pellet stoves	
Place	Slovenia
Description of action	Similarly as in “Replace and save” CA, CAS accessed the quality of pellet stoves and offered the best options to possible households. By collection of offers the household received best possible prices for their new pellet stoves.
Actors	Consumers Association of Slovenia
Targets of action	Ensuring the best possible price for pellet stoves
Impact on the energy system	Reduced consumption in households It’s not known if the households used the stove for replacement of the old one or for replacement with other energy carrier.
Economic viability (availability	Subsidies for pellet stoves are offered by Eco fund.

of subsidies)	
Barriers	Long procedure.
Challenges	Auction bids, organization and managing the campaign and implementation in big number of households
Manageability	
Replicability	The project is considered to be highly replicable.
Ecological relevance (qualitative climate change mitigation potential)	The project resulted in reduced CO2 footprint, since households bought more efficient heating system.
Links for further information	https://www.zps.si/index.php/clear-2-0/9789-skupinski-nakup-kaminskih-peci-na-pelete-9-2019

Collective actions SI No. 3	
CA Group purchase of air-conditioning devices	
Place	Slovenia
Description of action	More than 6,000 consumers have joined CA of air conditioning group buying campaign, and most of them have already received an offer via email in February 2020. This includes four high-quality air conditioners that have been rated well by an independent consumer organization benchmark and for which we have negotiated with a successful bidder at a reasonable price, including basic installation.
Actors	Consumers Association of Slovenia
Targets of action	Ensuring the best possible price for air conditioning devices
Impact on the energy system	Reduced electricity consumption in households in the case of replacement.
Economic viability (availability of subsidies)	Subsidies for air conditioning devices are not offered by Eco fund.
Barriers	Long procedure.
Challenges	Auction bids, organization and managing the campaign and implementation in big number of households
Manageability	
Replicability	The project is considered to be highly replicable.
Ecological relevance (qualitative climate change mitigation potential)	The project resulted in reduced CO_2 footprint, since households bought more efficient heating system.
Links for further information	https://www.zps.si/index.php/clear-2-0/9537-skupinski-nakup-klimatskih-naprav-3-2019

Legal national status of data management, exchange and ownership

Through heat mapping methods it's possible to identify areas where the inefficient heating systems are located. Due to GDPR issues it's forbidden to formally address them and inform them on the topic of HC replacements. The majority of most important and relevant database are available for research purposes.

Considering the access to facilities of heating systems' owners, two aspects are considered. First one is related to the substations in residential buildings and the second one to the chimney, boilers and furnaces in houses and buildings.

Regarding the heating systems in Ljubljana, the biggest city in Slovenia, as of July 2016, the Decree on Priority Use of Energy Products for Heating in the City of Ljubljana (Official Gazette of the Republic of Slovenia, No. 41/16), which sets out the priority use of energy for heating in the City of Ljubljana (MOL) in form of order of use energy products for heating, hot water production and heat production in end-user energy production processes. The Decree is made on the basis of guidelines from the Local Energy Concept, taking into account the environmental and energy criteria and the technical characteristics of buildings or production processes.

Maintenance of chimneys and furnaces is a legal obligation of all tenants. The co-owners of the building (tenants), as well as the house owners, have to allow the chimney sweeper to access each chimney and furnace used, inspect and clean the chimney and the furnace, as well as provide information on the number and type of chimney and furnace. In order to properly inspect and clean the chimney, it is necessary to allow access to the door, fittings, chimney cap and other parts.

The concessionaire i.e. authorised chimney sweeper must carry out regular and extraordinary inspections of the chimneys and to clean the chimneys. Regular chimney maintenance is carried out following the requirements of the building and at least once a year.

Providers of the heat energy activities, the heat energy buyer activity and chimney sweepers are obliged to follow relevant national and EU directives, including the General Data Protection Regulation (GDPR). End consumers are notified about which consumer data is collected, how it is processed, for what purposes it is used, and the customers' rights related to the disclosure of personal data.

Short national summary on existing/possible implementation fields, challenges and barriers and potential outlook

The biggest potential for addressing energy poverty, inefficient heating systems and thermal envelopes presents the development of heat mapping. Such interactive database should include data on energy consumption of public buildings (that has to be reported in the scope of energy bookkeeping), as well as data on DH connections. By the Energy Act, energy suppliers should already report such data to the Ministry of Infrastructure, but this is still not in place. Based on such data and the overall heat mapping process method, it could be possible to identify critical areas.

4.4.9 Collective actions (and other examples) existing in Spain

For Spain, examples about a Renewable Energy Cooperative that inaugurated a PV power plant entirely funded by cooperative members, the collective purchase of energy, and a Renewable Energy Cooperative that inaugurated a hydroelectric plant are given below.

Collective actions (CA) actions ES 01

Somenergia, Renewable Energy Cooperative inaugurates PV power plant entirely funded by cooperative members	
Place	Spain
Description of action	The inauguration of a PV plant achieving decentralized generation, distribution and sale of renewable sources of energy produced and managed by the members of the cooperative.
Actors	Natural people in a Cooperative
Targets of action	-Independence from large corporations. -Local growth and investment -Lower energy prices
Impact on the energy system	Lower prices, ownership, local investment.
Economic viability (availability of subsidies)	High inversion is reduced to small monetary participation of numerous individuals.
Barriers	-High initial investment for an only consumer, but solved by joining in a cooperative -Traditional, large companies' monopoly over energy production
Challenges	- Changes (negative) during a period of years in Spain for the renewable energies - Reaching individuals and awareness to be part of the cooperative.
Manageability	Managed directly by cooperative members, that select members of the board and have direct decision responsibilities when making investment and starting projects.
Replicability	High
Ecological relevance (qualitative climate change mitigation potential)	Promotion of green, renewable energies.
Links for further information	https://blog.somenergia.coop/comunicados-prensa/2019/12/ndp-som-energia-inaugura-la-florida-la-segunda-planta-solar-financiada-por-1-600-personas-socias/

Collective actions (CA) actions SP No.2	
Collective purchase of energy	
Place	Spain
Description of action	The idea is based on the fact that the energy suppliers, both gas and electricity, offer similar prices. The organizers of the collective purchase believe that the opportunity to win a large number of customers will stimulate competition among suppliers, which will

	offer lower prices at the cost of reducing their profit margins. The format chosen for the negotiation is an auction, in which the suppliers that makes the best offer will keep all the contracts.
Actors	Consumers The association
Targets of action	- Collective negotiation with energy suppliers by an aggregator, with experience in this negotiation field -Independence from large corporations. -Lower energy prices
Impact on the energy system	- Lower energy prices - Shifting consumer tendencies
Economic viability (availability of subsidies)	Lower energy price than the typical market price for consumers.
Barriers	- Need to reach a high volume of interested consumers in advance of the negotiation -Traditional, large companies' monopoly over energy distribution and commercialization
Challenges	- Still low experience in local communities with self-production and energy management -Reaching the critical mass of individuals to develop a project.
Manageability	Managed by consumer associations or others that can reach the level of stakeholders necessary to carry out this type of action.
Replicability	High
Ecological relevance (qualitative climate change mitigation potential)	All energy produced is renewable and local consumed, thus creation of local energy communities
Links for further information	https://www.ocu.org/especiales/quieropagarmenosluz/

Collective actions (CA) actions ES No.3	
Enercoop, Renewable Energy Cooperative inaugurates hydroelectric plant	
Place	Spain
Description of action	The energy produced by Enercoop is 100 % renewable, thus contributing to sustainable development and a lower presence in the atmosphere of greenhouse gases, covering the whole demand of the town of Crevillent, 28.000 inhabitants.
Actors	Consumers

	The cooperative
Targets of action	-Independence from large corporations. -Local growth and investment -Lower energy prices
Impact on the energy system	Lower prices, independency, local investment.
Economic viability (availability of subsidies)	-High inversion is reduced to small monetary participation of numerous individuals. -Promotion of renewable energies, European and national subsidies.
Barriers	- Need to reach a high volume of interested consumers in advance of the negotiation -Traditional, large companies' monopoly over energy distribution and commercialization
Challenges	- Still low experience in local communities with self-production and energy management -Reaching the critical mass of individuals to develop a project.
Manageability	Managed by consumer associations or others that can reach the level of stakeholders necessary to carry out this type of action.
Replicability	High
Ecological relevance (qualitative climate change mitigation potential)	Promotion of green, renewable energies. 4,000 tons of CO_2 reduction estimated.
Links for further information	https://www.enercoop.es/energias-renovables/

Legal national status of data management, exchange and ownership

Cooperatives and consumer associations must comply with European and National data management regulation, specifically UE Regulation 2016/679, Law Decree 34/2002 and comply with the Data Protection Organic Law from 2018.

The type of client information these companies work with is: identification data, addresses, commercial information, economic and transaction data, occupational and contact data.

Short national summary on existing/possible implementation fields, challenges and barriers and potential outlook

In Spain, more than 90 % of the ownership and production of fossil energies corresponds to large electric companies, leaving very small room for collective actions outside of these large companies, as of today energy cooperatives in Spain represent 0.3 % of all energy contracts.

Due to the growing importance of renewable energies in National and Regional Energy Action Plans , energy cooperatives are expected to benefit and represent a real alternative to the traditional energy contracting way. Apart from these indirect benefit, National and Reginal legislations are starting to consider and promote cooperatives or other collective actions.

5 | Outlook on future legal framework

Further, more information is provided for the RECs and CECs, which will play an important role in the near future, the implementation of measures to foster RECs shall be carried out until 30 June 2021, and the measures regarding CECs until 31 December 2020.

RECs - Renewable Energy Communities

The definition of RECs is laid down in the Article 2 (16) of RED II, the Renewable Energy Directive II (Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources). Renewable energy community means a legal entity which (…) is based on open and voluntary participation, is autonomous, and is effectively controlled by shareholders or members that are located in the proximity of the renewable energy projects that are owned and developed by that legal entity, of which the shareholders or members are natural persons, SMEs or local authorities, including municipalities. The primary purpose of RECs is to provide environmental, economic or social community benefits for its shareholders or members or for the local areas where it operates, rather than financial profits. Article 22 RED II regulates the rights for RECs and lays down that natural persons who are involved in a REC shall not be discriminated for being members of it. It says furthermore that Member States shall provide an enabling framework to foster RECs. The national REC framework implementation shall be part of the updates of the Member States' integrated national energy and climate plans and progress reports (pursuant to Regulation (EU) 2018/1999). It is open for Member States to decide whether RECs are open to cross-border participation. However, Members States shall design support schemes (without violating EU laws on subsidies, as laid down in articles 107 and 108 TFEU (Treaty on the Functioning of the European Union) that allow RECs to compete for support on an equal footing with other market participants.

According to Article 36 RED II, until 30 June 2021, Member States must implement laws, regulations and administrative provisions necessary to (among many more) foster the creation and operation of RECs.

More details about RECs are provided in the beginning of RED II, in the recitals 26 (funding), 67 (energy poverty), 70 (local involvement), 71 (form of entity) and 72 (rights for members of RECs).

CECs - Citizens' Energy Communities

In Article 2 (11) of Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU (recast), in this document named Electricity Market Directive Electricity Directive II (ED II), it is laid down that a citizen energy community’ (CEC) means a legal entity which is based on voluntary and open participation and is effectively controlled by members or shareholders that are natural persons, local authorities, including municipalities, or small enterprises. A CEC has for its primary purpose to provide environmental, economic or social community benefits to its members or shareholders or to the local areas where it operates rather than to generate financial profits and may engage in generation, including from renewable sources, distribution, supply, consumption, aggregation, energy storage, energy efficiency services or charging services for electric vehicles or provide other energy services to its members or shareholders. In Article 16 ED II is laid down, what regulatory framework for CECs Member States shall (open and voluntary participation, no loss of rights and obligations as household customers or active customers, fair compensation to facilitate electricity transfers within CECs, and non-discriminatory, fair, proportionate and transparent procedures and charges) and what they may (open to cross-border participation, entitlement to own, establish, purchase or lease and autonomously manage distribution networks) provide. Member States shall ensure that CECs are able to access all electricity markets, their activities, rights and obligations I the activities are treated in a non-discriminatory and proportionate manner. CECs shall be balance responsible parties or shall delegate their balancing responsibility in accordance with the law. Member States may allow (subject to all regulations) under CECs the right to manage distribution networks in their area of operation and establish the relevant procedures.

According to Article 71 ED II, until 31 December 2020, Member States must implement laws, regulations and administrative provisions necessary to (among many more) foster the creation and operation of CECs.

More details about CECs are provided in the beginning of ED II, in the recitals 43 (community energy), 44 (membership of CECs), 45 (rights and obligations), 46 (framework conditions for CECs) and 47 (allowance to become a distribution system operators).

REC and CEC seem very similar, yet have at least some differences as can be seen in the table below:

REC	**CEC**
Objectives:	Objectives:
Local acceptance, local investment, **ownership**	Local participation, **market access, non-discrimination**
Participation:	Participation
Natural persons, local authorities, SMEs, **vicinity to the project**	Natural persons, regional authorities, SMEs
Activities:	Activities:
Generation, consumption, storage, sale of renewable energies	Generation, **distribution**, **supply**, consumption, aggregation, storage of renewable energies, **energy efficiency service, recharge service or other energy services**

6 | References

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Figures

Tables