



Policy framework conditions assessment and outlook for sustainable heating and cooling in selected European regions

Report D2.1

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Executive Summary

With heating and cooling (HC) comprising 50% of the final European energy consumption and over 68% of all gas imports, 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 of C or D gives rise to major concern.

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 supports them in the making of informed decisions.

Purpose: The activities performed in task T2.1 deals with an overview of policy strategies, measures and instruments related to HC equipment. By identifying the main drivers and barriers, the work in further tasks will be more focused and oriented, respective to each analysed region. On top of that, success stories of HC replacement projects/instruments in each region are presented, which can be potentially replicated in other regions.

Methodology: The methodology employed for the compilation of information for this report is mainly based on desk research techniques via literature review, partner knowledge and targeted interviews/discussion with experts. Limitations include the new and rapidly evolving conditions and the ever-changing markets for sustainable heating and cooling, and especially relevant to boiler replacements, and the disaggregated and heterogeneous contexts and markets from the technical to legislative point of views.

Key Findings and Conclusion: While REPLACE aims to boost the phase-out of inefficient and old heating and cooling systems by targeting consumers, investors/owners as-well as intermediaries and replace them with renewable heating and cooling (RHC) equipment, only Austria, Slovenia and Spain have incorporated a phase-out plan for coal and fuel oil used for heating in legislation. Furthermore, Land Salzburg in Austria has prepared a plan to phase-out natural gas until 2040, while Slovenia intends, through its National Energy and Climate Plan, to prohibit the purchase of new gas condensing boilers. Financial incentives play an instrumental part for HC replacements in all target regions. Some have implemented higher incentives when replacing fuel oil, while others offer incentives on both national and regional level, which results in a higher co-financing rate and thus higher motivation for investors. Assessment of market barriers for RHC replacement activities has highlighted diverse findings: from heat pump installation in not sufficiently efficient buildings to high investment prices as one of the major barriers. Furthermore, there's a lack of qualified installers, designers and energy auditors, which forces the residents to often carry out the installation works themselves. The main barriers for HC replacement in south-eastern regions of Europe are related to (1) lack of subsidies for, (2) lack of boiler inspection, and (3) insufficient establishment and applicability of the energy audit system.

Lessons Learned: In addition to the specific findings regarding the potential RHC replacements in target regions and assessment of drivers and barriers from various aspects, five key challenges for the implementation of RHC replacement were identified:

1. Better awareness of end-consumers for more informed decisions.
2. Ensure continuous incentives programmes.
3. Regulatory provisions that give a clear planning horizon and milestones for a complete phase out of fossil fuelled and inefficient heating systems are crucial.
4. Establishment of an energy advisory network.
5. Education of installers and chimney sweepers.

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1 | Introduction

1.1 Scope and objectives of the project REPLACE

With heating and cooling (HC) comprising 50 % of final European energy consumption and over 68 % of all gas imports, 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. 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. With mature technology widely available REPLACE is developed with three major directions in mind to facilitate mass-deployment of efficient and clean HC systems:

- 1) REPLACE focuses on representative target regions with dedicated campaigns steered through local working groups. The geographical scope of REPLACE also implies that we can address a pressing issue in South and South-East Europe: individual, very energy inefficient, a large share of individual biomass and coal stoves, polluting, and requiring high efforts to operate.
- 2) Capacity-building and knowledge transfer are at the heart of REPLACE. On the one hand, this relates capacity building for intermediaries to ensure installers, plumbers, chimney sweepers and building developers do not continue to use technologies they are “used to”. In addition, the involvement of candidate and potential candidate countries implies that REPLACE not only addresses a pressing EU issue but goes further to facilitate know-how transfer beyond the EU and support Bosnia and Herzegovina, Serbia and North Macedonia on their path towards EU integration.
- 3) REPLACE is centred on the creation of incentives that induce stakeholders to make “good” choices. The two main reasons why previous effort have failed are: (a) dispersed ownership of the EU building stock, which creates specific barriers, such as conflicting interest between tenants and owners; (b) HC system breakdowns usually lead to “like-for-like” replacements because there is little time to make an informed decision. REPLACE therefore aims to resolve “split incentives” by developing target group specific campaigns and fostering the use of co-operative measure and addresses lock-in effects by fostering the implementation of innovative solutions (such as temporary mobile heating containers).

1.2 Scope and objectives of this report

This report presents a complete survey on ten regional and nine national strategies and related plans, policy objectives, implemented/planned measures and instruments (focused on the target regions) related to sustainable HC equipment.

The key is to get information describing the target region regarding the overall framework conditions on sustainable heating and cooling system replacements (e.g. legal and regulatory issues as well as existing measures and instruments), opportunities to enhance the impact of replacement activities (e.g. discussions ongoing in the region regarding fostering framework conditions), as well the financial aspects (e.g. support schemes). Based on desktop survey (e.g. energy strategies, subsidy schemes) and interviews with key stakeholders the report offers:

- identification and elaboration of overall strategies and policies (e.g. qualitative and quantitative climate and energy targets, if any etc.) on the national and regional level of relevance for this survey;
- description of legal and regulatory framework conditions (e.g. regarding hardware and its operation, e.g. emission regulations, challenges for contracting entities etc.), and the policy measures (what is the target on policy level) and instruments (by what means something is targeted) which actually promote HC replacement and elaboration of status quo of target region;
- qualitative assessment of the non/financial measures and their implementation instruments;
- qualitative assessment of the impact of the financial instruments
- assessment of drivers and barriers from the end consumer side (e.g. availability of information, ability to invest, availability of debt financing etc.; except split-incentives which are tackled in T2.2), from policy side (e.g. practical, legal, regulatory regarding hardware and its operation) and from market side (e.g. lack of availability of efficient and reliable and affordable equipment, qualified installers etc.) existing on the boiler replacement market
- description of policy measures which are currently not yet in force but are under discussion (policy outlook) and could foster replacement activities by what means and what the effect might be.
- success stories.

1.3 Abbreviations

DH	District Heating
DR	Demand-Response
EED	Energy Efficiency Directive
EPBD	Energy Performance of Buildings Directive
EPC	Energy Performance Contracting
ESCO	Energy Service Company
ETS	Emission Trading System
HC	Heating and Cooling
PM	Particular Matter
RES	Renewable Energy Sources
RHC	Renewable Heating and Cooling

2 | Policy set description

2.1 Salzburg region, Austria

2.1.1 Overview of policy instruments for sustainable heating and cooling system replacements

Fossil fuels may no longer be burned in a few years for climate policy reasons. The later the greenhouse gases are reduced, the faster they have to decrease (see following graph).



Figure 1: Global CO₂ emission scenarios for compliance with the 1,5° -6 or 2°C climate limit

Source: Austrian Climate and Energy Fund, Fact check on energy system transformation 2017/2018, Vienna, 2017.

Although the sense and necessity of the oil phase-out is generally known, corresponding ambitions meet with resistance in many places (e.g. the ban on oil-fired boilers in new buildings in Lower Austria adopted in early 2019 and in Vienna) or recently have been deliberately thwarted (e.g. "heating with oil" promotion).

"Heating with oil" promotion funded by mineral oil industry

Between 2009 and 2015, a total of more than 43,000 oil-fired boilers were promoted by the Heating with oil promotion campaign¹("IWO," 2016), and by the beginning of 2018 there were just under 50,000 oil-fired boilers promoted ("IWO," 2018).

In order to counteract these climate-damaging influences, clear political decisions were needed and are expected to be implemented on governmental and at the provincial level soon.

Government programme 2020-2024

The **Government programme 2020-2024** of the current Austrian Government (a coalition of Austrian green and conservative parties) accordingly states that the combustion of heating oil, coal and fossil gas for heating and cooling must be avoided as far as possible in order to ensure that Austria's climate protection targets for 2040 are met. According to the new Gov. Austria, this includes all sectors nation-

¹ www.heizenmitoel.at

wide, wants to become climate neutral by 2040. Accordingly, the following (partly) ambitious targets were set for Austrians' heating sector.

- **Phase-out for oil and coal in space heating:** A federal law regulates the phase-out of oil and coal in the building sector in a graduated plan. In order to avoid social hardship, all measures are implemented through a long-term, degressive and socially staggered funding
 - for new buildings (from 2020)
 - when changing the heating system (from 2021)
 - Mandatory replacement of older boilers than 25 years (from 2025)
 - Exchange of all boilers at the latest in year 2035
- Analogous to the step-by-step plan for oil and coal in space heating, **a legal basis for replacing gas heating systems is being created:**
 - In new buildings, gas boilers/new connections will no longer be permitted after 2025.
 - No further expansion of gas networks for space heating, except for desifcation within existing networks
- Creation of a **heating strategy:** In close cooperation with the federal states, the federal government is developing an Austrian heating strategy with the aim of completely decarbonising the heating market.
 - Paths and possibilities of a complete heat supply based on renewable energy sources (biomass technologies, district heating, direct solar usages, geothermal energy and ambient heat), including measures and roadmaps
 - Binding basis for the achievement of strategic goals
 - Promotion of local and district heating
 - Improvement spatial planning framework conditions: Definition of supply zones with the possibility of connection obligations in spatial planning instruments, legal regulation on the establishment of pipeline rights for district heating, regulations for the collection and simple integration of waste heat sources etc. accompanied by appropriate support programmes
 - Support for large-scale renewable plants and geothermal energy in district heating networks for increasing the average renewable share in district heating by at least 1.5 percent per year
- Securing the supply:
 - Anchoring the use of heat in deep layers of the earth (deep geothermal energy) in the Mineral Raw Materials Act (at. *Mineralrohstoffgesetz*) with the possibility of transferring the rights of use to third parties
 - Anchoring an obligation for producers and importers to stockpile pellets in the Raw Materials Stockholding Act

Also worth mentioning is the goal of equipping 1 million roofs with photovoltaic plants.

The Climate and Energy Strategy 2050 of Land Salzburg

The Government of Land (province) Salzburg has its own climate and energy targets which, were adopted in its Climate and Energy Strategy 2050 in 2012 already (see table below), with looking at the heating sector comparable ambitions as the actual Federal Government. Salzburg State also wants to fully decarbonize its heating sector by 2040. Space heating shall be provided by renewable heat or district heat completely by then.



Diese Zielsetzungen verstehen sich bilanziell pro Jahr. Das Bezugsjahr für die Treibhausgasreduktion ist 2005 und entspricht dem Bezugsjahr der EU-2020-Vorgaben. Erneuerbare Energieträger sind wie in der Energieträgerklassifikation der Energiebilanzen (Statistik Austria) nach den EU-Vorgaben definiert. Die Treibhausgase entsprechen jenen der Zweiten Verpflichtungsperiode des Kyoto-Protokolls.

Figure 2: The Climate and Energy Strategy 2050 of Land Salzburg.

Source: Land Salzburg (available in German only).

Masterplan Climate + Energy 2030 of Land Salzburg

Currently the “Masterplan Climate + Energy 2030” is being elaborated in Land Salzburg. It shall be adopted by its Government in 2020. The ongoing discussions include the following preliminary targets for the Lands’ heating sector:

- 25% less final energy demand compared to 2005
- Complete phase-out of fossil oil
- Complete phase-out of fossil gas by 2040
- Substitution / deconstruction of natural gas infrastructure where a district heating grid expansion, or densification is possible

2.1.2 Financial and legislative promotion

According to the Integrated National Energy and Climate plan for Austria, Period 2021-2030 under Regulation (EU) 2018/1999 of the European Parliament and of the Council on the Energy Union and Climate Change Governance System (published on 18.12.2019), greenhouse gas emissions in the building sector (residential buildings as well as private and public service buildings) in Austria have fallen by about one third (-34%) since 2005. This is due to various effective measures, in particular the conversion of oil and gas-fired heating systems to renewable energy forms and district heating systems, the thermal refurbishment of existing buildings from particularly problematic building age groups (1950ier to 1980ier years), successively increasing building law requirements for new buildings and increasingly also for refurbishments.

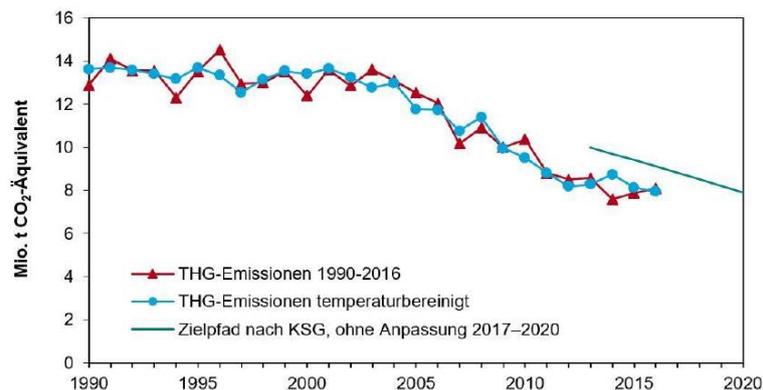


Figure 3: Greenhouse gas emissions from the building sector, 1990 – 2019 and target according to federal climate protection law (at. *Klimaschutzgesetz*).

Source: Progress Report 2018, According to § 6 climate protection law. BMNT.

Major impulses have been provided in recent 10 years by federal and state funding instruments. In an agreement under Article 15a of the Federal Constitutional Law between the Federal Government and the Länder (provinces), high energy standards for housing subsidies (mainly for social purposes) have been laid down that go beyond the standards required by building law. The energy-relevant measures in the »Residential Subsidy Schemes« of the Länder (refurbishment and new construction) saved between 2009 and 2018 cumulatively around 2,65 million tonnes of CO₂ per year (data basis: reports by the Länder within the framework of the agreement). In addition to the housing construction subsidies provided by the Länder, the Federal Government (together with the Länder) offers subsidies not only for private households or owners of residential buildings for building refurbishment (refurbishment cheque) as part of the refurbishment offensive (handled by the federal »Environmental Subsidy Scheme UFI«²), but also for companies for their commercially used buildings.

- The federal UFI is furthermore the main instrument to support larger district heating and smaller local e.g. biomass heating grids, besides support for fuel-switches for low carbon options for in-house energy supply for companies. Between 2014 to 2018 around 560 GWh/a or 29% of the renewable energy produced by approved projects was in the biomass district heating sector. On average, each of the supported local heating plants produced 1,5 GWh/a of thermal energy and supplied a local heating network. Further significant amounts of energy were realised through projects in the heat distribution sector. The heat distribution funding priority also includes 40 projects for feeding waste heat into existing or new local and district

² Umweltförderung im Inland

heating networks or setting up waste heat distribution networks, which account for a large proportion of the renewable energy use in this priority area (around 350 GWh).

- The Residential Subsidy Schemes of the Länder donate about 2 to 3 billion Euros per year for building new and renovating existing residential houses and related energy efficiency measures and (a switch for) renewable energy use. The majority of renovations, especially in the residential sector, are financially supported by those schemes. The conditions under which these subsidies are granted focus on the improvement of building quality in terms of higher comfort and better energy performance, renewable energy measures are gaining importance to achieve the minimum criteria for subsidies (see below). It is intended to have buildings with both lower space heating demand and lower greenhouse gas emissions. Most subsidies are distributed in the form of non-refundable payments (one-time non-repayable investment expense), requiring the issue of appropriate planning and completion energy certificates.

Additional financial instruments and incentives for existing buildings

“Renovation Cheque (at. Sanierungsscheck)”

Federal subsidies (National schemes in addition to UFI, funded by the Austrian Climate and Energy Fund) on building renovations have been provided since 2009 for privately owned single-family households. The annually reoccurring renovation campaigns implemented from 2016 onwards, called “Renovation Cheque (Sanierungsscheck)” grant financial support for the thermal insulation of roofs, external walls, floors, replacement of windows and exterior doors and for changing the heating system into a renewable heating system. The available grant of federal subsidies lay between 3,000 and 5,000 € depending on the level of renovation (either according to OIB Directive 6 or with higher quality according to klimaaktiv³ criteria). Beginning with 2016 it was possible to obtain increased funding within the scope of a “best-practice renovation” (at. *Mustersanierungen*), particularly for sustainable thermal renovation measures. In this case, the space heating demand had to be very low⁴ and 80% of the energy demand had to be provided by renewable energy carriers. For this kind of renovation, up to 8,000 € of funding could be granted per building. In apartment buildings the grant amounts to a maximum of 30% of investments for thermal renovation.

“Get out of the oil” (at. Raus aus dem Öl) bonus

The “Get out of oil” bonus is focused on single/two-family houses and terraced houses, as well as multi-family houses and is aimed at (co-)owners, persons entitled to build or tenants of a single/two-family house or terraced house. The bonus promotes the replacement of a fossil heating system with a climate-friendly technology in private housing. The bonus amounts to up to 5,000 euros. In case of a multi-family house, apartment owners and tenants of apartments in the case of renovation of the entire multi-storey residential building can get up to 1,000 euros per residential unit. In both cases a maximum of 30% of the eligible costs can be subsidised on top of the Renovation Cheque (Sanierungsscheck) subsidy scheme. For the “Get out of oil” bonus eligible measures are the conversion of a fossil heating system (oil, gas, coal, electricity and all-purpose burners) to wood-fired central heating, heat pumps and highly efficient local/district heating; the dismantling and disposal costs of decommissioned boilers and tanks are also eligible.

3 klimaaktiv is the Austrian climate protection initiative and part of the Austrian climate strategy and is on voluntary basis.

4 Reduced to 40 kWh/m².year or even lower

The following table shows the combination of both subsidy schemes for single/two-family houses and terraced houses

Table 1: Financial subsidies applicable in 2020 for single/two-family houses and terraced houses, in euros

Type of renovation	"Get out of oil" bonus	Renovation Cheque	Total Subsidy
Exchange of the fossil heating system	5,000		5,000
Partial refurbishment 40 %	6,000	4,000	10,000
Comprehensive renovation good standard max. 63 kWh/m ² .a	6,000	5,000	11,000
Comprehensive renovation klimaaktiv standard max. 50 kWh/m ² .a	6,000	6,000	12,000
3.000 Euro surcharge for the use of insulation materials made of renewable materials			

The support is limited to a maximum of 30 % of the eligible investment costs.

With additional Länder subsidies, a fuel-switch from fuel oil for renewable energy in 2019 became even more interesting. For example, the funding applicant in Carinthia will receive up to 11,000 euros if she/he switches to pellets (get out of oil bonus plus Länder subsidy). In Salzburg in 2020 applicants can get up to 9,000 euros for a fuel switch for log-wood, 10,000 euros for pellets, 11,500 euros for wood-chip boilers or 10,000 euros for heat pumps or 10,500 euros for connection to biomass micro-grid/district or waste heat usage. In any event, the financial aid is limited to 100 % of the eligible costs.

The "Get out of oil" funding campaign has been offered in recent years: in 2018, 7,678 applications were approved as part of the renovation offensive, resulting in CO₂ savings of 61,000 tonnes per year. In 2019, 6,555 people had taken advantage of the "Get out of oil" bonus and replaced boilers. Due to the increased demand, the Parliamentary National Council decided in July 2019 to stock up budget for this action. 42.6 million euros were originally budgeted for 2019, with an additional 20 million euros available for the extension. With the "Getting out of the oil bonus" (including the redevelopment cheque), for 2019 around 13,000 projects should be supported. Approximately 96,000 tons of CO would be saved and an annual final energy saving of approximately 113 GWh is expected.

Both the Renovation Cheque and (especially) the "Get out of oil" bonus are well accepted by end consumers, but due to high success are offered on a stop-and-go basis. Furthermore end consumers cannot plan their refurbishment activities as it is not known for the next years when and with what height of budget the next roll-out of the schemes would start.

In Austria municipalities are responsible for air quality. They are responsible, that residential buildings install and operate heating systems that fulfil emission standards. Chimney sweepers are measuring and reporting to municipalities. In some Länder municipalities give grants in the height of some hundred euros, e.g. for insulation of the uppermost ceiling or for efficient, renewable heating systems, for improvement of air quality.

Regulatory stipulations in Salzburg – at new buildings and after comprehensive refurbishments the utilization of fossil fuels since 2016 becomes increasingly difficult

In accordance with Article 4 of the Energy Efficiency Directive (EED) 2012, Austria adopted a long-term strategy to mobilise investment in the renovation of the national building stock for both public and private residential and commercial buildings ("Austrian Building Renovation Strategy," 2017). This strategy identifies the "Residential Subsidy Schemes of the Länder" – alongside the building regulations of the provinces – as the main instrument for implementing energy efficiency measures in the residential building sector.

In recent years, the building law has been amended in particular in response to the EU legal requirements of the Energy Performance of Buildings Directive (EPBD). The Länder (which are responsible for building regulations) have recently agreed on a new roadmap for the implementation of nearly zero-energy buildings (NZEBS) in new construction from 2021 onwards – taking into account cost-optimality. This is intended to ensure that greenhouse gas emissions can be kept low despite the significant increase in construction volumes as a result of population growth, increasing specific residential space and the growing need for comfort. In addition, there are minimum standards for the renovation of buildings ("major renovation"). Major renovation can also be carried out in partial steps as part of multi-year renovation concepts. Since a decline in renovation activities is currently being recorded, this requires massive further efforts and a coordinated mix of measures. Cost-optimal levels should apply to renovation (including partial renovation) in any case.

In Austria, the implementation of building regulations is under the jurisdiction of the Länder. The Austrian Institute of Construction Engineering (OIB) was assigned to manage the harmonising process of the implementation of the EPBD in the Länder in 2006. The Austrian national plan for increasing the number of residential and non-residential nearly zero-energy buildings (NZEBS) by 2020 was finalised and published in 2014. The national building regulation directive ("OIB Directive 6," 2019) as regards energy efficiency is being tightened in two-year steps to achieve the requirements by 2020. Recast of OIB-Directive 6 were published in spring 2015 and 2019. This directive 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.

The main indicators for the energy performance calculation of buildings (space heating demand, useful energy demand, final energy demand, primary energy demand and CO₂ emissions), maximum U-value of the building elements, geometry of the building, energy carriers, heating/cooling systems and domestic hot water systems as well as household appliances are defined in the OIB Directive 6 or respectively in Austrian Standards (the OIB Directive 6 refers according to user profiles for lighting, ventilation, humidification to valid Austrian Standards). The determination of the required maximum space heating demand is based on the cost-optimal verification report ("OIB-RL6," 2013). Furthermore the OIB Directive 6 includes requirements for heating, cooling and final energy demand for existing buildings undergoing major renovations.

The contents of the OIB Directive 6 are implemented in each respective province's building regulations.

The NZEB is defined as an energy-efficient building with a thermally well-insulated envelope and an efficient heating system. Compliance with the requirements of the OIB Directive 6 can be achieved by two methods:

- Through the provision of the maximum permissible final energy demand of the building. In this case the focus relies on the insurance of a tight building envelope in order to reduce the space heating demand (HWB, at. *Heizwärmebedarf*) (not considering the total energy efficiency factor f_{GEE}).
- Through the installation of a very efficient or renewable heating system. In this case the f_{GEE} has to be taken into account, which reflects the type of energy use and production. In this method, a slightly higher space heating demand of the building is acceptable.

In both cases, the maximum values for primary energy demand and CO₂ emissions are defined.

The OIB Directive 6 requires that energy supply systems of buildings **must consider and demonstrate the technological, ecological and economic feasibility of high-efficient systems**.

In this context, new apartment buildings with more than three building units must have central heating systems (specific exceptions are allowed) and ventilation systems must be equipped with a heat recovery system. The Directive does not explicitly exclude any heating system. However, the Directive

stipulates that part of the building's energy needs should be met from renewable sources. There are several possibilities to meet this requirement:

- At least half of the required heat demand is covered by biomass, a heat pump, waste heat or district heating based on renewable energy sources or from a CHP;
- On-site yields from solar thermal, photovoltaic or heat recovery are used (in each case to the extent of at least 10% of the final energy demand for hot water/electricity/space heating without the measure).
- It is also permissible to take any measures to increase efficiency if they are at least 5 % below the permissible final energy demand or f_{GEE} of the building.

In addition to the requirements for the renewable share, OIB Guideline 6 states that in the case of new buildings and major renovations, it must be checked whether a highly efficient alternative system can be used instead of a conventional (fossil) heating system. This **alternative assessment** is based on technical, economic and ecological aspects and must be documented. In any case, as highly efficient alternative energy systems are considered:

- decentralised energy supply systems based on energy from renewable sources
- Combined heat and power plants (CHP)
- District/local heating grids or district/local cooling networks, in particular if it is at least partly based on energy from renewable sources or from high-efficiency cogeneration
- Heat pumps

The alternative assessment is fulfilled, if a system is chosen which covers at least 50% of the space heating and hot water demand by biomass, a heat pump or district heating based on renewable energy sources or from high-efficiency cogeneration.

The following two tables give an overview of how the OIB Directive 6 (2015) was implemented in the Länder, also related to the alternative assessment (Status mid-2019). In addition the country-specific requirements for phasing out fossil heating systems are stated.

Implementation of OIB Directive 6 (2015)		Country-specific requirements for phasing out fossil heating systems
Salzburg	Major amendments (country specific requirements on energy performance indicators and technical building system)	The use of country-specific energy indicators makes the installation of fossil heating systems considerably more difficult. The condition for funding is the use of a highly efficient alternative energy system. Biomass boilers and heat pumps must be combined with solar or PV systems wherever possible.

Figure 4: Implementation of IOB Directive 6 (2015)

Going into more detail, in Salzburg the OIB Directive 6 (2015) currently is implemented as follows, by means of the **Salzburg Building Technology Ordinance (Bautechnikverordnung 2016)**

The exemptions for certain buildings and parts of buildings mentioned in point 1.2 of the OIB guideline 6 do not apply in Salzburg. Also, the non-residential building category "other energy-using buildings" is added to the building categories, making the requirements of OIB guideline 6 applicable to all non-residential buildings. Consequently, all residential and non-residential buildings must comply with the requirements of OIB Directive 6.

In contrast to OIB Guideline 6 (recast 2015), in Salzburg, proof of compliance with the requirements for energy saving and thermal insulation must be provided by meeting the LEK_T value and the primary energy indicator (P_i value). The following maximum permissible values are set for 01.01.2021:

Table 2: Specifications for energy saving and thermal insulation, according to Annex 1 Part B (4) Sbg. Bautechnikverordnung.

	New Buildings	Major Renovations

	LEK _T -Value	
Residential and non-residential buildings	22	26
	P _i -Value	
Residential Buildings	40	68

LEK_T... Transmission heat losses according to the lines of European criteria, $LEK_T = 300 \times U_{Medium} / (2 + l_c)$

P_i... primary energy indicator, $P_i = (\text{primary energy demand} + 10 \times \text{CO}_2 \text{ emission}) / \text{building constant} + 4 \times l_c$

Even higher LEK_T and P_i values are permitted until 31.12.2020 depending on the date of the application for a building permit or the start of the renovation.

Table 3: Permissible increase of the requirement values according to Appendix 1 Part B (4) Sbg. Bautechnikverordnung

Date of application for building permit or start of renovation	Increase of the LEK _T value by	Increase of the P _i value by
Until 31.12.2020	-	+4*

* The increase does not apply to buildings used by public authorities and offices.

In addition, for technical, functional and economic reasons, the LEK_T and P_i values may be exceeded in the case of major renovations, as long as an improved overall energy efficiency is achieved after the completion of the renovation. Furthermore, the requirements for the LEK_T value and the primary energy indicator do not generally apply to extensions and superstructures up to 50 m² of conditioned gross floor area.

In contrast to OIB Guideline 6, the requirements for heat-transferring components (U-values) (see point 4.4, OIB Guideline 6) also apply to major renovations and individual measures. However, again for technical, functional and economic reasons, these requirements may be exceeded if an improved energy performance is achieved after the renovation is completed.

Furthermore, in contrast to OIB Directive 6, the following requirements apply to technical building systems:

- For new buildings and major renovations, the use of highly efficient alternative energy systems does not have to be considered and documented (cf. point 5.2, OIB Directive 6).
- New buildings with more than five residential units must be equipped with supply and exhaust air systems with heat recovery or demand-based exhaust air systems.
- For new buildings with district heating connections, the temperature difference between the district heating return and the return of the secondary system must not exceed 2 K at the design point.
- In new buildings, the flow temperature of heat distribution networks may not exceed 55°C. The temperature may be higher if a supply of safe drinking water is required.
- The return temperature in heat distribution networks in new buildings may not exceed 40°C.
- In the case of central heat supply systems for more than five units of use, a common two-pipe heat distribution network must be provided for heating and decentralised hot water preparation. However, this does not apply if the central heat supply is provided by an electrically operated heat pump.

The following example of a single family house, with 181 m² gross floor area, heated by a fuel oil boiler with condensing technology shows, what consequences the current stipulations of the Bautechnikverordnung Salzburg do have. In future this house will need an increasingly large PV plant (see first and last column) to compensate for emissions, coming from the fuel oil boiler with condensing technology to fulfil the required P_i and LEK_T values.

Table 4: Example of a single family house for current stipulations in Salzburg region

Year	Requirement		Assumed features of the equipment installed					PV power needed for 181 m ² gross floor area
	P_i	LEK_T	Space heating fuel	Domestic hot water production	PV	Solar thermal	Ventilation with heat recovery	
Until 2017	≤ 52	≤ 18	Fuel oil	Exhaust air heat pump	17 W/m ² gross floor area	-	Yes	3077 W
From 1.1.2021	≤ 40	≤ 18	Fuel oil	Exhaust air heat pump	17 W/m ² gross floor area	-	yes	5068 W

Source: Franz Mair, 2016. Land Salzburg.

In general fossil fuel usage in new or comprehensively refurbished houses will need additional active renewable energy systems (e.g. solar technologies) to overcompensate the emissions from that fossil fuels. This is also the case for natural gas utilization in a new or comprehensively refurbished residential building.

Funding criteria for promoting the phase-out of fossil heating systems

To qualify for housing subsidies, highly efficient alternative energy systems must be used. Such systems include biomass boilers, heat pumps and district or local heating from (at least 80%) biogenic fuels or CHP. If possible, biomass boilers and heat pumps must be combined with a solar or photovoltaic system (“LGBI,” 2018)

A further prerequisite for funding is that the building must have an LEK_T value of no more than 20 and a P_i value of no more than 40 (or 96 for nursing homes) (“LGBI,” 2018).

Regulation of system performance, distinct from whole building performance

In addition to the aforementioned requirements, the OIB Directive 6 also includes specific mandatory requirements for individual elements used in connection with the renovation of existing buildings, such as minimum requirements for the insulation of the heat distribution system.

Furthermore, Directive 2009/125/EG (the Eco design Directive) includes specific requirements for HVAC systems to guarantee the implementation of energy-efficient technologies. This directive enables the European Commission to set mandatory minimum requirements for individual product groups. In Austria, the implementation of Directive 2009/125/EG was provided by the update of the national **Eco design decree (“Ökodesign-Verordnung” 2007)**. The following relevant mandatory requirements for HVAC systems came into force by decree between 2015 and 2016:

- The decree for space heaters and combination heaters came into force on 26 September 2015, including specific requirements for seasonal space heating energy efficiency, sound power level, emissions of nitrogen oxides and product information (Regulation 107/2009).
- The decree for water heaters and hot water storage tanks came into force on 26 September 2015, including specific requirements for water heating energy efficiency, sound power level, emissions of nitrogen oxides and product information. Furthermore, the decree includes requirements for standing losses and product information for hot water storage tanks (Regulation 814/2013).
- The decree for ventilation units came into force on 1 January 2016, including specific requirements for energy efficiency, sound power level and product information (Regulation 1253/2014).

Inspection requirements – heating systems, air conditioning

Articles 14 and 15 of the EPBD (Directive 2010/31/EU) have been implemented according to an agreement (“VG,” 2015) between Austrian provinces regarding regular on-site inspections and monitoring of the emissions of HVAC systems.

The Austrian provinces have a long tradition of inspections of heating systems regarding emissions and the performance of boilers. The periods of inspections vary based on the kind of energy used, from one inspection per year (e.g., for biomass boilers) up to four inspections per year (e.g., for gas-fired boilers). Regular inspections fulfilling the specifications of the EPBD were introduced after 2012 by different regulations in the Austrian provinces (the legislative regulations are continually being adapted).

The qualification of inspectors is set in the Austrian trade regulation act (at. *Gewerbeordnung*) on a national level.

For the enforcement of inspection laws, penalties are imposed under the relevant laws of some of the Austrian provinces (e.g., in Carinthia, up to 4,000 € or Styria, up to 20,000 €), but there are no statistical data indicating frequency and level of penalties, which have yet to be imposed.

The Austrian provinces conduct quality controls of inspections reports regularly. Some of the Austrian provinces had combined the first full inspections of heating systems with an information and formation action for inspectors (like Carinthia: 2,500 inspections; Styria: 1,000 inspections), thus controlling the quality of inspections and of the inspectors as well. These actions had been supervised by the administrations of the provinces. Results show that many installations had hydraulic problems or had inefficient pumps and/or oversized boilers.

Progress and current status on air conditioning (AC) systems

Up until the late 1990s, AC systems were rarely used in Austria except in new non-residential buildings. As a result of the EPBD, performance-related requirements were implemented for new and existing systems.

Vienna started implementing some articles on AC systems in a law concerning the performance and inspection of heating systems (> 20 kW), including dimensioning of boilers and cooling systems (> 12 kW). The other Austrian provinces followed by implementing inspections through different regulations, either by modifying existing clean air acts or laws for heating systems (Burgenland, Tyrol, Vienna) or building codes (Carinthia, Lower Austria, Salzburg, Styria, Vorarlberg), or by ratifying a new act (Upper Austria).

Inspection intervals range from one to three years for a simplified procedure (visual inspection) and from five to 12 years for an additional comprehensive inspection (including a complex performance

check: Upper Austria, Styria, and Vienna). Lower Austria, Salzburg and Tyrol provide one inspection every five years.

Emission regulations

The legal basis for the approval of a facility in heat and power generation is provided in the Combustion plants Regulation (Feuerungsanlagen-Verordnung FAV) and the Combustion plants emission law (Emissionsschutzgesetz für Kesselanlagen EG-K). These legislative documents include regulations concerning the construction of facilities as well as emission limit values.

The **emission limit values** for small and larger biomass combustion facilities are presented in the following table. Further information on that topic is available at the governmental information webpage RIS – www.ris.bka.gv.at.

Table 5: Emission limit values for biomass combustion facilities firing straw and other herbaceous materials (e.g. fiber plants, grain, grasses, miscanthus) according to the Combustion plants Regulation (Feuerungsanlagen-Verordnung – FAV), version dated 26.05.2015, Austria

- Pollutant		- Thermal input of the fuel (MW)				
		<0.4	0.4 – < 1	1-2	> 2-10	> 10
Dust	mg/m ³	150	50*	50	20	20
CO	mg/m ³	800**	250	250	250	100
HC	mg/m ³	50	20	20	20	20
NO _x	mg/m ³	500	500	400	400	200
SO ₂ ***	mg/m ³	350	350	350	350	350
HCl***	mg/m ³ ****	30	30	30	30	30

*) For firing of miscanthus and of other standardized biogenic fuels 150 mg/m³.

**) For furnaces of up to 100 kW net heat load with operation at 30% of net heat load the emission limit may be exceeded by 50%.

***) Does not apply to firing of miscanthus and of other standardized biogenic fuels.

****) By 11% O₂ in the flue gas.

The following table gives an assessment of the instruments mentioned in the text above.

Table 6: Instrument assessment for Austria

Instrument	Type	Level	Encourages replacement	Directs the purchase	Impact
Federal Environmental Subsidy Scheme UFI	F	N	X	X	very high
Residential Subsidy Schemes of the Länder	R/I/F	R	X	X	very high
“Renovation cheque” (Sanierungsscheck)	F	N	X	X	high
“Get out of the oil” bonus	F	N	X	X	very high
OIB Guideline 6	R	N		X	high
Salzburg Building Technology Ordinance (Bautechnikverordnung)	R	R		X	very high
Eco design decree (“Ökodesign-Verordnung” 2007)	R	N		X	moderate
Voluntary agreement on inspections of heating systems	I	N/R	X		moderate
Combustion plants regulation and emission law	R	N		X	moderate

Type: regulation (R), improvements (I), financing (F)

Level: national (N), regional (R), local (L)

Impact: very low, low, moderate, high, very high

Information campaigns / complementary policies

Since the introduction of the EPBD, comprehensive efforts (annual energy and building exhibitions, congresses and international conferences) have been undertaken in Austria to provide information to the public and to professionals.

The Austrian regions and their regional energy agencies develop and implement training programmes for different target groups in the building sector and offer comprehensive information campaigns, competitions and energy advice services for building owners and users. For example, the “Energy Academy” in Upper Austria offers more than 30 courses every year on building-related technologies and services. In the context of the “Arge Eba” (see below), the nine (9) Austrian regions offer standardised training for energy advisers.

2.1.3 Drivers and barriers

As a rule, from the **end consumer's viewpoint**, outdated heating systems are only replaced when they are no longer functional or are about to fail. There is then often no time for informed decisions. In addition, the amount of information required for a changeover is high, many questions have to be clarified and different bodies consulted. In this situation, many households are also confronted with significant costs that present them with a challenge. Elderly people and households suffering energy poverty have severe difficulties to get loans on the market. Split-incentives still are a severe barrier in multi-family and multi-storey buildings. Here regulatory and legal amendments would be needed (see T2.2 report).

From the **policy side** end consumers, intermediaries and industry are confronted with stop-and-go (subsidy) policies. This makes it hard to plan measures and take related investments. More planning and investment security is needed. For implementing and measuring policy measures more valid market figures would be needed (especially regarding the existing stock of heating and cooling systems. Without these it will hardly be possible to measure the performance of activities, and to give valid messages to the stakeholders. By lacking a level-playing-field, (independent) heat cost comparison calculations regularly show that heating with natural gas is the cheapest option (from a micro-economic view), especially as the emission of greenhouse gases (GHG) does not have a price in Austria and are not adequately represented in the level of taxes and fees on natural gas yet, respectively.

From a **market side viewpoint** Austria has promising conditions. Austria is a rather wealthy nation. Heat markets, services (e.g. consulting, see below) and equipment offered are diverse and efficient (see below); in general markets are at a rather mature level. Some markets still are in-transparent, however. People have difficulties to compare prices for district heat, for example. A real challenge will be the number of intermediaries needed in near future (see below). A uniform industry terminology, so as not to unsettle the customers, would be favourable too.

From a **technology view** a further challenge are air/water heat pumps that become more and more dominating, and are a problem especially at the renovation market – especially when they are installed in houses (with a building shell remaining un-refurbished and) with high heat distribution temperatures (i.e. equipped with radiators). This leads to a higher power demand and loads in winter, where an electricity system relying more and more on wind and PV power supply is challenged because of increasing residual loads, especially during winter period. This in turn means (especially if natural gas CHP plants shall phase-out in future on the market too) that the demand of seasonal storage of electricity or synthetic gas from PV and wind power, respectively, increases further. In the view of facing severely high seasonal system services costs that development could/should be avoided right

now. The application of air/water heat pumps should not be allowed or at least reasonably restricted in high energy and/or temperature level demanding houses, as long that those systems are not sufficiently efficient at such applications.

2.1.4 Key considerations for defining policy sets

Those are the identified key considerations (besides others, the authors are still unaware of) that would have to be taken into account for defining new policy sets for the Replace pilot region Land Salzburg.

- Better awareness of end consumers on the age and efficiency of their old boilers and the alternative options they have (enabling chimney sweepers to place boiler age labels and hand over info maps including information on the energy efficiency and comfort gains as well as cost savings they can expect, important issues to consider and contacts to independent advisory bodies, competent installers etc.)
- Consistent and technology-neutral information for end consumers from energy advisors, installers and chimney sweepers (and politicians too); including broadly accepted techno-economical assessment tools for end-consumers and professionals
- Stable and predictable funding schemes (no stop-and-go flow of funds) that are not too complex and easy to file in and understand on federal and Länder level
- Better data on both existing boiler stock and actually implemented new heating equipment and any accompanying measures in case of a heating system and additional housing shell refurbishment (within and outside the provincial residential housing scheme) by the Länder
- Strong regulatory provisions that give a clear planning horizon and milestones for a complete phase out of fossil fuelled (as announced by the Austria Government recently) and inefficient heating systems accompanied by an eco-social tax reform that allows for a level playing field and addresses issues of social cohesion, energy poverty and age of people (which within the Austria Government currently is under negotiation until 2022; therefore it is not clear yet what it will look like)
- Identification and gradual reduction of contradictory regulations, legislative requirements, subsidies, taxes and fees, other incentives etc.;
- Timely education of much more trustful and competent installers to overcome the predicted lack of installers to realize ambition lying ahead with a sustainable decarbonisation of the heat market
- Establishment and implementation of replacement campaigns that effectively address and overcome main barriers of a fuel switch for renewable energy based heating systems, i.e. providing an enabling environment for end consumers and important stakeholders (e.g. installers, implementing agents, etc.)
- The Energiewende in the building sector is on the one hand depending on the phasing out of fossil energy and on the other hand the efficient use of energy. The expansion of renewable heating systems will only lead to the desired goal if the overall demand for space heating is reduced accordingly.

2.1.5 Success stories

Optimization of the energy consulting process and instruments

In order to support the optimal use of the financial means of housing subsidies, comprehensive refurbishment concepts are being developed in the Länder within the framework of energy consulting. The training courses for energy consultants have already been harmonised across the Länder through the “Arbeitsgemeinschaft der Energieberater” (ARGE-EBA).⁵ The provision of energy consulting services in combination with the GEQ-EBS consulting tool can be seen as a national best practice example for the development of overall refurbishment concepts (including refurbishment energy certificates).

The consulting tool GEQ-EBS is used by energy consultants in Salzburg, Styria and Carinthia. The calculations of the consulting tool GEQ-EBS are based on a simplified energy certificate calculation in combination with a dynamic profitability calculation based on ÖNORM M 7140. By using the consulting tool GEQ-EBS, energy consultants can calculate and present cost-optimised thermal renovation and heating system variants for buildings. The results are summarised and ejected by the consulting tool in the form of a consulting protocol. The consultation protocol is stored in the provincial energy certificate database ZEUS (see below) as a basis for the further implementation of the renovation and can be used to create a new planning and completion energy certificate.

In the following, the process of an on-site energy consulting with the consulting tool GEQ-EBS is shown graphically.

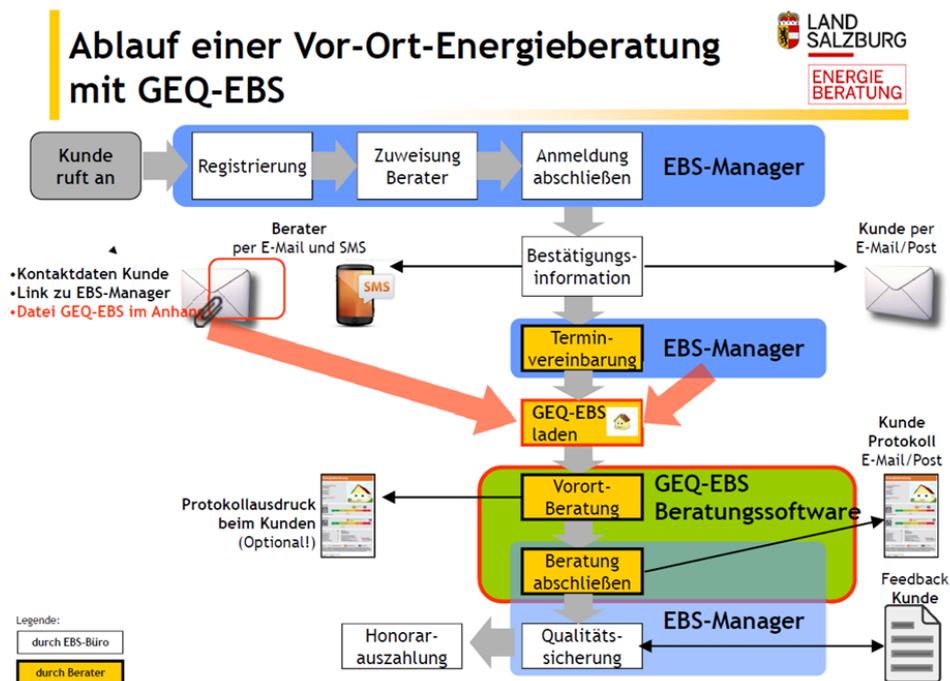


Figure 5: Procedure for on-site energy consulting with GEQ-EBS (Source: Energieberatung Salzburg)

The process of on-site energy consulting starts with the data of the existing energy certificate of the building (if already available in the energy certificate database of the federal states), which should already contain the first recommendations for renovation. Based on the results of the on-site energy consulting (consulting protocol), a planning energy certificate (based on the improvement suggestions of the on-site energy consulting) is created and uploaded into the energy certificate database of the Länder in case the renovation is actually started by the building owner. After completion of the refurbishment, a corresponding completion energy certificate is created and uploaded as a final

⁵ ARGE-EBA lays down the professional standards for energy consultants throughout Austria in cooperation with the provinces and the courses (according to ARGE-EBA) take place throughout Austria.

certificate in the federal state energy certificate database. Ideally, the completed energy certificate is 100% in line with the recommendations of the consultation protocol.

The following figures illustrate how a consultation protocol can look like in detail.

Beratungsprotokoll

Nummer: E17-1111
Termin: 07. Juli 2017
von 15:00 bis 16:30 Uhr

LAND SALZBURG
ENERGIE BERATUNG

Energieberatung Salzburg
Fenny-von-Lehnort-Strabe 1
Postfach 527, A-5010 Salzburg
0662 8042-3151
energieberatung@salzburg.gv.at

Berater:
Max /Musterberater
0676 11111111
office@musterberater.com

[eventuell inkl. Solarpotential aus SAGIS]

Kunde
Max /Musterkunde
0664 11111111
musterkunde@gmx.at

Objekt
Sanierung Einfamilienhaus
Musterstraße 18
1111 Mustergemeinde
Baujahr: 1995
Bruttogrundfläche: ca.388m²

Grund der Beratung
Der Grund für diese Energieberatung ist der, bei der Energieförderung des Landes Salzburg erhöhte Betrag.

Energieökologische Bewertung:

Primärenergieindikator Pi: 291 (Ist), 51 (Soll)

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ist: Bestand (oder Neubauplanung)

Gebäudehülle

Bauteil	Spezifikation	U-Wert [W/m ² K]
Außenwand	6 cm Dämmung vorhanden	0,56
Dachschräge	Abschätzung	0,3
Kellerdecke	Abschätzung	0,47
Fenster	Abschätzung	1,9

Gebäudetechnik

Komponente	Spezifikation
Raumheizung	Heizöl Extra Leicht, 20kW, Verteilung: 1/3 gedämmt, kein Speicher
Warmwasser	Boiler, kombiniert, indirekt beheizter Speicher, 450l, Verteilung 1/3, Steig 1/3
Abgabe/Verteilung	Radiatoren, 70°/55°C, Einzelraumregelung mit Thermostatventilen, Leitungsdämmung: Verteilung 1/3, Steig 1/3, Anbinde 1/3 Umwälzpumpe 60W???

Anmerkungen:
Es ist bereits der Tausch der bestehenden Heizöltretralechkessels auf einen Pelletskessel geplant.
Die Grundfläche wurde aus dem Plan des Kellerschobes auf drei beheizte Geschöbe (EG, OG, DG) aufgerechnet.

Ergebnis:

Primärenergieindikator Pi: 291

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soll: Empfehlung wirtschaftlichste Modernisierung lt. ÖNORM B 8110-4 und M 7140

Gebäudehülle

Bauteil	Spezifikation	U-Wert [W/m ² K]	Maßnahme
Außenwand	Dämmung 20cm, Lambda 0,031	0,12	empfohlen
Dachschräge	Dämmung 16cm, Lambda 0,040	0,3	empfohlen
Kellerdecke	Dämmung 6cm, Lambda 0,031	0,47	bleibt bestehen
Fenster	Kunststoff	1,9	bleibt bestehen

Gebäudetechnik

Komponente	Spezifikation	Maßnahme
Einbau Pellets	Heizlastabschätzung 15kW, Hocheffizienzpumpen	empfohlen
Einbau Puffer	1000 l, Durchflusssystem oder Frischwassermodul	empfohlen
Einbau kontroll. Wohnraumlüftung	mit Wärmerückgewinnung	empfohlen
Montage Photovoltaikanlage	4 kWp, Ausrichtung Süd, Neigungswinkel 30°	empfohlen
Abgabe/Verteilung	Radiatoren, 45°/35°C, Einzelraumregelung mit Thermostatventilen, Leitungsdämmung: Verteilung 2/3, Steig 2/3, Anbinde 2/3, Umwälzpumpe 20W	empfohlen

Anmerkungen:
Erklärung weshalb dieser Wärmeerzeuger angeführt ist. (Kundenwunsch, oder niedrigster Pi, ...)

Ergebnis:

ökol. Bewertung (Pi): 19

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geplant

Gebäudehülle

Bauteil	Spezifikation	U-Wert [W/m ² K]	Maßnahme
Außenwand	Dämmung 20cm, Lambda 0,031	0,12	geplant
Dachschräge	bleibt unverändert	0,9	bleibt bestehen
Kellerdecke	bleibt unverändert	0,8	bleibt bestehen
Fenster	Kunststoff	0,8	bleibt bestehen

Gebäudetechnik

Komponente	Spezifikation	Maßnahme
Einbau Pelletskessel	Nennwärmeleistung 15kW, Hocheffizienzpumpen	geplant
Einbau Puffer	1000 l, Frischwassermodul	geplant
Einbau kontroll. Wohnraumlüftung	mit Wärmerückgewinnung	Umsetzung später
Montage Photovoltaikanlage	4 kWp, Ausrichtung Süd, Neigungswinkel 30°	Umsetzung später
Abgabe/Verteilung	Radiatoren, 45°/35°C, Einzelraumregelung mit Thermostatventilen, Leitungsdämmung: Verteilung 2/3, Steig 2/3, Anbinde 2/3, Umwälzpumpe 20W	geplant

Ergebnis:

ökol. Bewertung (Pi): 39

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Anmerkungen zur geplanten Variante

Es ist ein neuer Pelletskessel mit 15kW Nennwärmeleistung geplant. Es wird ein Pufferspeicher mit mindestens 1.000l Inhalt empfohlen. Besser wären 2.000l, weil die Kessellauzeiten und die Stillstandzeiten sehr stark erhöht werden. Ein Speicher sollte ein Hygienespeicher sein. Bei diesem Speicher ist die Warmwasserbereitung im Durchflussprinzip (gewellter Edelstahlschlauch) integriert. Der Durchflusswärmetauscher sollte herausperforiert, und über KFE-Hähne spülbar (aufgrund der hohen Wasserhärte) angeschlossen werden. Bei 2.000l ist ein Hygienespeicher mit 1.000l und ein Erweiterungsspeicher in Parallelschaltung mit 1.000l Inhalt empfohlen.

Qualitätskriterien

Pelletsheizung (Zentralheizung, Brennwert)

- Kesseldimensionierung nach Heizlastberechnung (max. 30% Überdimensionierung nach Energieausweis oder nach exakter Berechnung gemäß ONORM H 7500).
- Auf Emissionen des Kessels achten (Emissionsgrenzwerte gem. Umweltschichtrichtlinie UZ 37).
- Kesselwirkungsgrad mind. 85%.
- Für Brennwertgerät: Kondensatablauf beim Gerät vorsehen, Rücklauftemperatur max. 40°C.
- Elektrische Leistungsaufnahme im Dauerbetrieb, max. 1,5 % der Kessel-Nennleistung.
- Pufferspeicher und Anschlüsse dämmen.
- Berechnung des Lagerolumens: 0,9 kW (Heizlast) = Platzbedarf in Kubikmeter.
- Dokumentierte Inbetriebnahme (Inbetriebnahmeprotokoll) aushängen und erklären lassen).
- Prüfen ob Kaminanierung notwendig (Rauchfangkehrer).
- Rohrleitungen dämmen (Empfehlung: Dämmstärke = Rohrdurchmesser).
- Anlagenschema im Heizraum aushängen.
- Bauanzeige notwendig.

Hydraulischer Abgleich von Heizungsanlagen

Der hydraulische Abgleich beschreibt ein Verfahren das sicherstellt, dass alle Heizkörper bzw Heizflächen einer Heizungsanlage gleichmäßig mit der erforderlichen Wärmemenge versorgt werden.

- Hydraulischen Abgleich durch Professionisten anhand des Protokolls durchführen lassen (siehe weiterführende Informationen).
- Vorlauftemperatur am Heizungsregler einstellen lassen (meist zu hoch).
- Umwälzpumpe auf möglichst niedriger Stufe betreiben bzw. Hocheffizienzpumpen verwenden (Energieeffizienzindex EEI max. 0,23).

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Gebäudetechnik Varianten (optional)

Schalholzkessel m. therm. Solaranlage Nennwärmeleistung 11 kW, Solar 8 m ² , Puffer 800 L, Flächenheizung 35/28° Gesamtkosten pro Jahr 3.330,- € PI: 59,79	1.234,- Netto	2.096,- Kap.Betr.
WP, Sole/Wasser, Tiefenbohr, PV Nennwärmeleistung 11 kW, PV 3 kWp, Puffer 800 L, Flächenheizung 35/28°, Jahresarbeitszahl 4,2 Gesamtkosten pro Jahr 3.028,- € PI: 40,84	188,- Netto	2.440,- Kap.Betr.
WP, Sole/Wasser, Tiefenbohr Nennwärmeleistung 11 kW, Puffer 800 L, Flächenheizung 35/28°, Jahresarbeitszahl 4,2 Gesamtkosten pro Jahr 2.907,- € PI: 58,04	795,- Netto	2.112,- Kap.Betr.

[Eurobeträge runden]

■ mittlere jährliche verbrauchgebundene Kosten ■ mittlere jährliche kapitalgebundene und betriebsgebundene Kosten

Beratungsgrundlagen:

Farbcodes Haus (rot/orange/gelb/...)

 Außenwand
 Fenster
 Haustür
 Kellerdecke/erdanliegender Boden

Primärenergieindikator (PI): Ökologische Bewertung des Hauses
 LEK-Wert: Gesamtdämmwert des Hauses
 U-Wert: Wärmedurchgangskoeffizient - Maß für den Wärmedurchgang des Bauteils. Je höher der Wärmedurchgangskoeffizient, desto schlechter die Wärmedämmung des Bauteils.
 [-]

Betrachtungszeitraum: Wärmedämmung 30 Jahre, Haustechnik 20 Jahre
 Verbrauchgebundene Kosten: Energiekosten inkl. Installation und Anschlussgebühren Betriebsgebundene Kosten: Instandhaltung, Wartung, Service
 Kapitalgebundene Kosten: Anlagenkosten inkl. Installation und Anschlussgebühren Betriebsgebundene Kosten:
 Dämmstoffpreise: Schrägdach 120,- €/m³ (0,038 W/m²K); Wand 190,- €/m³ (0,031 W/m²K); Kellerdecke 190,- €/m³ (0,031 W/m²K); Heizöl extra leicht 0,080 €/kWh; Pellets 0,080 €/kWh; Wärmepumpenstrom 0,160 €/kWh;
 Elektrische Energie 0,190 €/kWh
 Die Preise beruhen auf Schätzungen und Erfahrungswerten der Energieberatung Salzburg. Preise inkl. alter Steuern, Kostensteigerung 3% p.a., kalkulatorische Zinsen 2% p.a.
 Berechnung gemäß ONORM B 8110-4 bzw. ONORM M 7140 (Restbarwert gemäß EN 15459)

Das vorliegende Protokoll wurde aufgrund des Augenblicks und in mit zum Aufwand entsprechendem Verhältnis stehenden Hilfsmitteln (z.B. Temperaturmessungen) erstellt. Es dient ausschließlich der Erstinformation des Kunden und stellt kein Gutachten im Sinne des § 1299 ABGB bzw. § 52ff AVG dar. Die detaillierte Planung und die Umsetzung von Maßnahmen obliegt allein beauftragten Unternehmen und ist nicht Gegenstand der Beratung. Das Beratungsprotokoll ist kein Energieausweis. Bei Inanspruchnahme von Förderungen sind die jeweils aktuellen Förderrichtlinien zu beachten.

Seite 6 von 6

Figure 6: Exemplary consulting protocol for Salzburg

Source: *Energieberatung Salzburg*

Essential for the presentation of the consulting result is that the end customer receives a simple and clear comparison between the energetic and ecological evaluation of his current existing building, a cost-optimal renovation variant and the renovation variant planned by him on the basis of the consulting protocol. In order to provide a good overview of the results for the end customer, a clear distinction is made in the presentation between refurbishment measures on the building envelope and on the building technology.

This promising approach to the development and documentation of overall refurbishment concepts for buildings as well as the preparation of refurbishment energy performance certificates (current implementation in the context of a consultation protocol) is currently being discussed by the Länder.

Certification of heating boiler installers

In Austria there is currently a training certification of installers in the fields of:

- certified heat pump installer
- certified solar heat installer and planner
- certified photovoltaic installer and planner
- certified biomass heating installer.

Here some details for the training for the “Certified biomass installer” are given. It is carried out by the Austrian Biomass Association. Biomass installers take care for successful distribution and reliable functioning of technology. The Austrian “Biomasse Installateur” courses are held regionally in the 9 Federal States of Austria:

- Since 2000 courses are held regionally in the 9 Federal States of Austria
- Close co-operation with all relevant actors, e.g. agricultural chambers, and the federal union of installers

- Two days of theoretical training and one day of practical instructions at the site of one of the boiler producers
- Up to now, about one third of all Austrian installers (1,300) have received training, which covers the demand of the whole country
- All installers who complete the courses successfully receive a certificate “Biówärme-Installateur” (bioheat-installer), which can be used for marketing purposes
- Follow up courses and advanced trainings is offered (1,170 participants).

The “klimaaktiv” heating check: An objective assessment of the energy efficiency of heating systems

In Austria, some 700,000 heating systems are outdated and due for renewal. But there is also economically feasible improvement potential in many newer systems.

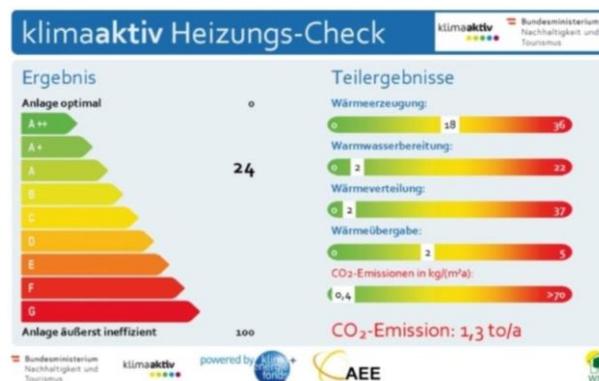


Figure 7: The klimaaktiv heating check

Source: BMNT

The klimaaktiv heating check is an overall efficiency check of the heating system and includes

- the heat generator (boiler),
- the regulation,
- the heat distribution and delivery and
- the hot water supply.

The klimaaktiv heating check is therefore a standard-compliant inventory of the entire heating system. It describes existing weak points and lists optimisation and improvement measures.

So far, well over 1,000 heating checks have been carried out in seven Austrian provinces.

The most frequent weak points are in

- the oversizing of the heat generator,
- the "non-existence" of pipe insulation,
- regulatory errors and
- the lack of hydraulic balancing.

The best optimisation successes from the heating check can be shown by savings of around 2,000 euros per year for a single-family home. Savings of 15 % are feasible in almost every system - without any loss of comfort.

ZEUS database for handling of Energy Performance Certificates (EPCs) and online energy accounting systems, GET boilers and collectors database

There is also a list of on-going individual initiatives in the Austrian provinces. Salzburg, for example, with the **ZEUS database**⁶, besides the centralized electronic recording and administration of EPCs, provides a cost-free online energy accounting system for building owners and managers⁷. Since some years the Länder Styria, Carinthia and recently Burgenland use this tool as well. EPCs in ZEUS serve various purposes: for building permits, for housing subsidies, for own archiving and many others. ZEUS enables energy certificate storage and versioning, process support and statistical evaluations.

Furthermore this tool enables obliged stakeholders to enter the real energy consumption of their building into the database and to obtain an annual or monthly overview of their energy consumption. According to Salzburgs Energy Efficiency Directive 2015 (Land Salzburg, 2016):

- For buildings with a conditioned gross floor area of $\geq 2,000 \text{ m}^2$, the central meter data for heating energy consumption including heating supply and return temperatures, for thermal solar energy yields as well as for water and electricity consumption must be automatically stored daily before midnight on the energy performance certificate (EPC) database ZEUS.
- The meter readings for the total electrical power consumption of the heat pump (without heating circulation pump(s)), heat output of the heat pump and yields of the PV system (in kWh from the inverter) must be read at the end of the month from the time the system is commissioned and stored in the ZEUS EPC database for a period of three years.

By this initiative, the energy consumption of buildings can be monitored both by the owner and by the province⁸. The aim of this initiative is to raise the awareness of the consumers, to provide data on the performance of the buildings and heating systems (target-performance comparison) and thus to increase renovation activities and improve the energy efficiency of operation (and pay-back times).

Furthermore by the GET database⁹, a product database, building services engineers can find product lists for eligible (efficient) boilers and collectors to assist them in preparing the system design declaration required for funding applications.

In Salzburg, there are plans to introduce a notification and authorisation requirement for certain measures, which can also be sanctioned by the competent building authority (municipality) in the event of deviating implementation of measures. Via the ZEUS database, the municipalities have access to planned measures on the building envelope or on building services engineering, as well as measures reported for execution.

Klimaaktiv website topprodukte.at

Similar to GET database, the website topprodukte.at informs consumers and professional procurers about the best energy-saving appliances and products currently available in Austria, among others in the categories centralized in-house heating systems, ovens and air conditioners etc. In total about 3,000 products are currently listed online. For each category there is a comprehensive guide section that provides information on energy labelling and important criteria for purchase and use.

topprodukte.at is a partner of the Eurotopten network (topten.eu), within which comparable information services are offered in over 20 countries (an offer that currently is going to be extended by REPLACES' "sister" Horizon 2020 project HACKS). Products are selected on the basis of manufacturer information based on European regulations and standards (e.g. EU Energy Label, Energy Star

6 energieausweise.net

7 energiebuchhaltung.at

8 Over 1,500 buildings are participating in this programme

9 energieaktiv.at/produkte

Programme, Austrian Eco-Label, test reports from accredited testing institutes). Depending on the product category, other environmental and quality criteria such as noise, water consumption or service life are also included in the evaluation in addition to energy consumption or energy efficiency.

Certification / quality improvement – Certification programs for biomass boilers

A fundamental driver for the improvement of the energy efficiency and emissions of biomass boilers was the introduction of an official biomass boiler testing facility at the Bundesanstalt für Landtechnik in Wieselburg (BLT) in 1979. The 1980's was also the time when more stringent emission regulations for wood boilers started to be introduced and dedicated research and development programs focusing on biomass combustion were implemented.

An increasingly sharp competition for more efficient and cleaner burner products was stimulated by the testing site, as the publicly available testing reports always show(ed) the cutting edge of technology. The result is a continuous improvement of technology development in biomass combustion over three decades now. The figure below show that the emissions could be reduced and the energy efficiency improved impressively.

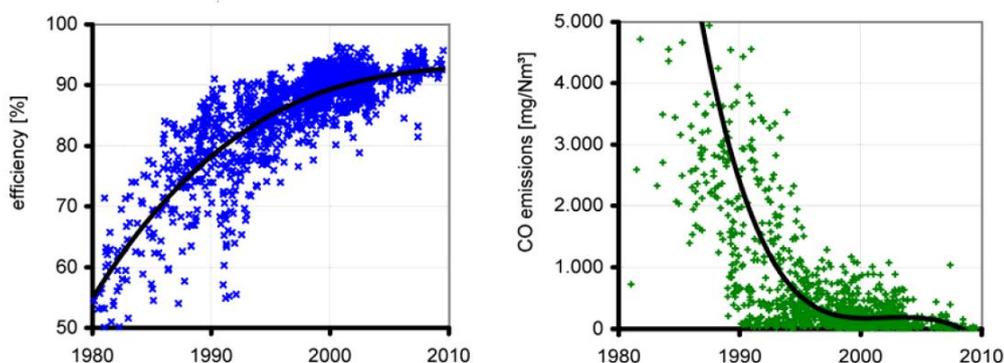


Figure 8: Development of the boiler efficiency and CO-emissions of tested small-scale (< 400 kW) biomass boilers (source: BLT Wieselburg).

The use of a standardised test procedure and assessment is possible for accredited European testing institutes since the release of the ÖNORM EN 303-5 Heating boilers - Part 5: Heating boilers for solid fuels, manually and automatically stoked, nominal heat output of up to 500 kW - Terminology, requirements, testing and marking, in 1999, which was elaborated under guidance of BLT Wieselburg. Since then, all biomass combustion installations with a nominal heat output of up to 500 kW must provide evidence regarding the fulfilment of required emission standards and boiler efficiencies at the nominal and lowest possible heat capacity.

Since the 1990's only biomass boilers certified (with type approval) at the BLT in Wieselburg have been able to be introduced on the Austrian heat market and subsidised with public funds. In general the equipment of biomass heating installations has to bear the CE marking.

On European level the Eco Design Directive will oblige producers of biomass combustion installations to label their products accordingly, furthermore the installations achieve certain minimum ecodesign standards and by 1.1.2020 (see Lot 15: Solid fuel small combustion installations). The proposed requirements include solid fuel boilers with a rated heat output of 500 kW or less.

Quality Assurance for wood combustion and district/local biomass heating plants

A fundamental tool for the implementation of biomass heating plants is the Quality Assurance for Wood Combustion Plants named "QM Holzheizwerke®". QM Holzheizwerke® is a comprehensive and project-oriented quality management system to assure a high technical quality of biomass-based DH systems leading to sustainable, durable and economic DH systems. This quality management system

was invented in Switzerland and further developed by a consortium of Austrian experts (now working at) AEE INTEC, German experts from C.A.R.M.E.N. and Swiss experts from Hochschule Luzern, all being experts in the field of biomass DH systems and therewith related issues.

The quality management system “QM Holzheizwerke®” and specially trained quality delegates respectively, accompanies projects from an early planning phase through the whole design and construction process as well as the commissioning and optimization of the plant. These project stages are represented by the five Milestones of the quality management system:

- Milestone 1 - preliminary study
Results: reasonable project model
- Milestone 2 – design engineering
Results: Detailed planning, grant application data
- Milestone 3 – tender procedure
Results: Fixed project design, service contracts
- Milestone 4 – plant construction and acceptance inspection
Results: Acceptance certificates
- Milestone 5 – Monitoring and Optimisation
Results: Optimised plant and district heating network

“QM Holzheizwerke®” is currently applied in Germany and Switzerland on a voluntary basis. In Austria the quality management system is an integral part of the Austrian climate protection initiative “klimaaktiv” funded by the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management, managed by AEE INTEC.

Since 2006, QM Holzheizwerke® in Austria is connected to the UFI funding scheme for biomass DH systems with a grid length of > 1,000 m as well as in-house biomass boilers, both above 400 kW net heat capacity. This obligation is valid for the expansion of existing plants and for new plants as well. For those plants, the participation at QM Holzheizwerke® is obligatory in order to receive investment subsidies from the UFI subsidy program. For biomass projects below 400 kW a simplified Quick Quality Check is applied.

Since all relevant data of the Austrian projects accompanied by QM Holzheizwerke® are recorded in a central database, a detailed benchmarking and evaluation of the projects is possible. Results thereof show that QM Holzheizwerke® leads to a significant improvement of the efficiency and quality of Austrian DH plants based on RES.

The following requirements have been defined for the owner and planners of biomass heating plants:

- the heat demand data have to be plausibly determined according to the relevant valid rules and have to be documented by load characteristics and annual heat lines as well
- the district heat network has to have a minimum density
- the combustion system has to be constructed according to a certain utilisation rate
- defined standard solutions have to be used for the hydraulic and pertinent measuring and the control system
- a high utilisation rate requires an optimised waste heat recovery and an optimal layout of the heating network
- the biomass storage has to be designed in accordance to the biomass demand of the plant and the regional biomass supply
- the used biomass has to be in line with the detailed classification of QM heating plants.

The European Court of Auditors made an audit of the Austrian UFI funding scheme and found that the quality management system is a “...good practice example...” and that “...a quality management tool for biomass heating plants assured proper monitoring arrangements...”(Europäischer Rechnungshof, 2014).

2.1.6 HC replacement outlook

In the last decade, a good fourth of the oil heating systems in private households throughout Austria have been replaced by other heating systems. In the trend comparison Salzburg, Vienna and Vorarlberg stand out. There proportionately above average many oil heaters were exchanged and/or not again established. The strongest decrease of oil heating systems could register Salzburg in the period under consideration (see graph below).

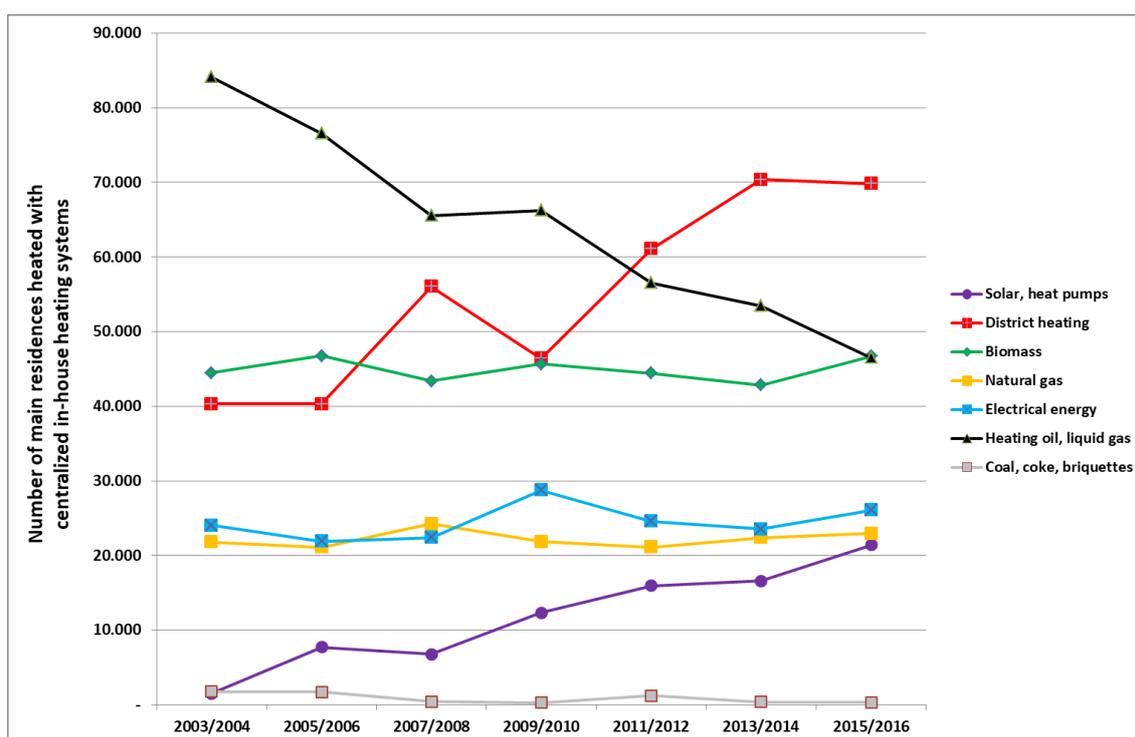


Figure 9: Development of the number of main residences heated with centralized in-house heating systems in Land Salzburg.

Source: Austrian Energy Agency, based on data of Statistic Austria (Micro Censuses).

The main reason for that outstanding result was a strong expansion of district heating (new biomass district and micro grids and extension and densification of existing district heating grids). Nearly every third oil boiler was substituted by district heat. While between 2003 to 2016 an average of 3,000 fuel oil and LPG¹⁰ boilers were replaced p.a., it is expected that this number currently stagnates at 2,250 p.a.. Constantly over the whole observation period about 600 fuel oil and LPB boilers stay(ed) with oil after renovation. While in the segment of new buildings less than 10 p.a. fuel oil boilers were installed until 2016, currently no fuel boilers are installed.

In existing houses, however there are still 45,000 main residences heated by oil & LPG. As this boilers should disappear by 2030 (Strategy of Land Salzburg) or 2035 (Strategy of the Austrian Gov.) there is need for action.

¹⁰ liquefied petroleum gas

According to the current government programme in Austria, oil heating systems will no longer be installed in new buildings as of this year, as the phasing out of oil heating systems in new buildings has already been regulated by law on federal level.

- In September 2019 the National Council passed a federal law prohibiting the installation of oil boilers in new buildings (ÖKEVG¹¹). It affects all new buildings, i.e. residential buildings, public buildings and also commercially used buildings.
- From 2021 oil heating systems will also be banned when heating systems are changed. There is not yet a corresponding regulation in force on federal or Länder level.
- From 2025 on, the obligatory replacement of boilers that are more than 25 years old is to come.
- By 2035 at the latest, all of the 600,000 or so domestic oil-fired boilers currently still in use should then disappear from the heating market.

In recent years, 15,000 to 20,000 oil-fired boilers per year have been replaced. At the same time, since 2009, the oil industry itself has supported around 5,000 new oil-fired heating systems per year with an investment subsidy. It is expected, that by 2025 430,000 fuel oil boilers will be at least or older than 25 years (see figure below).

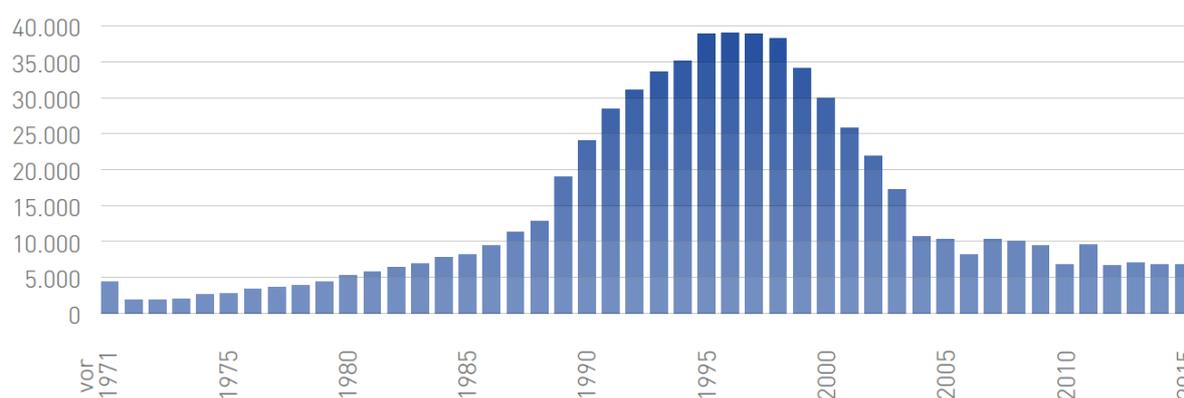


Figure 10: Annual fuel oil boiler installations in Austria (with a peak between 1990 to 2005), which have been operational in 2016.

Source: Austrian Climate and Energy Fund.

In order to achieve the targets for phase-out of the oil-fired boilers, their number would have to be reduced by an average of 40,000 units per year throughout Austria, i.e. over 100 boilers per day. To ensure that the phase-out of oil-fired boilers can be achieved by 2035, effective strategies and implementation concepts must be developed as quickly as possible. A further rapid and extensive phase-out of oil in the area of space heating is legally, technically and economically possible in Austria.

According to the Integrated National Energy and Climate plan for Austria, Period 2021-2030 new developments are expected for the following fields addressing Austrians' heating markets:

- In the event that a boiler based on fossil liquid energy sources is replaced, the aim is to use only heating systems based on highly efficient alternative energy systems from 2021 on. Only in justified exceptions should it be possible to deviate from this requirement.

11 Ölkesselbauverbotsgesetz – ÖKEVG 2019

- In addition, the aim is to convert existing fossil-liquid boilers that are more than 25 years old to renewable energy sources or district heating from 2025 onwards.
- A coordinated mix of instruments is required to achieve the phase-out of fossil liquid fuels. Temporary subsidies offered to cushion social hardship cases in combination with subsidised product-independent public consultations with the simultaneous announcement of regulatory provisions that will take effect in the medium term, as well as rising costs for end consumers of fossil liquid fuels and a targeted phase-out of fossil liquid energy sources for heating purposes by 2035 should motivate people to switch over as early as possible.

Some further details

- The aim is to double the “rate of thermal refurbishment” between 2020 and 2030. Major renovations can also be carried out in partial steps as part of multi-year renovation concepts. Since a decline in renovation activities is currently being recorded, massive further efforts and a coordinated mix of measures will be required. Cost-optimal levels should apply to renovations (including partial renovations) in any case.
- Where possible, the natural gas network should no longer be extended for heating/hot water purposes; compression of the connections for heating and hot water is possible in areas where district heating (if based on energy from renewable sources or from highly efficient combined heat and power plants) is not available
- In the long term, fossil gas will be replaced by renewable gas in the gas network
- Fossil gas should only be used in new buildings in well-founded exceptional cases, whereby compensation measures must be taken.
- Consistent and harmonised implementation of the requirements of the "alternative assessment" in new construction and refurbishment - this means that fossil gas will also be successively replaced by renewable alternatives where this is sensible and reasonable.
- By means of spatial planning, areas with grid-bound energy infrastructure (e.g. district heating areas) should be designated as soon as possible/2025
- No liquid fossil fuels are to be used in federal and state public buildings (owned and used) by 2030.
- Information and awareness-raising activities and consultations (product-independent, funded and public)
- Measures for spatial planning, settlement development and spatial energy planning
- Review of targeted subsidies for accompanying services and smaller investment measures (hydraulic balancing, heating check, renovation schedules/overall renovation concepts, improvements in heat distribution and delivery, etc.)
- A targeted qualification for architects, planners and craftsmen is necessary in order to create sufficient quantitative and qualitative capacities for the necessary implementation of measures.

Spatial energy planning in Austria is an upcoming issue

Building law, regional planning, subsidies and information duties are largely the responsibility of the Länder (legislative and executive) and the municipalities (executive) and represent the decisive matters for heat planning. To varying degrees, the phase-out of oil and gas is expected for the forthcoming amendments to building law. The regulations under consideration range from the increasing

promotion of highly efficient alternative systems to the equivalence principle, with which CO₂ emissions could be capped without technological restrictions.

In regional planning, the possibilities are more diverse. In Vienna, the ordinance on energy space plans is currently being partly implemented already. Vienna currently is planning to ban natural gas from the new buildings markets in inner-city districts via such ordinances applicable for energy zones (“Energieraumzonen») issued by the cities council.¹² New buildings within such zones must then be supplied with district heating or renewable heat without exception. Also worth mentioning is that in Vienna owners of small-volume houses – of which there are after all almost 100,000 in Vienna – are obliged to insulate the top floor ceiling when renovating.

In Vorarlberg, Salzburg and Styria, spatial energy planning is anchored as a “can-be” option. In other federal provinces, this basis is still completely lacking. Even more limited are the legal possibilities for specifying concrete energy systems. While in Styria there are explicit, but spatially very limited possibilities for specification via immission control, in other Länder there are at most options via development planning, and here too legal uncertainty remains until further notice.

Role of Replace

At REPLACE, all concepts and accompanying measures developed, implemented and tested in the pilot regions, the experiences made and recommendations taken as well as tools developed will be made available to the public so that other regions can easily adopt successful approaches. REPLACE will inform homeowners and offer attractive changeover offers. To this end, key players in the regions, such as local authorities, consumer protection organisations, installers, energy consultants, energy supply companies, other guilds, etc., will be networked in local working groups. Together, they design comprehensive, locally adapted packages. The idea is that installers, suppliers of green heating systems as well as of fuels and banks work together and put together “all-round carefree packages” that make the changeover much easier.

This implementation concept is accompanied by broad-based communication and on-site know-how & show know-how activities for the replacement of old and inefficient heating systems (e.g. “open cellar” events, information evenings or even the indication of the age on the oil boilers). Essential here are target group-specific communication with diverse online and offline marketing activities and the online REPLACE your heating system” calculator: With this bundle of activities we will create the necessary momentum to bring joint implementation solutions to the local population and to make heating in Europe efficient and climate-friendly.

¹² See waermeplanung.at, for example.

2.2 Rhodope municipalities, Bulgaria

2.2.1 Overview of policy instruments for sustainable heating and cooling system replacements

According to the draft National Energy and Climate Plan (NECP), by 2030 Bulgaria will aim to reach at least 27% RES share in the gross final energy consumption, compared to 19.56% expected share in 2020. This includes a sectoral target for heating and cooling from renewables (RES HC) of 49.09% by 2030, compared to 31.20% (expected) in 2020.

According to the same document, by 2030 Bulgaria will aim to reach at least 27.36% reduction of the primary energy consumption, compared to PRIMES 2007 scenario for 2030.

The sectors covered by the EU emission trading system (ETS) will have to cut GHG emissions by 43%, compared to 2005. For these sectors there is no binding target for each Member State and the target is at EU level. Concerning the non-ETS sectors, such as buildings, Bulgaria has 0% national target, meaning that by 2030 it shall not to exceed the 2005 GHG emission level.

2.2.2 Financial and legislative promotion

The relevant legal and financial framework considers the following decision-making levels:

- National level: almost all legislative requirements and financing opportunities are established at that level
- Planning Region level: the country is divided into 6 regions, whose administrations have limited competences, and Rhodope region is part of South-Central planning region
- Rhodope region: not an official administrative region, in this study considered to include the municipalities that are members of the Association of Rhodope municipalities.
- District level: the country is divided into 28 districts, whose administrations have limited competences; Rhodope region is located within 3 districts – Smolyan, Kardzhali, and Plovdiv
- Municipalities: there are 265 municipalities in the country and they have moderate decision making power in the field; Rhodope region covers 12 municipalities.

At national level, in the draft National Energy and Climate Plan (NECP), there are several priorities, related to the replacement of the heating system in the residential sector:

- Increased biomass utilization in existing and new district heating (DH) plants
- Increased biomass utilization in households
- Increased heat production for own use
- Increased utilization of renewable energy in buildings
- Increased use of geothermal energy, solar energy, and efficient heat pumps for heating and cooling.

The following policy measures are planned to achieve these priorities:

- Replacement of inefficient coal- and firewood-fired stoves with efficient heating systems, using funding from Operational Programme (OP) Environment
- Increased financing (see details below)
- Softer administrative procedures
- Obligation to use RES in new and renovated buildings, if technically and economically feasible
- RES potential assessment, including waste heat assessment
- Access to heat networks
- Support to establish RE cooperatives, through easier access to the market and easier administrative procedures
- Support for development of DH network, support for small DH plants
- Informational measures.

According to NECP, the necessary investments for RES-E and RES-HC altogether (no separate estimation provided) amount to 2 billion euros, which would come from the following sources:

- EU Structural and Investment Funds for the next programming period 2021-2027
- Invest EU
- Modernization fund
- Financial instruments – EIB, EBRD, Fund of funds (national fund managed by the Government)
- National Energy Efficiency and Renewable Sources Fund (EERSF), National Eco Trust Fund
- Private investments.

At Planning Regional level, South-Central planning region has adopted a Development Strategy, that includes urban gasification as one of its priorities.

At District level, Smolyan District, which covers the majority of the region, has included in its District Development Strategy two relevant priorities: 1) increased biomass residues utilization and 2) opportunity to create a fund, funded by the cost of carbon emission allowances, to support RES utilization in households, which would result in lower GHG and PM emissions. Kardzhali District has specified in its District Development Strategy that the following steps need to be undertaken: 1) introduce more efficient heating technologies in the residential sector; 2) develop financial stimuli for using energy efficient equipment; 3) accelerate the urban gasification in the residential sector; and 4) establish local informational centers for residents.

At Rhodope region level, within the Intelligent Energy Europe – funded project “RES H/C SPREAD”, a Regional heating and cooling programme for Rhodope Region has been developed in 2016. It envisages the following measures to be carried out by the local and regional authorities, directed towards the replacement of the residential heating systems:

- Provision of support (financial, organizational, expert, etc.) to the local population in order to implement energy efficiency & RES projects in residential buildings;
- Support for the establishment and operation of logistics centres for biomass;
- Support for the creation of Civil energy cooperatives;
- Organisation of information campaigns to increase the capacity of all stakeholders, and dissemination of information among the population.

The programme has no single implementation body, but the Rhodope municipalities and regions have committed to its implementation.

At municipal level, the relevant legislation includes:

- Municipal Development Plans – framework documents, setting general priorities towards energy efficiency, renewables, and environmental protection. None of the plans mentions heating specifically.
- Sustainable Energy Action Plans, under the Covenant of Mayors initiative. A half (6 out of 12) of the municipalities in the region have such plans, through which they have committed to specific targets and measures towards energy efficiency, renewables, and GHG emissions.
- Energy Efficiency Plans / Programmes. Due to a legal obligation, all municipalities have such, but they typically focus only on the municipal (public) sector.
- Renewable energy plans / programmes. Although all municipalities are obliged to have such, they are available at 10 out of 12 municipalities. The plans contain no specific targets. In most cases they include only a general list of priorities, most of which not substantiated by particular measures. The most common measures related to the residential heating are organization of information campaigns and appointment of an expert in the municipal administration to provide technical assistance to households in the area of sustainable energy.
- Environment protection plans, typically available at the larger municipalities, address the problem of air pollution resulting from the residential heating, mostly through planning of information campaigns and urban gasification. Smolyan has a very comprehensive municipal programme for the improvement of air quality, planning substantial measures in the residential heating sector (see the below section “Success stories” for details).

Table 7: Instrument assessment for Rhodope Region

Instrument	Type	Level	Encourages replacement	Directs the purchase	Impact
Support from OP Environment	F	N	X		Moderate
Other financial instruments (see above)	F	N	X	X	Moderate
Softer administrative procedures	R	N	X		Low
RES obligation for new / renovated buildings	R	N	X	X	Low
Access to DH network	R	N	X		Very low
Support to DH investments	F	N	X		Very low
Support to RE cooperatives	R	N	X		Low
Information and advice to residents	I	L	X	X	Moderate
Urban gasification	I	L	X	X	Low
Establishment of logistics centres for biomass	I	L	X		Low

Type: regulation (R), improvement (I), financing (F)

Level: national (N), regional (R), local (L)

Impact: very low, low, moderate, high, very high

2.2.3 Drivers and barriers

The factors (drivers and barriers) that affect heating system replacement at end-consumer side are presented in the below table.

Table 8: Factors affecting heating system replacement at end-consumer side

Factor	Level (1=low; 5=high)	Trend	Description
Environmental awareness of consumers	2	+	Although generally low, it is improving, especially in towns with high air pollution levels
Available information about technologies and funding	3	+	Information is increasingly available, supported by the higher penetration of modern technologies
Ability to finance the initial investment	2	+	Rhodope region is a rural region with low standard of living. The majority cannot afford to make such an investment.
Financial feasibility of replacement	2	+	Low price of inefficient firewood and coal stoves, currently dominant in the region. Low, but increasing price of coal briquettes and firewood. Dwellings are typically under-heated, due to region depopulation and poverty.
Access to affordable financing	2	+	There are limited opportunities to receive partial grants, sometimes combined with a loan. Debt financing from commercial banks is not accessible for most households.

At the policy side, the only serious barrier affecting replacement is the lack of restrictions for the use of polluting solid fuels and inefficient stoves. The policy framework generally promotes the use of efficient and clean heating at households, as described above. Nevertheless, considering the specific

circumstances in Rhodope region (e.g. no opportunity for DH, limited new and renovated buildings, limited multi-family buildings), there are no substantial drivers, except the newly established opportunity for some households to receive free-of-charge modern heating equipment (see the below section “Success stories” for details).

At the market side, there are two main aspects to be considered – technology availability and availability of qualified installers. Efficient and clean heating technologies – biomass boilers, heat pumps, solar thermal collectors, etc. - are generally available, but their prices are often too high, due to limited competition. On the other hand, there is lack of qualified installers. Often residents carry out the installation works themselves. While some distributors (e.g. of heat pumps) offer installation services, others (e.g. some distributors of biomass boilers) do not.

2.2.4 Key considerations for defining policy sets

A new policy towards the promotion of clean and efficient heating in Rhodope region need to take into account the following considerations:

- Individual (for each dwelling) heating systems are necessary in the majority of the residential sector in the region, due to the dominance of single-family houses.
- Public support is needed to address the high initial investment and the (often) low financial feasibility of replacement. In parallel, the price of firewood and coal briquettes need to be adjusted to reflect the externalities.
- Annually the State provides a small financial support for the heating of low income households. This approach generally results in lower fuel / energy cost burden, but not in technology replacement.
- Residents need to become aware of the non-financial benefits of the replacement, such as comfort, easier servicing compared to inefficient firewood and coal stoves, better indoor climate, less environment pollution.
- Wider promotion of new technologies and financial programmes and funds is needed.
- The qualification of installers need to be increased.

2.2.5 Success stories

OP Environment 2014-2020

In Bulgaria, OP Environment 2014-2020, funded by the EU Structural and Investment Funds, provides grants for „Measures for the improvement of the air quality”. It is a national programme, managed by the Ministry of Environment and Water, with a total budget for the specific priority of 57 million euros. The priority's objective is to reduce the particulate matter (PM) emissions of the residential heating in municipalities with high PM air concentrations and adopted mitigation programmes.

The beneficiaries are the municipal administrations, which in turn ensure the replacement of the polluting heating systems at the households on their territory. The heating fuelled by firewood and coal briquettes shall become fuelled by natural gas, electricity, pellets, or district heating. As a last resort, if none of these alternatives is applicable, the new technology can run on firewood or coal, provided that the technology has high performance.

Smolyan municipality, one of the largest municipalities in Rhodope region, is among the programme beneficiaries. In July 2019, it signed a 58-month contract amounting to nearly € 5 million. The project is implemented into 2 steps. The first step is a preparatory one and includes:

- Survey of at least 4 000 households to identify both the pollution sources and people's attitude towards heating replacement - preferences, drivers, barriers, etc.
- Information and training campaign aiming to increase residents' awareness about both PM adverse effects and advantages of modern heating
- Assessment of heating in each city district
- Prioritization of the investments
- Energy audits, visits of households to assess the individual technology and conditions
- Development of a financial plan, including average and marginal replacement costs.

The second step of the project in Smolyan is the actual implementation of the heating replacement and includes purchase, delivery, and installation of the equipment at the selected households. Additionally, this step includes uninstallment and handling (e.g. recycling) of the old equipment.

The project in Smolyan is expected to benefit more than 2 600 households and the average cost per household is estimated at about € 1 530.

It is too early to evaluate the success of the programme, as it is still not completed. At this stage, it is apparent that the programme targets the right municipalities and it applies a comprehensive approach to select the right households and the right measures. The replication potential seems high in the EU Member States, as they can design a similar OP, utilizing EU Structural Funds. Replication is possible in other countries, provided that funding is secured.

Residential Energy Efficiency Credit Line (REECL)

The Residential Energy Efficiency Credit Line (REECL) is a € 20 million facility, established by the European Commission, the European Bank for Reconstruction and Development, and the Bulgarian Ministry of Energy. It provides householders and associations of apartment owners with loans and investment incentives through local participating banks. The eligible investments include improvement of the building envelope, heat pumps, biomass stoves and boilers, solar water systems, hot water gas boilers and others. There is a comprehensive list of both the eligible installers and the eligible technologies (specifying the brand and exact model) at REECL website <http://reecl.org/>.

To stimulate the uptake of energy efficiency projects, in addition to the loan, 15% grant is provided to borrowers after verification by independent consultant that each project has been completed. The grant comes from the Kozloduy International Decommissioning Support Fund (KIDSF).

The maximum loan amount for single family houses is € 50 000 and for multi-family – € 1 million. The maximum grant amount for individuals is € 7 500 and for associations – € 100 000.

REECL is active since 2005. As of 2016, it has supported over 52 000 households with total loans of € 83 million and grants of € 20 million. Advantages of the facility are the accessible loans and the efficient (due to their small share) spending of public grants. The facility seems easily replicable in other countries.

2.2.6 HC replacement outlook

During the last couple of years, the high PM concentration levels in settlements became one of the top concerns of citizens. Correspondingly, the pollution mitigation is increasingly becoming part of the policy priorities at local, regional, and national level. The main source of PM emissions in settlements is the individual heating, based on inefficient firewood and coal stoves. Several municipalities have started projects to support the population in the replacement of the polluting heating systems and in the installation of PM filters on chimneys.

Public support is currently the single politically acceptable opportunity to effectively achieve heating replacement. Restrictive measures, such as prohibiting of certain technologies, emission regulations, or fuel/energy taxation, would face strong opposition, unless proper compensation is offered.

Policies to make residential heating cleaner and more efficient are under discussion in relation to the preparation of the Bulgarian NECP. The ones considered promising are laid down in the draft Plan (see section „Financial and legislative promotion“ for details).

Several measures have the potential to effectively encourage heating replacement:

- Availability of support programme combining soft loans and limited grants for households. The positive experience of REECL programme can be expanded, so that more households can benefit from the support. The development of such a programme is realistic, considering the efficient spending of the public funds (small grant share). Such a programme shall have only a transitional role, i.e. run only for several years, until more sustainable measures are enforced.
- Stringent requirements for the stoves / boilers and solid fuels available on the market. Such a measure seems realistic, if implemented gradually, following a long-term plan.
- Change of the „annual payment“ approach to support the low-income population to make heating affordable. Households using inefficient stoves can be encouraged to replace them.
- Large – scale information campaign, demonstrating the “multiple benefits” of replacement; training of installers.

To assess and develop the above and other possible measures, it would be useful to study the experience of other EU Member States.

2.3 Canton of Sarajevo, Bosnia and Herzegovina

2.3.1 Overview of policy instruments for sustainable heating and cooling system replacements

In Bosnia and Herzegovina to date the issue of heating was addressed solely on the local level, in individual cities and municipalities in the cantons. The goals for sustainable heating and cooling system replacement for Canton of Sarajevo are based on a few strategic documents on the three different levels: national (BiH), entity (Federation of BiH) and cantonal (Canton of Sarajevo). The legal framework is absent, as is the strategic/systematic approach from higher government levels that would ensure its harmonisation with the priority areas.

According to the **Climate Change Adaptation and Low Emissions Growth Strategy of BiH to 2025** (2013) adopted by the Council of Ministers on 2013, climate change adaptation goal is to improve the resilience of BiH to climate variability and climate change, with developmental benefits. The low emissions growth goal is to achieve the highest value and stop the growth of annual emissions of GHG in BiH around 2025 at a level below the average emissions per capita in EU27. Relevant specific objectives to HC are:

- End the use of heavy fuel oil and coal for heating of households and in district heating systems and replace them with energy efficient systems, biomass, solar thermal and geothermal energy (using electricity to power these plants) by 2022;
- Introduce heat consumption metering per building and per individual consumer in all district heating systems by 2020;
- Reduction of average residential heating demand from 200 kWh/m² to 100 kWh/m² by 2025;

The Second National Communication on Climate Change contains measures and priority actions for reducing CO₂ emissions from the DH sector in BiH for the period 2010-2025, which include:

- increasing the capacities of the existing DH system,
- improving the efficiency of the systems by optimizing their operations,
- expansion of heating networks.

Framework Energy Strategy of Bosnia and Herzegovina until 2035 (2018) contains the options for development and expanding of district heating system in Canton of Sarajevo by using fossil fuel i.e. natural gas. The main focus is on the implementation of additional solution which includes cogeneration on coal from the thermal power plant without using energy from renewable resources.

National Renewable Energy Action Plan of Bosnia and Herzegovina (NREAP BiH) (2016): In the heating and cooling sector, increase of the RES share from 805.8 ktoe in the baseline year to 1085.2 ktoe in 2020 is foreseen. This will result in an increase of the RES share from 43.3 % to 52.4 % in heating and cooling sector, which is an increase of 9.1 %. The goal of the heating and cooling sector for Bosnia and Herzegovina was based on the parameters from entity action plans where these goals for 2020 were set. In addition, the use of renewable heat energy from heat pumps, including aerothermal, geothermal, and hydrothermal energy, is not subject to this action plan.

Energy Efficiency Action Plan of Bosnia and Herzegovina for the Period 2016 - 2018 (NEEAP BiH) (2017): Activities at the level of Bosnia and Herzegovina are extensively being carried out for the adoption of the Energy Efficiency Action Plan, which is an obligation under the Energy Community Treaty. NEEAP BiH referring to the obligation to promote efficient heating and cooling (Article 14 of the Directive 2012/27/EU), considers the following viable alternatives for improved energy efficiency in this area:

- Use of high-efficiency cogeneration;
- Efficient heating and cooling;
- Heating using waste heat from industrial processes and renewable energy sources;
- Use of other efficient heating and cooling options, in the case that none of the above options are economically feasible.

Table 9 provides an overview of current strategic documents related to heating and cooling system replacements at the Federal and Cantonal level.

Table 9: Strategic documents in BiH including targets regarding sustainable heating and cooling system

Strategic documents		Targets / objectives / measures	
(plans, strategies, programs, actions, and roadmaps)		Targets / objectives / measures	
ENTITY LEVEL – FEDERATION OF BIH	Environmental Protection Strategy of FBiH for the period of 2008-2018. (2009)	The main strategic objectives are as follows:	<ul style="list-style-type: none"> • Emissions reduction from the sources (stationary-large heating units and small heating units, and mobile units); • The air quality management as an integral component of spatial and urban planning; • Improving the use of energy (increasing energy efficiency and the use of renewable energy sources).
	Strategic Plan and Programme of the Energy Sector Development of FBiH for the period 2010-2030. (2009)	The Plan covers and contains goals related to the renewable sources of energy, among which:	<ul style="list-style-type: none"> • Consider the possibility of construction of district heating to biomass (Possibly in combination with solid waste), in places with developed wood industries, along with the power plants of industrial enterprises; • Investigate the possibility of building hybrid system (hybrid systems of renewable energy, for example. biomass / solar thermal energy, and renewable energy with natural gas, for example. natural gas / solar thermal energy); • Establish the system of liquid fuels substitution by renewable sources, especially in facilities of public institutions;
	Renewable Energy Action Plan for the Federation of Bosnia and Herzegovina (Official Gazette of the Federation of BiH, issue no. 48/14)	Sets targets for the share of energy from renewable sources by 2020 as a total final consumption for the heating and cooling sector. The projected increase the participation of renewable energy sources in this sector is from 46.8% to 49.5% by 2020. The defined measures to achieve this goal are:	<ul style="list-style-type: none"> • Stimulation of the renewable energy sources usage in heating and cooling sector; • Encourage the application of cogeneration;

Strategic documents (plans, strategies, programs, actions, and roadmaps)		Targets / objectives / measures
LOCAL – CANTONAL LEVEL (Canton of Sarajevo)	Cantonal Plan of Environmental Protection of the Sarajevo Canton (KEAP) for the period 2016 - 2021	<p>One of the strategic goals set in the KEAP is to "improve energy use" in the field of air quality management. The objective is to elaborate on operational objectives and defined measures to achieve the objectives as follows:</p> <ul style="list-style-type: none"> • The initiative to create or complement legal regulations with the aim of limiting the use of solid fuels; • Development of a strategy on limiting the use of solid fuels in the Sarajevo Valley; • Developing the energy development plan to 2030; • Study of expanding the district heating system in the area of Hrasnica;
	Spatial Plan of Canton Sarajevo for the period 2003-2023	Regulates the routing and monitoring of the district heating system development, which is operated by PUC Toplane-Sarajevo. In the area "development of the district heating system" further states that the implementation of development plans (measurement of heat consumption, as an element of the management of the energy system, replacement of radiator convectors, replacement of hand valves, construction of cogeneration plant, etc.) expected to achieve significant savings in the needs of energy products.

The list of key relevant policies is provided in Table 10.

Table 10: List of key policies on sustainable heating and cooling systems in Bosnia and Herzegovina

FBiH	Description
Law on Energy Efficiency ¹³	In the Federation of BiH, there is a legal framework for energy efficiency in buildings stipulating that every new building has to have an energy performance certificate (EPC) when applying for the final permit. EPCs are the most visible aspect of the new regulation concerning the energy performance of buildings. This document assigns an energy performance label to residential and non-residential buildings or building units. The minimum energy performance of the existing building after renovations is class B (which stipulates that the maximum energy consumption for heating is 95 kWh/m ² annually)
Law on the Use of Renewable Energy Sources and Efficient Cogeneration ¹⁴	The Law on RES adopted in 2013, established the main legal framework and implementation model of the incentive system in FBiH. The Law containing provisions and obligations for more intensive guidance in terms of the use of renewable energy sources, especially in the case of new facilities where it is technically and economically justified, it is expected that the intensity of the implementation of RES projects in the forthcoming period will experience its expansion. The purpose and scope is to ensure the widespread use of renewable energy sources in order to meet the target for the share of renewable energy in final consumption — 41% by 2020 defined within the Energy Community.
Law on Public Enterprises of FBiH ¹⁵	The Law regulates certain issues of management and business in public companies. Public companies are defined as economic companies that perform activities of public interest (including public activities).
Rulebook on Regular Energy Audit of Heating System and Air Conditioning Systems ¹⁶	<p>The Decree regulates the following issues:</p> <ul style="list-style-type: none"> • Manner, conditions, mandates and procedures for conducting regular energy audits of heating systems and air-conditioning systems, • Time intervals of conducting regular energy audits depending on the technical characteristics of the system,

13 Official Gazette of FBiH, No. 22/17

14 Official Gazette of FBiH, No. 70/13 and 05/14

15 Official Gazette of FBiH, No. 8/05, 81/08, 22/09 and 109/12

16 According to Article 29, paragraphs (3) and (4), 36. and 37 of the Law on Energy Efficiency FBiH (Official Gazette of FBiH, No. 22/17) and Article 1, paragraph (5) Decree on Auditing and Issuing Energy Certificates (Official Gazette of FBiH, No. 87/18)

FBIH	Description
	<ul style="list-style-type: none"> • Form and contents of the report on the regular energy audit, • Conditions necessary to acquire the authorisation to carry out the regular energy audits of the heating and air-conditioning system, • The conditions necessary to acquire the mandate to carry out training and training programmes.
Canton of Sarajevo	Description
Law on Public Utilities of Canton of Sarajevo ¹⁷	The Law regulates the supply of thermal energy through a district heating system in Canton of Sarajevo.
Decree on General Conditions for the Production, Supply and Use of Heat Energy ¹⁸	The Decree regulates in more detail the production, delivery for heating and preparation of hot water consumption in buildings, conditions for the connection of buildings, contractual relations, production, supply and sale of heat energy, conditions of measurement, calculation and heat consumption, conditions for the application of the process of interruption of delivery or suspension of the supply of heat energy, and procedures for determining compensations.
Decree on the Subsidizing of Heating Costs ¹⁹	The Decree recognises the right to subsidize heating costs for five months (January, February, March, November and December), and regulates the conditions, manner and procedure for obtaining the right to finance the costs of heating.
Decision on Protection and Improvement of Air Quality in the Canton of Sarajevo ²⁰	<p>The Decision regulates the management of air quality in the area of Canton of Sarajevo, which includes: involvement of the competent authorities of the administration and administrative organizations of Canton, City and municipalities, and other legal entities in the system of air quality management, identification of sources and register of emissions into the air, limitation and monitoring of air emissions, maintenance of flue facilities, informing and training in order to improve air quality. Specific provisions contained in this Decision are as follows:</p> <ul style="list-style-type: none"> • Combustion plants can only use those types of fuels for which they are designed; • The construction and use of combustion plants whose normal exploitation will not satisfy the emission limit values for

17 Official Gazette of Canton of Sarajevo, No. 14/16, 43/16, 10/17 and 19/17

18 Official Gazette of Canton of Sarajevo, No. 22/16

19 Official Gazette of Canton of Sarajevo, No.4/05, 07/08, 37/13, 51/14 and 8/18

20 Official Gazette of Canton of Sarajevo, No.23/16

FBIH	Description
	<p>installations in accordance with the Rulebook on Emission Limit Values in the Air from Combustion Plants in FBIH is forbidden.</p> <ul style="list-style-type: none"> • Owners of residential and commercial premises are obliged to provide regular cleaning and inspection of the flue facilities.

2.3.2 Financial and legislative promotion

Support schemes to promote the use of energy from renewable resources in heating and cooling: In order to achieve the goals, set for the heating and cooling sector in Bosnia and Herzegovina by 2020, in addition to using biomass for household heating, other forms of renewable energy that have been neglected so far should also be used, all for the purpose of reducing the share of fossil fuels. Pursuant to the Law on the Use of Renewable Energy Sources and Efficient Cogeneration (Official Gazette of the FBiH 70/13 and 5/14) incentive programmes for central heating and cooling using RES are planned. Here are some of the definitions contained therein:

- The Federal Government, upon proposal from the Ministry, shall enact a decision on issuing of the origin guarantee for heat energy generated using RES.
- Origin guarantees from the previous paragraph can be used on the federal territory only.
- Decision on issuing origin guarantee shall be enacted by the Federal Government once the RES&EC Operator is established.

Still, the incentives model is lacking for the full implementation and realization, therefore implementation of such projects on the field will be postponed. The financial instrument adopted by the laws are the feed-in tariffs for electricity produced by renewable energy sources. Also, there is no specific feed-in tariffs for heat production from cogeneration or renewable sources. The incentives are backed by interconnection policies that provide CHP and renewables with transparent and consistent interconnection procedures for selling the generated electricity to the grid.

The Revolving Fund for Energy Efficiency of the Federation of Bosnia and Herzegovina

The Revolving Fund for Energy Efficiency (hereinafter: EE RF) operated by the Environmental Fund of the Federation of BiH provides loans placed via public calls and are available to natural and legal persons. This is the first true revolving fund in Bosnia and Herzegovina and financing is allocated under very favorable terms (interest rate 0-4%, grace period up to 12 months, repayment period up to 7 years). EE RF enabled to finance following EE projects:

- energy efficiency in public and residential sector,
- energy efficiency in industrial processes,
- energy efficiency within existing energy generating units and primarily distribution systems, and
- renewable energy sources as energy efficiency measures.

Subsidizing the heating costs for households with low-income (Canton of Sarajevo):

At the cantonal level, the right for subsidizing the heating costs is regulated by Decree on the Subsidizing of Heating Costs. According to the regulation, heating costs are considered to be the costs of district

heating, natural gas, electricity and solid fuels, and heating costs of only one type of energy can be subsidized.

Subsidizing the PUC Toplane-Sarajevo district heating company and the distributive gas system operated by the PUC "Sarajevogas" Sarajevo:

Law on Public Utilities of Canton of Sarajevo regulates subsidizing the PUC Toplane-Sarajevo district heating company and the distributive gas system operated by the PUC "Sarajevogas" Sarajevo. It generally regulates the principles, manner of performing and financing public utilities, and other issues of importance for the successful performance of public utilities in the area of Canton of Sarajevo.

Table 11: Instrument assessment for Canton of Sarajevo region

Instrument	Type	Level	Encourages replacement	Directs the purchase	Impact
Support schemes to promote the use of energy from renewable resources in heating and cooling	R	E	X	X	Moderate
Subsidizing the heating costs for households with low-income (Canton of Sarajevo)	F	L		X	High
Subsidizing the PUC Toplane-Sarajevo district heating company and the distributive gas system operated by the PUC "Sarajevogas" Sarajevo	F	L		X	High
The Revolving Fund for Energy Efficiency	F	E	X	X	Moderate

Type: regulation (R), improvements (I), financing (F)

Level: national (N), regional (R), local (L), entity (E)

Impact: very low, low, moderate, high, very high

2.3.3 Drivers and barriers

Following table gives a brief overview of the main identified drivers and barriers per aspect (end consumer side, policy side and market side). As one could conclude there are lack of drivers from policy and market point of view.

Table 12: Drivers and barriers assessment

Aspect	Driver(s)	Barrier(s)
	Subsidizing the cost of new connections of residential buildings to the gas distribution network – implemented by Ministry of Spatial Planning, Construction and Environmental Protection of Sarajevo Canton	There is not enough information on the market to encourage informed decision making when selecting heating and cooling devices
	Allocation of governmental budget for replacement of old inefficient stoves in households– implemented by Ministry of Spatial Planning,	The end consumer is not shown the comparative characteristics of different heating and cooling devices in the context of their efficiency, energy

End consumer side	Construction and Environmental Protection of Sarajevo Canton	consumption and benefits leading to non-sustainable choices
	Financial and technical support to Canton Sarajevo citizens via Energy Efficiency Model (for more see Success stories) - implemented by Sarajevo Development Agency	Regional demand for highly-efficient heating appliances is hindered by buyers' low awareness of the benefits of certification and efficiency of appliances
Policy side	Feed in tariffs for efficient cogeneration are in place (regulated on entity level)	No energy strategy at cantonal level, which should contain priorities for expanding the district heating and gas distribution systems including heating from RES
		Spatial planning documentation does not detail the area covered by the district heating system
		Incentive measures for the use of renewable energy sources for heating and cooling envisaged by the Law on the use of renewable energy sources and efficient cogeneration have not been put in place
Market side	Workshops to present the new technology and systems; Promotion energy efficiency through the social networks and other media networks.	The lack of regional market structures for RES fuels such as biomass
		New modern equipment is imported from abroad (region and EU) (e.g. heating pumps)
		Lack of skilled and qualified staff within heating and cooling value chain: designers, installers, energy auditors. Dependency on the external knowledge and experiences that lead to increased operational costs

2.3.4 Key considerations for defining policy sets

- At the cantonal level, energy strategy was not adopted to determine strategic directions and priorities regarding the expansion of the district heating system operated by PUC Toplane-Sarajevo and the distributive gas system operated by the PUC "Sarajevogas" Sarajevo.
- A Law on Thermal Energy is in preparation in the Federation of Bosnia and Herzegovina and there is no heat-energy tariff system in place nor the regulator of heat energy; however, a more coherent framework regulating heating and cooling sector operation at the national, entity and local level needs to be established.
- The Rulebook on conditions for production and delivery of heat energy at the cantonal level is not yet adopted by the Minister of communal activities and infrastructure. The Adoption of the aforementioned act would stipulate the regulations on general conditions for the production, supply and use of heat energy.

- Subsidizing mechanisms to increase the energy efficiency of residential buildings and incentives for the replacement of inefficient heating and cooling appliances are not yet sufficiently developed at the federal and cantonal levels.
- Municipalities issue permits for the construction of facilities with individual heating plants and in areas where the municipal infrastructure for connection to the remote heating system has already been secured. This is not in accordance with the regulations adopted at cantonal level. The Law on municipal activities regulates the obligation for the building owners to join their buildings on communal infrastructure under the conditions established by regulations about the area of spatial planning and construction, as well as other regulations.
- There are no measures to increase a share of RES in final consumption in the heating and cooling sectors for the pilot area (Canton Sarajevo). This matter has not been harmonised with the Directive 2009/28/EC, and their standardisation is therefore necessary.
- There is a critical need for governments in the canton to take a strategic view at heating and cooling sector and put in place adequate policies to trigger citizens to utilize affordable and quality heating services. The challenge facing governments, both at the national and local levels, is to design policies and promote investments that enable all people to access clean and affordable heating. Such policies should consider the advantages of centralized (DH) and de-centralized (stoves) heating systems according to specific market conditions.

2.3.5 Success stories

Ministry for Spatial Planning, Construction and Environment of Canton Sarajevo in cooperation with the Sarajevo Regional Development Agency (SERDA) implements the project "Model for improving energy efficiency in building sector in Canton Sarajevo" (hereinafter: EE Model) to increase the number of users of the model and represents a universally applicable, transparent, non-discriminatory and socially sensitive framework for the promotion and support of energy projects efficiency in Sarajevo Canton. The objective of the Model is to provide systematic support to citizens in improving energy performance, under more favourable conditions. Reducing the energy needed to heat residential buildings will result in reduced air pollution and improved user comfort. The EE model seeks to reduce the consumption of solid fuels, especially in urban areas and the sustainable use of natural gas for heating.

The BASIC PRINCIPLE on which the EE Model is based is the payment of energy efficiency costs from the savings achieved, meaning that there is no cost increase for building owners implementing energy efficiency measures, and therefore the project slogan is: WARM BUILDING - HALF ACCOUNT.

Potential beneficiaries of the Model are:

- Owners in collective housing buildings
- Owners of individual residential buildings (houses) and
- Public facilities.

The beneficiaries of the EE Model project are individual residential and collective housing units from the Sarajevo Canton municipalities, which includes the urban urban core and the slope parts of the Sarajevo Canton municipalities.

Benefits for project users:

- Costs of energy audits and project documentation for implementation of energy efficiency measures are covered

- Possibility of using a dedicated credit line with banks that are partners in the implementation of the Model EE
- Subsidizing a portion of the interest rate for beneficiaries who have been granted credit under the project
- Co-financing up to 45% of the cost of insulation of buildings and other energy efficiency measures provided for a given facility
- Expenditure on construction supervision to improve energy efficiency in buildings is covered.

The model envisages the promotion and education activities of condominium collective building owners and individual object owners on the benefits of implementing energy efficiency measures in residential buildings, above all energy savings and improving the air condition, but also some others that are in line with the EU and worldwide commitment.

Project was launched in 2019. So far, no online information could be obtained vis-a-vie the implementation phase.

2.3.6 HC replacement outlook

- Canton Sarajevo Government is planning to establish the Air Quality Management Center as an administrative organization within the Ministry of Spatial Planning, Construction and Environmental Protection. Priorities are the statistical processing of the air quality data collected so far, the application of computer fluid mechanics for the purpose of modelling airflow for urban planning purposes, as well as campaigns to reduce energy losses in individual residential buildings, that is, to change the way of combustion with appropriate instructions, establish counseling centers and work with citizens, lectures in schools and local communities.
- The United Nations Development Program (UNDP), in partnership with the Ministry of Spatial Planning, Construction and Ecology of the Republika Srpska, has started implementation of the project called “Fourth National Climate Change Report and the Third Biannual Report on greenhouse gas emissions in line with the United Nations Framework Convention on Climate Change (UNFCCC)”. The project aims to achieve sustainable development without further threatening the environment, thereby facilitating economic growth while reducing the increase of greenhouse gas emissions and adapting to the negative effects of climate change.
- Set of “Integrated Energy and Climate Plans - National Energy and Climate Plans (NECP)” are under development. It is expected that those plans imply adherence to the goals of the Energy Union by 2030 - modified EnCS; to provide security and predictability for investors and simplified monitoring of energy and climate commitments.
- A Law on Thermal Energy is in preparation in the Federation of Bosnia and Herzegovina; however, a more coherent framework regulating heating and cooling sector operation at the national, entity and local level needs to be established.
- Sarajevo Canton and the European Bank for Reconstruction and Development (EBRD) have launched the Green Cantonal Action Plan (GCAP) with the aim of updating the Cantonal Environmental Plan, in line with the EBRD methodology, as part of the Canton's inclusion in the EBRD Green Cities. The GCAP includes: assessing and prioritizing environmental challenges as well as developing an action plan to tackle these challenges through policy interventions and sustainable infrastructure investments and facilitating and stimulating public or private green investments in water and wastewater, urban transport, district energy, individual heating, buildings energy efficiency, solid waste and other interventions that improve the city's adaptation and resilience to climate shocks.

- Promote switching to efficient biomass heating technologies through the introduction of incentive schemes to facilitate refurbishments/conversion of DH systems and heat-only boilers and promote local manufacturing and energy labelling of efficiency firewood stoves.

2.4 North-West Croatia and Primorje-Gorski Kotar County, Croatia

Geographical area of the REPLACE project covers two regions in Croatia: North-West Croatia and Primorje-Gorski Kotar County. North-West Croatia region covers three counties: Karlovac, Krapina-Zagorje and Zagreb county and the City of Zagreb, which is considered a county according to the City of Zagreb Act (NN 62/01, 125/08, 36/09, 119/14, 98/19). Project partner Regional energy agency North-West Croatia (REGEA) coordinates the project implementation in the North-West Croatia and the Energy Institute Hrvoje Požar (EIHP) coordinates the project implementation in the Primorje-Gorski Kotar County. Geographical coverage is given in the figure below.



Figure 11 Geographical scope of the REPLACE project

The chapter includes both North-West Croatia and Primorje-Gorski Kotar County as the national regulatory, strategic and financial framework is applied in all counties equally and no differences between the counties were observed in those aspects.

2.4.1 Overview of policy instruments for sustainable heating and cooling system replacements

Integrated National Energy and Climate Plan for the Republic of Croatia for the period 2021-2030 (Ministry of environment and energy, 2020)

In accordance with the Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action (EC, 2018), each Member State is obliged, in accordance with the prescribed content and dynamics, to develop integrated energy and climate plans for a ten-year period, the first one covering the period from 2021 to 2030. Croatian **National Energy and Climate Plan for the period 2021-2030** (hereinafter: NECP Croatia) provides an overview of Croatian national targets for each of the five key dimensions of the Energy Union and appropriate policies and measures for achieving these goals, as well as it establishes an analytical basis. NECP Croatia builds on the work done on the draft of the Low-Carbon Development Strategy of the Republic of Croatia until 2030 with an outlook to 2050 and the draft Energy Development Strategy of the Republic of Croatia until 2030 with an outlook to 2050.

National climate and energy targets given in the NECP Croatia are the following:

- greenhouse gas (hereinafter: GHG) emissions covered by the EU Emissions Trading System (hereinafter: ETS) reduced by 43%;
- GHG emissions not covered by the ETS, reduced by 7% compared to 2005;
- share of energy from renewable energy sources (hereinafter: RES) in gross final energy consumption in 2030 increased to 36,4%;
- share of energy from RES in final energy consumption in the transport sector in 2030 increased to 13,2%;
- primary energy consumption (total energy consumption without non-energy consumption) to reach 344,38 PJ (8.23 ktoe);
- final energy consumption to reach 286,91 PJ (6,85 ktoe).

In the table below are given measures of the NECP Croatia considered to be of importance for the REPLACE objectives.

Figure 12: Measures of the NECP Croatia

Abbreviation	Measure	Description
OIE-1	Information, education and capacity building for RES use	Dissemination of information to the general public and target groups through targeted information campaigns related to investments in systems using RES, especially in systems for own needs. The measure will be implemented in order to build the capacity of consumers who produce energy for their own needs and energy communities.
ENU-3, ENU-4, ENU-5, ENU-6	Energy renovation programmes for single-family houses, multi-apartment buildings, public sector buildings	Energy renovation programmes for different buildings' categories will provide grants for energy audits, energy certificates, project documentation and technical assistance in the preparation and implementation of the renovation project. This also includes the replacement and reconstruction of the existing heating systems with the energy-efficient ones. It is highlighted that the implementation of programmes must be accompanied by strong promotional activities and technical

Abbreviation	Measure	Description
	and heritage buildings	assistance to applicants to ensure correct implementation and raising awareness.
ENU-12	Providing information on energy efficiency	Providing information to the general public and target groups shall be conducted through the organization of targeted information campaigns related to specific programmes of promoting energy efficiency, particularly energy renovation of buildings. The National Energy Efficiency Authority will maintain the national energy efficiency portal and provide up-to-date information to ensure the continued promotion of energy efficiency and energy services.

The Energy Strategy of the Republic of Croatia

The Energy Strategy of the Republic of Croatia (Ministry of economy, labour and entrepreneurship, 2009) is considered a fundamental document for further development of the energy policies of the Republic of Croatia. It follows three energy goals: security of energy supply, the competitiveness of the energy system and sustainable energy development. The public consultation process for the new Energy Strategy of the Republic of Croatia by 2030 with a view to 2050 (Vlada RH, 2019) has been completed and it is expected that the new Strategy will be soon adopted. The new Energy Strategy is focusing on the transition to low carbon energy, thus providing a wide spectrum of initiatives and energy policies, which should ensure reliable, secure and quality energy supply. Targets, measures and activities identified in the new Energy Strategy are aligned with the measures given in the NECP Croatia.

The National Renewable Energy Action Plan by 2020 (Ministry of economy, 2013)

The National Renewable Energy Action Plan adopted at the end of 2013 sets the overall national target for renewable energy, as well as sectoral targets and trajectories for the production of electricity, heating and cooling energy and energy in the transport sector from RES. The heating and cooling sector is closely linked to electricity generation in CHP plants, and as such contributes to the overall target of up to 20% by 2020 with a share of 8.2%. One of the measures identified in the National Renewable Energy Action Plan by 2020 is to incentivize and promote using RES for heating and cooling systems.

The Fourth National Energy Efficiency Action Plan for the period until the end of 2019 (Ministry of environment and energy, 2017)

In January 2019, the Government of the Republic of Croatia adopted the Fourth National Energy Efficiency Action Plan for the period until the end of 2019, which relies heavily on the Program for the Utilisation of Heating and Cooling Potential for the period 2016.-2030. and its conclusions and suggestions in the area of efficient heating and cooling. The Fourth National Energy Efficiency Action Plan pinpointed a number of measures necessary to improve energy efficiency in different sectors, educate energy consumers about energy efficiency and reduce energy poverty. Additionally, it established a foundation for the implementation of energy renovation programmes for different categories of buildings, which started in 2016. The action plan also indicated the possibility of financing the implementation of the energy-efficient RES heating systems in the family houses through funds acquired from the sale of emission allowances by auctioning on the ETS.

Programme for the Utilisation of Heating and Cooling Potential for the period 2016.-2030 (Ministry of economy, 2015)

This programme was developed in 2015 for the period between 2016 and 2030 and the evaluation and analysis conducted as part of the programme was focused on the existing district heating systems (hereinafter: DHS) and its development, as well as utilizing additional energy infrastructure potential. This program provides an assessment of national potentials for cogeneration and energy efficiency improvement of infrastructure, forecasting changes in energy consumption for heating and cooling over ten years, along with a description of measures, savings and opportunities to develop heating and cooling thermal energy systems in Croatia. The program mainly focuses on heating systems that use waste heat as well as thermal energy generated from cogeneration plants on natural gas and biomass, while heat pumps and solar collectors are listed as an option but not discussed in detail in this program. Although relevant for the wider scope of the heating and cooling sector in Croatia, the programme in question does not tackle the replacement of inefficient boilers on a smaller scale, ie. households.

The Energy renovation programme of family houses²¹

Single-family houses comprise 65% of housing stock in Croatia and with the majority of them built before 1987, thermal insulation and heating systems are not up to current energy standards. In order to address this issue, as well as to increase the energy efficiency of existing single-family homes, reduce energy consumption and consequently energy bills, Croatian government initiated Energy renovation programme of family houses for the period between 2014 and 2020 at the proposal of the Ministry of Construction and Physical Planning (hereinafter: MCPP). The programme was aligned with the 3rd National Energy Efficiency Action Plan, which covered the period between 2014 and 2016. Body responsible for the implementation of the Programme is Environmental Protection and Energy Efficiency Fund (hereinafter: EPEEF) and the first public call was open in 2014 for proposals from local and regional government authorities for co-financing of the energy efficiency measures for single-family homes and for the use of RES in single-family homes in their area.

In order to ensure the widest possible scope of the Programme, it was amended in 2015, enabling direct application of citizens for co-financing of energy renovation and the replacement of the inefficient heating systems, thus abolishing the “intermediary” in the form of a local or regional government authority.

The updated version of the programme with a detailed plan for 2020 is currently in the process of public consultation and the public call is expected to be published in the first quarter of 2020. Eligible co-funded activities will be renovation of the building’s envelope and installation of RES systems (solar thermal collectors, pellet boilers, pyrolytic boilers and geothermal heat pumps). For the upcoming period programme activities will be secured using the funds acquired from the sale of emission allowances through EU ETS auctions.

The Energy renovation programme for multi-apartment buildings²²

It is estimated that in Croatia there are about 50 million m² of useful floor area in multi-residential buildings. These buildings were mostly built before 1987, thus consuming large quantities of heat energy, approximately 200-250 kWh/m². In July 2014, the Government of the Republic of Croatia, in cooperation with the MCPP and the EPEEF as the implementing body, adopted the Energy renovation programme of multi-apartment buildings for period 2014 to 2020. During the first three years of implementation, the EPEEF provided 268 million HRK in grants, of which 200 HRK million was granted only for energy renovation works of 257 buildings with total works worth 461 million HRK. Measures

21 <https://esavjetovanja.gov.hr/ECon/MainScreen?entityId=13221>

22 <https://narodne-novine.nn.hr/clanci/sluzbeni/dodatni/432095.pdf>

eligible for co-financing were: energy audits and energy certification of buildings, technical aid for the preparation of project documentation for the renovation of a building, encouraging the integral renovation of apartment buildings (increasing the thermal insulation of the outer envelope, replacement of windows, improvement or replacement of the heating system) and installation of a system for individual measurement of thermal energy consumption.

Since 2016, source of grant funds for the energy renovation of multi-apartment buildings are European structural and investment funds (hereinafter: ESIF) distributed and aligned with the Operational Programme Competitiveness and Cohesion 2014-2020 (hereinafter: OPKK). Strategic framework of OPKK provides 100 million EUR for the reconstruction of the housing sector by 2020, of which approximately 70 million EUR is intended for the reconstruction of multi-family buildings. Number of the eligible applications exceeded the originally allocated budget for co-financing and the managing authority approved almost fivefold increase of the budget allocation. The MCCP announced a new public call for proposals for energy renovation of multi-apartment buildings to be published in the first quarter of 2020, which will support the implementation of energy renovation measures and the use of RES.

Energy Efficiency Action Plan (county levels)

In accordance with the provisions of the Energy Efficiency Act (Official Gazette 127/14), each county in the Republic of Croatia is obliged to develop an Energy Efficiency Action Plan, a planning document for a period of three years, which establishes policies and identifies strategic activities for improving the energy efficiency of final energy consumption in the counties, ie. regional government units. Measures and activities given in action plans of all three counties and the City of Zagreb in North-West Croatia considered by the REPLACE project (Karlovac, Krapina-Zagorje and Zagreb County) and Primorje-Gorski Kotar County have similar scope and objectives. Majority of the activities is related to the energy renovation of public buildings (schools, kindergartens, health centres, public administration buildings etc.), raising awareness about energy efficiency, conducting information campaigns for citizens on the use of RES and energy efficiency, as well as installation of photovoltaic systems on the roofs of public institutions and industrial zones.

2.4.2 Financial and legislative promotion

Legal and regulatory framework conditions

Currently, the main regulatory framework document involving the replacement of heating and cooling systems is the Energy renovation programme for family houses and the Energy renovation programme for multi-apartment buildings described in the previous subchapter. These programmes published by the MCCP and implemented by the EPEEF are aligned with the OPKK and are providing framework conditions for co-financing of the integral energy renovation including installation of RES heating systems and boiler replacement in households. Currently, both programmes are in the public consultation process being prepared for an update and no calls for proposals are published.

Announced update of the Energy renovation programme of single-family houses, which is to be adopted in 2020, excludes financing of the replacement of the inefficient boilers. The previous version of the programme included elements enabling the funding of the boiler replacement with the energy-efficient condensing gas boilers. Due to the buildings' decarbonisation initiative, the replacement of inefficient boilers with the condensing gas boilers is no longer eligible for funding in the programme update. However, the updated version of the Energy renovation programme for multi-apartment buildings that is in the public consultation process includes following measures related to the heating system replacement:

- Installation of a new highly efficient heating system or improvement of an existing one;
- Replacing or improving the existing domestic hot water preparation system with a highly efficient system;
- Promoting the use of RES for the domestic hot water preparation and heating.

The Construction Act (Official Gazette 153/13, 20/17, 39/19, 125/19) with the related technical regulations and rules define the requirements that have to be met when constructing new and renovating existing buildings. These regulations and requirements also include heating and cooling systems in the building. According to the new Construction Act (effective 10th of March 2020) the owner of a building with a heating and/or cooling system is obliged to ensure a regular inspection of the available parts of the heating and/or cooling system or combined heating and/or cooling and ventilation system with an effective rated power of more than 70 kW. Examples of the parts to be examined are heat generator, control system and circulation pump or pumps used for heating the buildings. The inspection has to be done at least once in ten years, which can be performed together with the energy audit of the building. The inspection shall include an assessment of the efficiency and capacity of the heat generator relative to the heating needs of the building and, where appropriate, take into account the capabilities of the heating system or combined space heating and ventilation system to optimize its efficiency under typical or average operating conditions. Regulations related to the replacement of heating systems, besides Construction Act, are Technical regulation on heating and cooling systems in buildings (Official Gazette 110/08), Technical regulation for chimneys in buildings (Official Gazette 3/07) and Regulations on simple and other structures and works (Official gazette 112/17, 34/18, 36/19, 98/19).

As of September 2015, EU has adopted stricter eco-design standards for home boilers sold across the EU, allowing only gas boilers and water heaters with energy-efficient condensation technology to be sold. Although the households are not required to replace their old inefficient boilers immediately, adoption of the new standards is causing difficulties for the owners of the old boilers.

It is estimated there are around 70.000 – 100.000 classic gas boilers of C4 type installed in Croatia, out of which 50.000 is installed in Zagreb area. Buildings in which these types of boilers are installed, have shared chimney system which only supports classic gas boilers. Replacing the classic gas boilers with the condensation gas boilers would require substantial investments. Additionally, to replace a single classic gas boiler in one apartment in the multi-apartment building, every boiler connected to the shared chimney system to which the boiler to be replaced is connected to, has to be replaced at the same time regardless of its state/condition. This situation caused a lot of stir with the homeowners as it would cause substantial (unnecessary) expenses on behalf of the homeowners. Croatia brought forward concerns regarding this EU regulation requirement in 2019, suggesting excluding specific gas boilers (classic gas boilers, type C4) from the regulatory requirements but the outcome is still unknown.

Policy measures

Based on the Energy Efficiency Act (Official Gazette 127/14, 116/18) every county and cities with a population of more than 35.000 people are obliged to prepare Energy efficiency action plan for a three year period, which provides strategic framework for the implementation of policies for improving energy efficiency in counties or large cities. These action plans and the measures within are oriented towards improving energy efficiency in public sector. The Fifth National Energy Efficiency Action Plan for the period beyond 2020 is currently being developed.

However, cities and municipalities, which are signatories of the Covenant of Mayors initiative developed Sustainable Energy Action Plans (hereinafter: SEAP). Currently, there are 23 Covenant of Mayors signatories in the North-West Croatia region and Primorje-Gorski Kotar County. SEAP documents include energy efficiency measures for each sector of the city or municipality (public, households, transport etc.). Majority of SEAP documents were developed for the period until 2020,

which causes a gap as the energy efficiency measures for the period between 2020 and 2030 are not drawn up in most cases. In the period between 2020 and 2030 SEAP documents will be updated to the Sustainable Energy and Climate Action Plans (hereinafter: SECAP) and currently, only City of Zagreb has prepared and adopted SECAP, while cities in Zagreb and Karlovac County (Velika Gorica, Sveta Nedelja and Karlovac) are in the process of developing SECAP documents for their respective areas.

According to the Act of Regional Development of Republic of Croatia (Official Gazzete 147/14, 123/17, 118/18), each county/regional governing authority is obliged to develop a regional development strategy determining development objectives and priorities for its area. Each development strategy on the county level promotes use of RES in households, public buildings, industry and agriculture sector and has a number of proposed indicators based on which the progress of the strategy implementation can be tracked. Although replacement of the inefficient boilers is not implicitly mentioned as one of the measures, Zagreb County has secured funds for the inefficient boiler replacement.

Instruments

The main financing instruments for the construction and development of renewable DH systems are the funds available from the EPEEF and from the ESIF granted as part of the OPKK. In 2019 EPEEF has published a series of public calls for co-financing energy efficiency and RES development projects in the households.

One of the public calls published by the EPEEF co-financed installation of the RES systems for heat energy production for own consumption in the households. Eligible activities within the call were the preparation of the project documentation, installation supervision and the purchase and installation of a biomass boiler or heat pump or solar thermal system. Maximum allocated funds per project were between 37.500 HRK and 75.000 HRK (approx. 5.000 EUR – 10.000 EUR), ie. between 40% and 80% of the investment, depending on the location of the household and its development index. The total amount of available resources within the call amounted to 11.000.000 HRK (approx. 1.450.000 EUR). This public call, as well as similar ones, has proven to be extremely attractive to the citizens as it closed before the application deadline, due to the utilization of the allocated funds. In this specific example, the call was closed one week after the publication indicating the demand on the market for similar initiatives.

Inefficient boiler replacement was one of the eligible activities in the public call for co-financing the installation of photovoltaic systems and condensing gas boilers for single-family homes in the area of Zagreb County in 2019 published by Zagreb County. The maximum amount of funds that individual household could obtain for the installation of condensing gas boilers was 50% of the eligible costs, ie. up to 15,000.00 HRK (approx. 2.000 EUR) and the total amount of funds available for this activity was 500.000 HRK (approx. 67.000 EUR). Similar to the public call for co-financing the installation of the RES systems for heat energy production published by the EPEEF, all allocated funds were used. The same activity is planned in Zagreb County budget for this year.

Although public calls for energy renovation of single-family houses and multi-apartment buildings published by the MCCP, listed chimney reconstruction as an eligible co-financing activity, it was often overlooked and not included in the reconstruction design. To address this issue Croatian Chamber of Commerce and its Association of Chimney sweepers issued a statement “Quality chimneys are prerequisite of safe and efficient heating” in 2019. The issued statement encourages the joint implementation of the activities within energy renovation public calls published by the MCCP and the Commission regulation (EU) No 813/2013 of 2 August 2013 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for space heaters and combination heaters (“EC Regulation 813/2013,” 2013). The statement highlights the criteria,

normative references and chimney reconstruction costs providing necessary information for all involved stakeholders in order to boost the chimney reconstruction rates.

Table 13: Instrument assessment for North-West Croatia and Primorje-Gorski Kotar County

Instrument	Type	Level	Encourages replacement	Directs the purchase	Impact
Financial incentives for the installation of the RES system for heating in single-family houses	F	N	✓	✓	High
Financial incentives for the installation of the RES system for heating in apartment buildings	F	N	✓	✓	High
Financial incentives for the installation of PV systems and natural gas condensation boilers in single family houses in Zagreb County	F	R	✓	✓	Very high
Campaign “Quality chimneys are prerequisite of safe and efficient heating”	I	N	✓	X	Low

Type: regulation (R), improvements (I), financing (F)

Level: national (N), regional (R), local (L)

Impact: very low, low, moderate, high, very high

2.4.3 Drivers and barriers

Figure 13: Drivers and barriers

End consumer side	
Drivers	<p>Financial incentives for energy renovation of family houses and multi-apartment buildings, which include installation of RES systems for own energy consumption and in some cases replacement of inefficient boilers.</p> <p>Energy savings due to the energy renovation and the installation of efficient heating and cooling systems.</p> <p>Lower energy bills due to energy savings caused by the efficient heating system.</p>
Barriers	<p>Large initial investment if no financial incentives are available.</p> <p>Lack of awareness about the potential energy savings and lower energy bills if the efficient boiler is installed.</p> <p>Lack of time to explore different possibilities if the boiler replacement is urgent (ie. old boiler broke down and cannot be repaired anymore).</p> <p>Expensive and time-consuming adaptation of the shared chimney system and each apartment connected to the shared chimney system in some multi-apartment buildings if the classic gas boilers (C4 type) are to be replaced with the condensing gas boilers.</p> <p>Inefficient boiler replacement requires consent of individual home-owners with functional boilers in multi-apartment buildings.</p>
Policy side	
Drivers	<p>Accomplishing national, regional and local energy efficiency objectives.</p> <p>Positive public perception of regional and local authorities providing the incentives for the energy efficiency measures.</p>
Barriers	<p>Updated version of the Energy renovation programme of family houses (to be published in the first quarter of 2020) removed the financial incentive for the inefficient boiler replacement, which was part of the previous version of the programme.</p> <p>Ecodesign Commission Regulation (EU) No. 813/2013 and Energy Label Commission Delegated Regulation (EU) No. 811/2013 for water-based space and combination heaters introduced new requirements for the gas boilers, not allowing classic gas boilers of C4 type to be sold in the EU after 2015.</p>
Market side	
Drivers	<p>Potential profit for the well-prepared companies (boiler manufacturers and installers), able to answer in a timely manner to the increasing demand.</p> <p>Expansion of business due to the increased demand for the boiler replacement.</p> <p>New jobs due to the increased demand for boiler replacement.</p>
Barriers	<p>Lack of qualified installers.</p> <p>Lack of affordable equipment aligned with the EU regulation.</p>

2.4.4 Key considerations for defining policy sets

The key considerations that have to be taken into account in both Croatian regions are as follows:

- Raising awareness of the potential energy savings and lower energy bills;
- Ensuring that the information and possible options for boiler replacements are clearly visible and accessible, i.e. making sure that when the proper policies are set, the information is disseminated and published on related sites;
- Since boiler replacements call for large investments, it is necessary to contemplate about ensuring financial incentives in some form and amount to stimulate the proper boiler replacement;
- The updated version of the Energy renovation programme of family houses, which will be published in the first quarter of 2020, removed financial incentives which formed a part of the previous version of the programme so it will be necessary to consider a rewrite and a new formulation of this document, taking in mind the necessity for some financial incentives;
- Consideration of possible incentives for the acquisition of equipment aligned with the EU regulation, which is necessary for proper boiler replacements;
- Making sure there are enough courses, workshops, lectures and info days throughout the regions (which are supported by the policymakers) for the education of installers on the new installation of new, more environmentally friendly and efficient heating and cooling systems.

2.4.5 Success stories

One of the most encouraging examples regarding HC replacement in Croatia is Tehnoston d.o.o. Vukovar, the first district heating (hereinafter: DH) company in Croatia to sell green heat, and there is remarkable interest in other utilities to follow up their example. In 2015 DH provider Tehnoston d.o.o. started its mission to introduce renewables into its DHS. The DHS of Tehnoston d.o.o. comprises six local boiler plants: two larger DHS Borovo Naselje and Olajnica and four smaller systems.

At the beginning of 2015, Tehnoston began with the transposition of one of the fuel oil boilers to pellets in DHS Borovo Naselje. In addition to pellets being a local and environmentally friendly energy source, its use contributes to reducing CO₂ emissions. With the application of new technology, the existing heat consumers living close to the local boiler plant now enjoy a healthier and cleaner environment. About 200 tons of pellets are used annually. The total investment amounted to approximately 500.000 HRK (approx. 67.000 EUR), and the city of Vukovar was the investor. The benefits to the local society were numerous: in addition to the domestic pellet supplied, the plant and most of the equipment was produced in Croatia and the local company was selected as the contractor. The pellet boiler was commissioned on December 16th 2015. The heat consumers reaped the benefits of a reduced price of heat by 38% (from the previous 56 lp/kWh to 35 lp/kWh).

At the beginning of 2019, a solar thermal field installation project (566 solar thermal collectors with a total installed power of 930 kWth) was launched, which will reduce natural gas consumption, especially during the summer. The completion of the project and the commissioning of the first phase of 160 solar thermal collectors was in June 2019, and the annual yield of the solar field is estimated at 300 MWh in the first year.

In 2020, additional 160 solar thermal collectors will be installed and in 2021 the remaining 246 solar thermal panels. In this way, almost 78% of the total consumption (98 MWh) will be produced at the point of consumption through the FN field, while reducing CO₂ emissions by 68 t/year. With these activities, the share of heat from the RES in 2019 will increase to a total of 7% with a growing share.



Figure 14. The solar thermal field in Vukovar.

Above all, the plan is to install a 300 kW air-to-water heat pump that will, at cheap electricity tariff, preheat the DH pipeline during the night. The existing SCADA system will determine, at 30-minute intervals, the energy source that would be economically the most cost-effective. In this way, the existing local boiler plant DHS Borovo Naselje will become the first 4G DHS in the Republic of Croatia.

Another interesting and new project in Croatia is Hotel Park, built in 2019 in Rovinj, known for its luxury and unique design, but as well as for the modern solution of thermo-technical installations, ie equipment for heating, cooling, ventilation and air-conditioning.

These are very encouraging examples not only for Croatia but for other countries as well. However, more promotion and education is needed and REPLACE for sure is one of the main drivers for innovation and progress in HC systems.

2.4.6 HC replacement outlook

It can be asserted that Croatia, i.e. both REPLACE regions in Croatia have significant potential for implementation of technologies for heating and cooling based on RES.

If we consider the replacement of old and inefficient technologies for heating and cooling in the household sector, then the solar energy and biomass can be considered as the most appropriate energy sources.

The obstacles for stronger implementation of efficient, renewable-based heating and cooling technologies can be divided into two main groups, as follows:

- **Technical:** In the sense of technical obstacles it can be concluded that there is a lack of knowledge of end-users on benefits that can be achieved by the usage of new and RES based technologies.
- **Non-technical:** Heating and cooling technologies based on RES, in general, have higher investment costs although the fuel is cheaper (e.g. biomass) or even free (e.g. sun, wind). Cost is usually the main deciding factor. Sometimes, e.g. in the case of biomass, storage and supply issues could be limiting factors. Regarding incentives, in Croatia, there are no subsidies available for thermal energy generated from RES. Therefore, the lack of financial support from the state/regional level is perceived as a limiting factor.

In order to overcome the above stated obstacles, it is necessary to have clear and no ambiguous policy framework related to the heating and cooling sector as well as for the entire integrated energy system. At the moment, a new Energy Strategy of the Republic of Croatia is in the process of preparation. It is expected that the new Energy strategy, together with accompanying law and sub-law acts will bring adequate measures to foster the stronger implementation of advanced technologies in the sector of heating and cooling.

In addition to that, to foster replacement of old and inefficient heating and cooling systems several actions could be undertaken. Some of them are listed below:

- Educational activities of end users: Common actions such as dissemination of best practice examples should be conducted to raise awareness. End users should be provided with relevant and reliable information on technical, economic and societal aspects of the usage of contemporary heating and cooling technologies.
- Educational activities of financial institutions: Even though some financial institutions have a credit line dedicated to energy efficiency/RES, it is perceived that more education and promotion to financial institutions on the economic sustainability and benefits of the introduction of new technologies are needed. Financial institutions managers do not have wide knowledge of the technical issues and benefits related to fuel switch or installations of new heating/cooling technologies based on RES.
- Capacity building of technical experts: Architects and engineering planners have limited experience with biomass, solar energy, heat pumps and in most cases lack of knowledge so they prefer gas-based heat system solutions. Thus, professionals should be provided with adequate knowledge and experience. It is necessary to ensure the transfer of know-how from well-experienced professionals to less experienced ones. In addition, it is necessary to motivate young and future professionals to specialise in modern heating and cooling technologies, i.e. to assure technical competencies.
- Administrative activities: Administrative procedures should be simplified and faster. Existing political/strategical decisions should be more severe and should put emphasis on the importance of RES in satisfying heating and cooling demands.

In general, more informative campaigns and education to the general public on the benefits of using RES for heating and cooling purposes is needed at national regional and local levels. More awareness raising on environmental and social benefits is needed as well. That is an initial and key step in order to overcome certain barriers and to take advantage of possible opportunities contemporary heating and cooling technologies provide.

2.5 Bayerisches Oberland, Germany

2.5.1 Overview of policy instruments for sustainable heating and cooling system replacements

In Germany, the objectives for heating and cooling systems are included in the overall strategy Energiewende (en. *energy system transition*). The objectives of the strategy is that it shall be reached by fostering renewable energies and by increasing energy efficiency and are targeted to five energy system transition platforms:

- energy nets (de. *Energienetze*)
- electricity market (de. *Strommarkt*)
- energy efficiency (de. *Energieeffizienz*)
- buildings (de. *Gebäude*)
- research and innovation (de. *Forschung und Innovation* -BMW, 2020)

Main target until 2030, is the reduction of greenhouse gas emissions by 55 % (compared to the emissions of the year 1990). In the so-called Klimaschutzplan 2030 (en. *climate protection plan*), the German parliament has updated the roadmap for the Energiewende and identified four elements that need to be realized:

- funding measures and incentives for CO₂ reduction
- pricing of CO₂
- reinvestment of additional revenues of the CO₂ pricing to the citizens
- regulatory measures (BMU, 2019)

Given, that the German building sector stands for 35 % of the national energy consumption, measures to reduce emissions from buildings and to increase their energy efficiency were already implemented. Especially for the heating sector, there are several funding measures available. On national level, six big funding measures were identified which include replacements of heating & cooling systems:

- Funding of the heating optimization by high-efficiency pumps and hydraulic balancing (Förderung der Heizungsoptimierung durch hocheffiziente Pumpen und hydraulischen Abgleich)
- Incentive program energy efficiency (Anreizprogramm Energieeffizienz (APEE))
- Energy efficient renovation – investment grant (Energieeffizient Sanieren - Investitionszuschuss (KfW-Produktnummer 430))
- Measures to promote the use of renewables in the heating market - market incentive program (Maßnahmen zur Nutzung erneuerbarer Energien im Wärmemarkt - Marktanzreizprogramm)
- Renewable Energies „Premium“ Deep Geothermics (Erneuerbare Energien "Premium" Tiefengeothermie (KfW-Produktnummer 272/282))
- Promotion of measures for increasing energy efficiency in agriculture and horticulture (Förderung von Maßnahmen zur Steigerung der Energieeffizienz in der Landwirtschaft und im Gartenbau) (BMW, 2020b)

2.5.2 Financial and legislative promotion

Since 2 January 2020, based on the market incentive program “Measures to promote the use of renewables in the heating market”, in Germany a replacement premium is available if oil heating systems will be replaced by a (at least partly) renewable heating source. Depending on the heating source which replaces the old oil heating system, up to 45 % of the costs will be funded. Table 14 shows the different funding rates for the eligible solutions. Those entitled to apply for the grants are:

- private persons,
- condominiums communities,
- freelancers,
- municipalities, area municipalities and special-purpose associations,
- companies, and
- non-profit organisations or cooperatives

The federal government, the regional governments and their facilities, as well as producers of eligible plants are not eligible to apply for the grants.

To receive funding, applications need to be made before the measures are carried out. Applicants can find and use an electronic application form on the internet pages of BAFA (Bundesamt für Wirtschaft und Ausfuhrkontrolle), the Federal Office of Economics and Export Control (<https://fms.bafa.de/BafaFrame/map>).

Together with the requirements to replace heating systems if they are older than 30 years (applicable for heating systems > 5 kW and < 400 kW and which are neither low temperature boilers nor condensing boilers (which is laid down in § 10 EnEV (energy saving regulations - Energieeinsparverordnung)), considerable effects are expected to be seen within the next years.

Table 14: Overview on funding for heating replacements (BAFA, 2020)

Type of heating system	Existing buildings		New buildings
	Funding rate ¹	Funding rate with replacement premium oil heating ¹	Funding rate ¹
Biomass or heat-pump system	35%	45%	35%
Solar collector heating system ²	30%		30%
Renewable energy hybrid heating (RE hybrids) ³	35%	45%	35%
Gas-hybrid heating	with renewable heat generation	30% ⁵	40% ⁵
	with later integration of renewable heat generation (Renewable Ready) ⁴	20% ⁶	

1 Funding rates refer to eligible costs for requested measures

2 As a solar collector heating system never can provide the total heating load of a building, a replacement premium is not warranted

3 Combination of a biomass-, heat-pump- and/or solar collector heating system

4 Renewable Ready: A gas condensing boiler system with already installed buffer and monitoring and control technology for a later integration of renewable heat generation

5 Applicable to the whole eligible system, including renewable heat generation

6 Applicable to the whole eligible system, excluding renewable heat generator that will be installed later

Else, there are promotional loans provided by KfW, tax deductibilities for works related with heating system replacement and renovation, and also different local promotion programmes (see Table 15).

Table 15: Instrument assessment for Bayerisches Oberland

Instrument	Type	Level	Encourages replacement	Directs the purchase	Impact
Financial incentives for (oil) boiler replacements (BAFA funding)	F	N	X	X	high (tbc)
Promotional loans of KfW (government-owned development bank) for electricity and heat	F	N	X	X	high
Regulation for replacement of old heating systems (§10 EnEV)	R	N	X	X	high (tbc)
Tax deductibility of services (heating system replacement and renovation), as of §35a EStG (income tax law)	R	N	X	X	moderate
Local promotion programmes	F	R/L	x		moderate

Type: regulation (R), improvements (I), financing (F)

Level: national (N), regional (R), local (L)

Impact: very low, low, moderate, high, very high

2.5.3 Drivers and barriers

In order to find out more about regional drivers and barriers to replace (old) oil heating systems with sustainable heating solutions, the civic foundation Energiewende Oberland (EWO) carried out several interviews in the beginning of 2020. The following persons were interviewed:

1. Sigrid Goldbrunner, Regional Manager Energy Consulting Verbraucherzentrale Bayern (Consumer Association Bavaria)
2. Andreas Süß, Climate Protection Representative of district Bad Tölz-Wolfratshausen
3. Andreas Scharli, Energy Manager & Consultant at EWO
4. Johannes Haas, Guild Master of the Sanitary, Heating, Climate Technology and Plumbers' Guild of district Bad Tölz-Wolfratshausen
5. Markus Kleinen, Managing Director of Housing Company (Wohnbaugesellschaft) Weilheim, furthermore city councillor in Penzberg and supporter of Energiewende

The results of the interviews are presented without weighting in a clear tabular form in Table 16 (statements can be related to the interviewees by the numbers in the brackets):

Table 16: Drivers and Barriers for heating system replacements

	Drivers	Barriers
Consumer Side	<p>Municipal regulations for new buildings, award criteria for development areas</p> <p>Municipal support for redevelopment in existing housing. Fostering of urban restoration through municipalities. Transformation of city centres carried out by municipalities</p>	<p>High prices for real estate → little incentive for energetic retrofitting by the property sellers</p> <p>After the purchase, house buyers have often only few resources left for energetic retrofitting</p> <p>For end consumers and landlords of holiday houses and flats, energy costs</p>

	Drivers	Barriers
	<p>If after a house purchase money is left, immediate refurbishment instead of waiting longer</p> <p>additional comfort after the refurbishment</p> <p>attractive funding programmes</p> <p>favourable interest rates</p> <p>growing respect for climate protection and the Energiewende</p> <p>desire and conviction by citizens to do something for themselves and for climate protection</p> <p>acceptance of additional costs</p> <p>time-limits for tax deductibility – three years from 01.01.2020 on</p> <p>possible prohibition of oil heating installations from 2026 on</p> <p>end of heating system lifecycle</p> <p>information by chimney sweepers</p>	<p>account for a small proportion of the total costs only and are therefore not focused on; low prices of fossil energy sources</p> <p>Lack of guidance about funding measures for consumers because of wide range of information (what solution is the best for the individual)</p> <p>Reluctance to get active</p> <p>lock-in effects</p> <p>high investment costs</p> <p>chimney sweepers often state that the heating system in place is still in good shape > system is not replaced</p> <p>new systems require less maintenance, meaning less revenue for companies in the sector</p> <p>owners of the heating systems tend to wait until the last possible moment before investing</p> <p>heating systems are only in the focus if they do not work</p> <p>sufficient participation in local district heating networks</p>
Policy side	<p>District heating is in the focus of municipal development, can be flagship project and drive private and business sector to connect</p> <p>Incentives or investments</p> <p>Regulations (for new buildings, replacement of heating systems)</p> <p>Flood protection (in vulnerable zones) > possible prohibition of oil tanks</p> <p>Fridays for Future movement (public awareness about climate change) > public pressure > policy needs to act</p>	<p>Legislation: slow process of complete prohibition of fossil energy sources</p> <p>Boiler replacement is not a municipal duty</p> <p>Legal exemptions for boiler replacements</p> <p>EC public procurement law</p> <p>Additional expenditures for sustainable solutions</p> <p>contractual arrangement of sustainable solutions or projects is very complicated</p> <p>lack of human resources or “enthusiasts” in the municipalities for the implementation of decided actions</p> <p>strict environmental constraints – e.g. for geothermal energy probe drilling in water protection area</p>

	Drivers	Barriers
		<p>often resistance to new projects > commitment for the long haul is necessary</p> <p>Concrete action plan for municipal properties is often missing</p>
Market side	<p>constant innovations among manufacturers</p> <p>training on latest technologies by the producers</p> <p>industry can increase production</p> <p>development of new markets</p> <p>markets need to react on changed public awareness</p> <p>political decisions</p>	<p>Bottleneck: shortage of skilled workers</p> <p>Professional education of new skilled workers can take between 5 to 10 years</p> <p>Quality of execution / workmanship</p> <p>Bad image of insulation</p> <p>Good order situation, leading to longer waiting times and no need to develop new business fields</p> <p>Some renewable energy sources are still too expensive, or have a long payback time</p> <p>Additional expenditure for new solutions, compared to fast implementations of familiar solutions</p> <p>time-limits for tax deductibility lead to overheating of the market</p>

2.5.4 Key considerations for defining policy sets

Although the policy framework for the heating sector has recently been changed in Germany, and positive effects are expected to be seen soon, several further issues were identified that should be addressed by the political sector:

1. the shortage of skilled workers (1, 3, 4) was identified as most important issue that needs to be addressed by the policy sector; the new funding measures will probably exacerbate this problem, as many owners have either cancelled their orders for new heating systems in 2019 (waiting for the new funding measures), and many more are expected to demand for new heating systems when the new funding measures are in place (i.e. January 2020); already now, plumbers are hardly in a position to handle their current order flow (4)
2. there is no lack in funding measures, however a lack in clear guidance about appropriate solutions; such consultancy should be offered at regional / municipal level and be closely supported (1, 3, 5), municipalities should cooperate with motivated citizens to achieve these targets more easily (5)
3. high prices for real estate have been identified as general inhibitor to invest in more sustainable, yet also more expansive renewable heating systems (3)

2.5.5 Success stories

It can be distinguished between national and regional success stories. On national level, the obligation to replace most heating systems which are elder than 30 years (regulated in § 10 EnEV) is expected to have a large impact (although some exemptions exist), knowing that more than a million heating systems will be affected of the regulation (in 2019, 34.4 % of the oil heating systems in Germany were

25 years and older (BDEW, 2019)). Already political decided measures like the CO₂ pricing (starting from 2021 on) will also drive the owners away from oil heating to more sustainable solutions and the new funding measures, which started on 1 January 2020, are also expected to have a major impact in the near future

On regional level, municipal activities like energy concepts and energy use plans or municipal district heating systems have a good reach out and have proven a considerable impact. Municipalities can also play a role model, show citizens which solutions work and consult. In the target region Oberland, EWO has carried out a so-called Energiekarawane, which targets specifically households with high energy demand in one municipality. Energy consultants, financed by federal and municipal funds, actively address homeowners and provide low-entry energy consultancy for free. This campaign results in a decrease in energy demand for heating and cooling and in replacement of heating and cooling systems (EWO, 2018). Heating system choices of public individuals (i.e. replacement of a 20-year-old oil heating system by a pellet heating system) can also be used.

2.5.6 HC replacement outlook

The warmer climate will maybe also lead to an increased demand for cooling systems, and these would need to be as sustainable as possible. Furthermore, the growing demand for energy storage batteries and e-vehicles might have an effect on heat pumps.

In addition to the described measures, in Germany a so-called Gebäudeenergiegesetz (GEG – building energy regulation) is discussed in the political process. A draft of the law has been available from the German federal government (BMWi, 2019). In this law, a possible prohibition of oil heating systems from 2026 on is discussed. In the neighbouring state of Bavaria, in Baden-Württemberg, it is obligatory to install a pv-system on new buildings.

2.6 Skopje region, Macedonia

2.6.1 Overview of policy instruments for sustainable heating and cooling system replacements

Macedonia as a candidate country for the European Union (EU) adheres to the EU Climate and Energy Policy, thus is taking on the obligations of the Annex I countries, although is not listed in Annex I to the UN Framework Convention on Climate Change (UNFCCC). It also participates in the Energy Community Treaty, which helps in implementing EU regulations on monitoring, reporting and verification of Greenhouse Gases (GHG) and tackling climate change.

Macedonia has also ratified the Kyoto and the Amendment of the Doha Kyoto Protocol (2019), has adopted the Copenhagen Treaty (2009) and has ratified the Paris Treaty (2017). In addition, the state has accessed other relevant climate change initiatives: Montreal Protocol Amendment to Ozone Depleting Substances “Kigali Amendment” (2019), Alliance for Climate Ambition (2019), Cultural Heritage Partnership for Ambitious Climate Action (2019), Climate Action for job placement (2019), Cool coalition - efficient, climate-friendly cooling for all (2019), etc.

The Ministry of Environment and Physical Planning (MoEPP) is the institution responsible for climate change policy, a national contact point for the UNFCCC and a national body implementing the Kyoto Protocol. Other ministries responsible for climate change are: Ministry of Agriculture, Forestry and Water Economy, Ministry of Transport and Communications, Ministry of Health and Ministry of Finance. Ministry of Economy is responsible for achieving the Sustainable Development Goals (SDGs) and also is a national designated authority for Green Climate Fund (GCF).

The legal framework for climate change is set out in the Law on Environment, which contains an article on the development of national GHG inventories. Other laws, bylaws and strategies that contain aspects related to climate change mitigation are: Strategy for Energy Development of the Republic of Macedonia for the period 2008-2020 with Vision by 2030 (2010), Macedonia's Renewable Energy Strategy by 2020 (2010), Energy Efficiency Strategy of the Republic of Macedonia by 2020 (2010), and Third Energy Efficiency Action Plan (EEAP) of the Republic of Macedonia (2016-2018), National Strategy for Sustainable Development in the Republic of Macedonia, etc.

The essence of the following documents is to provide information on GHG inventories, measures to mitigate and to facilitate adequate adaptation to climate change and come across with possible gaps, needs, and resources.

- First National Communication on Climate Change (2003)
- Second National Communication on Climate Change (2008)
- Third National Communication on Climate Change (2013)
- Intended Nationally Determined Contributions to climate change (2015)
- First Biennial Update Report on Climate Change (2015)
- Second Biennial Update Climate Change Report (2017)

A draft Law and Strategy on climate change are planned and will be aligned with the EU Climate and Energy Framework by 2030. The main goal of the Law and long-term climate action strategy is supporting the beneficiary country in achieving the long-term goals of climate action: full transposition / implementation of European legislation, allowing low CO₂ emissions and climate resilience of the beneficiary country (“Klimatski promeni,” n.d.).

Several different development scenarios up to 2050 were being made for analysing the potential for climate change mitigation in the energy sector in order to project energy demand, costs of providing needed energy and GHG emissions. Final energy consumption is envisaged to grow by 48% by 2032, and by 102% by 2050. The most significant share of final energy consumption is the use of diesel and electricity, as well as natural gas, available from imports. CO₂ emissions will increase from ~ 9.5 Mt in 2011 to ~ 14 Mt in 2032, and then sharply decrease due to the closure of existing thermal power plants and will increase again to ~ 14 Mt in 2050 [2].

A summary of integrated energy results for 2030 and 2040 for Macedonia is shown in Figure 1 which points out the energy targets for the given years. As a matter of interest for this research is the decarbonization which in the Green Scenario from the Strategy in 2040 reduces the GHG emissions up to 61.5% compared with 2005 or 72.8% compared with the business as usual (BAU) scenario, while significantly increasing the use of renewable energy sources (RES) in a sustainable manner reaching their share of 45% in gross final energy consumption (Министерство за економија, 2019а).

Energy pillar	Indicator	Metric	Year 2030			Year 2040		
			Reference	Moderate Transition	Green	Reference	Moderate Transition	Green
1 Energy efficiency	Energy efficiency	% reduction of primary & final energy consumption vs. BAU	-15.3% primary	-31.2% primary	-34.5% primary	-34.9% primary	-47.9% primary	-51.8% primary
			-10.3% final	-16.6% final	-20.8% final	-14.2% final	-21.7% final	-27.5% final
2 Integration and security of energy markets	Energy dependence	% of net import in primary energy consumption	48.7%	61.9%	59.1%	51.0%	61.9%	55.3%
3 Decarbonisation	GHG emissions	% reduction vs. 2005 and vs. BAU	-20.9% -22.9% vs. BAU	-57.2% -58.3% vs. BAU	-64.7% -65.3% vs. BAU	-8.1% -35.6% vs. BAU	-43.3% -60.2% vs. BAU	-61.5% -72.8% vs. BAU
	RES share	% of RES in gross final energy consumption	33%	38%	40%	35%	39%	45%
4 R&I and competitiveness	Total system costs	Bn. EUR in 2030 and 2040 with cumulative	3.8	3.3	3.2	5.1	4.8	4.5
			41.0	38.3	37.3	86.5	81.2	78.1
5 Legal & regulatory aspects	Legal & regulatory compliance	EnC acquis harmonisation & implementation	Full compliance			Full compliance		

Note: RES share results include heat pumps

Figure 15. Summary of integrated energy results in 2030 and 2040 (Министерство за економија, 2019а).

As the three municipalities included in the REPLACE project are part of the capital city - Skopje there are many regional and local documents tackling the sustainable development, climate change, EE and RES, listed below.

- Environmental Impact Assessment Study of the City of Skopje;
- Study for assessment of the potentials and opportunities for using RES in the Skopje region;
- The city of Skopje: Potential assessment for mitigation;
- Local environment action plan (LEAP) – Skopje;
- Program for EE for city of Skopje - 2012-2015;
- Resilient Skopje - Strategy for climate change (2017) (“Град Скопје - Заштита на животната средина,” n.d.).

The air pollution is increasing year by year and the heating sector is the largest air pollutant (90% of total PM emissions come from heating - firewood) in Skopje. Certain analyses indicate that the pollution will increase by 30% by 2025 unless urgent measures are taken into account to reduce the emissions. The first step towards resolving the pollution problem is to determine the pollution sources and therefore a Program for air pollution reduction was conducted in January 2017 initiated by the MoEPP in cooperation with the City of Skopje and UNDP. Also, the latest data (2019) on PM₁₀ and PM_{2.5} had been provided. The Program for air pollution reduction also provides benefits for replacement of the old, inefficient-fossil fuelled systems for H&C in the public buildings with RES H&C systems. Thus, they intend replacement of door and windows in public buildings.

The survey (5,044 households) revealed that only 21% of residents are connected to the central heating system, whereas 45% heat their homes with wood. In the Municipality of Gjorce Petrov only 1.6% are connected to the central heating, 54% are heating their houses with wood and 41.6% are using electrical energy. The Municipality of Karposh have 39.8% households connected to the central heating, 15.9% are heating their houses with wood and 38.1% are using electrical energy. The Municipality of Aerodrom have the biggest rate for households using the central heating 55.4%, 13.2% are heating their houses with wood and 30.1% are using electrical energy. In regions with intensive wood use for heating, studies showed high concentrations of PM_{2.5}, PM₁₀ and VOCs. The findings are analysed and the results presented in the report "Scientific research study: How are households heated in Skopje? which together with all the research results are presented in the documents on the web site www.skopjesezagreva.mk".

The conclusion is that only by combination of measures for changing household heating modes and all other sectors: construction, transport, landscaping, waste management along with strengthening inspection oversight capacities and frequent controls in industrial capacities and other legal entities will give the best results to solve the problem. The urging activities that should be consider are raising public awareness through educational campaigns about alternative, more efficient and economically viable opportunities for heating. Also, the activities should encourage private companies to offer more appropriate packages and to ease the decision whether the households will change their heating technologies. The activities in the heating sector might help achieving the following goals:

1. 10,000 households connected to the existing heat operator;
2. 5% tax reduction on heat delivered by heat operator which will increase the consumption by 11%;
3. 20,000 households will replace old wood stoves with more efficient stoves or inverters;
4. 3,200 households will replace the inefficient heating systems with inverters with a subside of 1000 EUR;
5. 10,000 households will improve the energy efficiency (EE) of their dwellings;
6. 2,000 socially vulnerable households will be subsidized to change the way of heating through a special support mechanism;
7. Prohibited sale of coal and oil for heating in households - Legislative changes adopted in 2019;
8. Private companies selling eco-friendly equipment will receive assistance in building their capacities, developing marketing strategies and establishing partnerships with banks to offer affordable packages to all categories of citizens (Министерство за животна средина и просторно планирање, 2017).

2.6.2 Financial and legislative promotion

The laws, policies, strategies are intertwined with each other and it is really difficult to make a distinguished line between them. However, the list of legal and regulatory framework describing the conditions in Macedonia is quite impressive, which means that we have strong base for developing and promoting sustainable heating and cooling (H&C) sector.

1. Ministry of environment and physical planning

- The Law of Environment set goals which anticipate, monitor, prevent, limit and eliminate adverse environmental impacts. The Law is encouraging the use of RES, the use of clean technologies and environment friendly products (Министерство за животна средина и просторно планирање, 2005).
- The Strategy for Environment and Climate Change 2014-2020 meets the goals from the Law of Environment. Regarding the promotion of sustainable energy sector and stimulation for construction of new renewable power plants it is ensured that these generating facilities can obtain the status of preferential producer, and thus the right to sell the electricity produced at preferential tariffs. In line with the adopted strategic documents and action plans in this sector, measures and activities for promotion of EE in the sectors of primary and final energy consumption (residential sector, commercial and service sector, industry and transport) are foreseen (Министерство за животна средина и просторно планирање, 2015).

2. Ministry of Transport and Communications

- The Law for Building also define the efficient use of energy and heat protection. The buildings and their heating, cooling and ventilation appliances shall be designed and constructed in such way that the energy consumption during its use shall be equal to or lower than the prescribed level, as well as meet the EE requirements prescribed by the regulations governing this matter.

3. Energy Agency of the Republic of Macedonia

The following RES bylaws and documents adopted by the Government, presented by the Energy Agency are listed and they all refer to the existing laws.

- Decision for the objectives and annual dynamics of increased energy share from RES in the final energy consumption;
- -Decree for measures to support electricity production from RES;
- -Decision for national mandatory targets for energy share produced from RES in gross final consumption of energy and for the share of energy produced from RES in gross final consumption of energy in transport;
- Rulebook of for highly efficient combined heat and power (CHP);
- Rulebook for preferential producers of electricity from RES.

4. The Energy and Water Services Regulatory Commission of the Republic of Macedonia stands for one of the most important reforms that the country has introduced in the energy sector that shall take care for: safe, secure and quality supply to the energy consumers, environment protection, consumer protection and protection of a competitive energy market on the principles of objectivity, transparency and non-discrimination.

- The Annual Report of the Energy and Water Services Regulatory Commission of the Republic of Macedonia for 2018 gives an overview of the current situation in Macedonia regarding the heating, besides the whole energy sector.

5. Ministry of economy

- The new Energy law (2018) shall regulate the objectives and manner of implementing the energy policy, the construction of energy facilities, energy markets (energy producers and consumers - especially the vulnerable consumers). The law shall be to provide efficient, competitive and financially sustainable energy sector, which provides a high level of security in the energy supply. Also the law is encouraging the RES use through appropriate and effective financial and other support measures in order to achieve the goals of the renewable energy policy, to ensure the security of energy supply, to protect the environment from the negative impacts in the performance of energy activities and to mitigate climate changes (Министерство за економија, 2018a).

-The new Law for energy efficiency (which is in the process of being adopted) ensures measures for the efficiency use of energy in Macedonia, to increase EE in the area of housing and construction by improving the energy performance of buildings, to increase EE in the commercial sector, industry, transport and energy equipment by encouraging the use of RES, to provide conditions for performance of energy services and ways of financing EE support measures and to establish a framework for energy labelling and eco-design of energy-using products. The SDGs could be achieved by reducing energy consumption, especially from fossil fuels, by applying EE measures to create an efficient, competitive and financially sustainable energy sector, reducing adverse environmental impacts and fulfilling the obligations assumed by ratified international agreements (Министерство за економија, 2018b) (Министерство за економија, 2019b).

- The Program for promoting RES and EE in the households for 2019 has fund of 50 million denars which will be used for the following measures: subsidies for purchased and installed solar thermal collector systems in households up to 30%, but not more than 15,000 denars per household, in total amount of 5 million denars; subsidies for PVC or aluminium windows in households up to 50%, but not more than 25,000 denars per household, totalling 25 million denars and subsidies for purchasing pellet boilers, not exceeding 25,000 denars per household, totalling 20 million denars. The annual number of pellet boilers replacement is 196 in 2016, 429 in 2017 and 187 in 2018. The number of solar thermal collector installed in 2019 is around 550 (Влада на Република Македонија, 2019).

-The Strategy for utilisation of RES in the Republic of Macedonia by 2020 gives the overview of relevant RES in Macedonia and the RES share in total energy, the RES targets, possible emission reduction and a 5 year Program for RES utilisation (Влада на Република Македонија, 2010).

- The Rulebook on Energy Performance of Buildings prescribes the energy performance of buildings and the method of calculating the thermal performance of new and existing buildings. The purpose of this Rulebook is to achieve policy of EE of buildings through: measures and activities for efficient use of energy, labelling the buildings, providing services for EE, fulfilment of obligations of the public sector in view of EE and energy saving. Beside this, the Rulebook provides the manner and period of control of the boiler heating systems for space heating in buildings (>20kW), but also the manner and period of control of air conditioning systems in buildings (>12 kW). This Rulebook defines the types of public buildings and building units for which the implementation of the hot water solar collectors when building new and significant reconstruction of existing buildings is required (Министерство за економија, 2013).

- The Action plan for RES of the Republic of Macedonia by 2025 with vision by 2030 is one the most important documents which gives an overview of all policies and measures for promotion and enhanced usage of renewable energy. Also the list of all relevant documents to this topic can be found here (Влада на Република Македонија, 2015).

- The Strategy for energy development of the Republic of Macedonia until 2030 is published in 2010, however there is a new 2019 Strategy for energy development of the Republic of Macedonia until 2040 from which some facts are presented, as the latest published document. Regarding the heat sourcing in Skopje the following data exists. District heating system (DH) is operational only in Skopje. 8.33% of households in Macedonia rely on heat energy from DH system, while 61.59% consume fuelwood, 28.60% use electricity, and the remaining 1.48% use other fuel types. Energy sector has the biggest impact on GHG emissions and the projections for 2030 are around 70% of total GHG emission. The GHG emissions in Macedonia are as follows: in 2014 the CO_{2-eq} emissions per capita were 5.9 tonnes, the overall SO₂ emissions in 2016 decreased by 47% compared to 1990, the NO_x emissions in 2016 declined for 51% compared to 1990 levels and the overall PM_{2.5} emissions in 2016 are lower by 57% compared to 1990 levels. The highest RES contribution is achieved in H&C sector, while the biggest GHG emission savings are in electricity sector. In terms of RES sectors in 2020, H&C sector (RES-H&C) should achieve the highest RES share of 30. The H&C sector relies mostly on biomass used in households which represents 90%-95% overall, but due to low efficiency of biomass stoves, its contribution to GHG savings is less impactful. The overall GHG emission savings are constantly increasing by 15% per annum, primarily due to increasing RES-E investments mainly supported with feed-in tariff mechanism. At the end of 2017, there were 170 eligible producers with 128 MW installed capacity that are using incentive feed-in tariffs with 67.5 MW hydro, 16.8 MW solar PV, 36.8 MW wind and 7 MW of biogas respectively. The Government plans to continue with the current feed-in tariff mechanism and to introduce market-based premiums (Министерство за економија, 2019a).

Other relevant documents:

- Strategy for improvement of the EE in the Republic of Macedonia until 2020;
- Rulebook for RES;
- Rulebook for energy control.

6. Municipalities

There are many possibilities for financial support such as the EBRD Program for municipalities which are providing 50 million EUR to the municipalities for street lights and modular systems (buildings) for RES heating systems in 2020 ("The EBRD in North Macedonia," n.d.). Also, the SGP GEF Program is worth to be mentioned by providing 12 million EUR for individuals for implementation of the EE measures and renewable H&C systems ("Глобален Еколошки Фонд - ГЕФ, Програма за Мали Грантови - ПМГ," n.d.). Some of the important regional and local documents are the Strategy for municipal development and the Programs for EE for municipalities and Annual action plans corresponding to the Programs.

- LEAP - Karposh

The LEAP serves as a roadmap for municipalities to implement visions and principles for a sustainable municipality, thus provides guidance on how Karposh Municipality can implement a green economy, address climate change challenges and maintain life quality, while reducing emissions.

The residential H&C sector currently has the most influence on the air quality in Skopje. Table 1 provides the results of a survey conducted by the Municipality of Karposh on the way households are heated.

Table 17: Types of households heating

	Number of households	Heating type		Number of households- fuel type			Fuel quantity			
		Central heating	Individual heating	Firewood	Oil	Electricity	Firewood (m3)	Coal (tonnes)	Oil (tonnes)	Electricity (kW/h)
Municipality of Karposh	21 297	8 789	12 508	4 620	605	7 283	25 407	0	1 210	5 825 600

Analysis show that 38% of households use electricity for heating (inverter air conditioners, electric stoves, power panels, etc.), and 29% of households are connected to the central heating system. In addition, the use of firewood is quite common in 33% of households. According to statistics, fuel consumption from the new generation (pellets, briquettes, etc.) is still low (less than 2% of total biomass consumption), with wood logs being the most popular form of wood.

This LEAP has a program with measures and actions in order to achieve certain goal/ target in particular field. Also, there are many questionnaires with results shown in graphs (Општина Карпош, 2019).

The municipality of Karposh also have a Strategy for municipal development that include replacement of the H&C system in public buildings with RES systems.

- LEAP -Aerodrom

The central heating network covers the majority of the households in the Municipality of Aerodrom. The households heating in some areas/neighbourhoods is individually solved depending on their needs and finance possibilities, using firewood, electric stoves, coal and extra light oil. Generally, the heating systems in the buildings are relatively old (20-25 years) and require a renovation, except for one kindergarten where the heating system is renovated.

Possible measures to be undertaken in order to promote energy savings, EE and RES use in the households are:

1. Awareness-raising campaigns for promotion of the efficient use of energy and the use of RES through the benefits of their use, subsidies for RES equipment;
2. Campaigns for DH, enhancing the financial, environmental and health benefits;
3. Campaigns to raise awareness of EE in households, collective and public buildings, to increase the number of citizens applying EE in their homes, EE subsidies (insulation, replacement of windows), reduction of heating / cooling costs of buildings, installation of EE lighting in public buildings, implementation of intelligent control technology to reduce energy consumption;
4. Buildings renovation by installing thermal insulation on the walls and roofs and installing high EE windows to increase the overall EE;
5. Replacement of the existing heating installations in residential buildings with advanced EE heating technologies (reduced energy consumption and reduced PM₁₀).

This LEAP has a program with measures and actions in order to achieve certain goal/ target in particular field. Also, there is a number of questionnaires with results shown in graphs (Општина Аеродром, 2017).

The latest document by the municipality is the Program for EE 2017-2019 with a goal to reduce the overall energy consumption in public buildings, therefore to have financial savings, to replace the

energy systems, to raise awareness for energy savings, to reduce the air pollution and enhance the local sustainable development. In order to properly perform the tasks envisaged by the program, the municipality plans to involve in the implementation process many stakeholders such councilors and municipal officials, users of municipal services, energy suppliers, government organizations / ministries, NGOs, external consultants and private companies performing public works and financial institutions. The activities that the municipality plans to undertake as an energy consumer are as follows: energy audits of facilities under its jurisdiction, medium and long-term plans for energy supply and demand, measuring and monitoring energy consumption (Општина Аеродром, n.d.).

- LEAP -Gjorce Petrov

The LEAP of the Municipality of Gjorce Petrov is lacking data for the thematic area - Energy and RES. However, there are some analysis and as far as fuel consumption for households heating is concerned, oil - 18% and solid fuels (wood- 13% and coal) have the largest share in domestic stoves at the level of the city of Skopje. There are no data on the consumption of natural gas and RES (geothermal, solar) at the municipal level.

Some issues that the Municipality of Gjorce Petrov is facing are:

1. Lack of a local monitoring network for air quality, thus lack of comprehensive and reliable data on emissions, plans, strategies and programs to reduce air pollution;
2. Insufficient cooperation of the parties involved in the air management process;
3. Inefficient stoves used for residential heating with high combustion pollutant;
4. Financial and technical problems for replacements of 1 wood and 5 oil boilers with heat pumps in public buildings (schools and kindergartens);
5. Outdated equipment/technology in the industrial sector;
6. Insufficient institutional and human capacity in the municipality, as well as lack of funding;
7. Difficulties with green loans (reduced interest rates);
8. Low presence of RES in the market and need for subsidies (Општина Ѓорче Петров, 2006).

The Municipal Energy Efficiency Program 2015-2017 is a legal obligation arising from the Energy Law to provide accurate data on the energy consumption in all buildings owned by the municipality of Gjorce Petrov, as well as all the lighting in its area. The Program gives an accurate insight into the state of each object (condition of the facade of buildings, roof structure, the condition of the windows, heating installation, actual energy consumption, define measures needed to increase EE, control of the need and techno-economic justification for installing solar collectors for hot water preparation). Based on the data from this Program, a one-year Energy Efficiency Action Plan has been prepared (Центар за енергетска ефикасност на Македонија, 2017).

Table 18: Instrument assessment for Skopje region.

Instrument	Type	Level	Encourages replacement	Directs the purchase	Impact
Subsidies for pellet boiler	F	L/N	x		high
Subsidies for solar thermal collectors	F	L/N	x		moderate
Subsidies for inverters	F	L/N	x		very high
Subsidies for façade	F	L/N	x		low
Subsidies for windows	F	L/N	x		high
Subsidies for replacement of inefficient H&C systems - public buildings	F	L/N	x		high

Type: regulation (R), improvement (I), financing (F)

Level: national (N), regional (R), local (L)

Impact: very low, low, moderate, high, very high

2.6.3 Drivers and barriers

There are few instruments at the national and regional level that are affecting the replacement of old, inefficient H&C equipment like the subsidies for inverters, pellet boilers, individual solar thermal collector, facades and PVC windows, as well as chimney cleaning. Pellet boilers might have the biggest success, as they are better alternative for the firewood stoves, thus less expensive option. Another asset is that the Municipality of Karposh is the only municipality in the country that provides such subsidies up to 20% on buildings that are better than at least 10% of the prescribed limit standards and RES use prescribed in an Additional Rulebook for EE in the municipality.

The municipality of Aerodrom benefits from the implementation of the EE projects such: financing EE projects through energy savings, reducing energy costs and providing significant social and health benefits, improving the municipal infrastructure, improving the heating system standards according to the European, improving people's health and living comfort and preserving the children's health in schools by reducing variations in heating and improving air flow in schools. The municipality has the potential to develop and use alternative sources (solar). The conducted analyses yielded that the implemented control of the municipal buildings indicates that the saving potential in the municipal buildings is between 22% and 62% and the proposed investments for pilot projects range from 539,112 MKD to 13,927,063 MKD, and the estimated return on investment is mostly 1.3 to 10.8 years.

However, some barriers existing on the boiler replacement market were identified:

- Insufficient understanding of the importance to replace old with efficient systems;
- Inadequate planning of public investment budgets in the area of H&C of the public sector;
- Poor quality projects and oversight of implemented projects;
- Lack of educated staff and EE/ RES sector in the municipalities;
- Lack of a system for verifying the results achieved;
- Inadequate high interest rates (10% -15%) to invest in RES/EE measures for municipalities;
- Lack of subsidies for example for heat pumps;
- Lack of clear property rights (state / local property) make the credit guarantees difficult;
- Lack of implementation of the Rulebook for Energy control of boilers;
- Lack of GHG inspection of the boilers;
- Failure to comply with development documents, strategies and programs adopted;
- Insufficient establishment and applicability of the energy audit system.

Moreover, the recommendations for solving identified EE problems identified in the municipalities are:

- Implementation of “Days of Renewable Energy” by organizing activities (workshop, competition, online event, visiting EE buildings in the municipality, etc.);
- Conducting activities for public communication (open day with the public, promotion through social networks, etc.);
- Development of new subsidizing models for RES use;
- Financial support for EE measures in low-income households;
- Notifying citizens on how to apply for EE building subsidies (incomprehensible administrative requirements often discourage households (especially those with lower incomes));
- Replacement of the subsidies for energy-poor households with one-off realization measures (i.e. PVs and RES thermal systems);
- Projects financially supported by the Government of Macedonia and the EU that will enable the supply of sanitary hot water in the summer to energy-poor households through the installation of low-budget renewable energy systems ("do it yourself" solar thermal collectors and provide training for constructing such collectors);
- Training and employment of members of energy-poor households in companies working in the energy field and EE;
- Assisting low-income individuals in reducing their energy consumption through consulting services and installing free energy-saving devices;
- Organizing discussions to define energy poverty and types of households affected by it in order to determine the exact number of households that should be assisted;
- In order to improve the energy poverty of the citizens, the Government of the Republic of Macedonia adopts an annual program for energy poverty reduction, which provides: subsidies for energy consumption and fuels for individual households (types of energy and fuels), more efficient energy use, implementation of measures, budget sources and other means of financing measures and bodies responsible for implementing the measures. A subsidy on energy consumption (electricity, firewood, coal, light household oil / household oil and central heating) was introduced in 2010 with a monthly amount of 600 MKD for the target group of households who are beneficiaries of social and permanent financial assistance. The Ministry of Labour and Social Policy and the Centres for Social Work are implementing this measure. In 2008 a draft law was submitted by a group of lawmakers entitled the draft Law on Social Protection against Energy Poverty. However, the law was not adopted, and there has been no similar proposal in the Parliament since then.
- Trainings for energy advisers for the employees in the municipalities;
- Collaboration with government institutions, academia, consulting firms to design nearly zero-energy Pilot projects - dwellings;
- Construction of solar systems on municipal, commercial and residential buildings;
- Stimulating the best student-engineers to attend trainings, conferences, seminars on the development of new technologies with particular emphasis on EE;
- Promotional materials about the benefits of using EE bulbs with longer service life and warranty;
- Preparation of project documentation for heat pumps heating systems and thermo-facades in the remaining public kindergartens.

2.6.4 Key considerations for defining policy sets

The key aspects for the municipalities that shown be taken in considerations are the indicative activities undertaken by the Municipality of Karposh, but in line with the other two municipalities:

1. Heat loss analysis of public buildings;
2. Projects to improve EE and preparation of technical documentation in public buildings;
3. Projects for introduction of RES (solar, PV, pumps) in public buildings (kindergartens, schools);
4. Replacement of existing boilers with pellet boilers/ heat pumps in public buildings;
5. Projects for the introduction of EE bulbs in public buildings and in the streets;
6. Preparation of public campaigns;
7. Preparation of information material on climate change, EE and RES;
8. Educational activities in the field of climate change, EE and RES;
9. Investment subsidies in new, more efficient ways for heating, cooling and lighting.

2.6.5 Success stories

Skopje region has many success stories, for instance the three municipalities have agreement with HABITAT²³ to support collective residential buildings for replacement of old windows and roofs in order to improve the heating and cooling efficiency.

The Municipality of Karposh has a lot of good examples such as the following systems that are currently operating in the buildings:

- Heating system with heat pumps (air-water) in one kindergarten. The change provides replacement of 14 tonnes of oil annually with RES which means 11kg less PM₁₀ and reduced CO₂ emissions. The facility's savings will range from 55 to 65% over the current oil heating system. It also provides automatic management and control of the system, which will use a cheaper overnight tariff and will be used for cooling in the summer, thus saving electricity from the inverter system now used in the kindergarten [14];
- Heating system with waste wood mass - wood chips in one elementary school. The elementary school is the first school in the country to save on heating thanks to a specialized machine that processes wood waste - wooden chips that will be collected from the public parks in Karposh and thereby produces heating energy. With the new heating method, the school has significantly lower costs compared to previous years. The previous heating system had capacity of 80m³ wood and the new reservoir has a significantly larger capacity of 140m³;
- Heat pump H&C system in the new administrative building of the Municipality - under construction;
- Solar systems for sanitary hot water in the one kindergarten and in five primary schools in November, 2016. The facilities' savings should be up to 70%;
- Heat pumps heating system (replacement of oil heating systems) in the municipal offices and in two primary schools;
- Within a H2020 project, a RES H&C system is planned for 10 000 inhabitants in one of the communities in the Municipality;

²³ <http://www.habitat.org.mk/indexmk.html>

- With its own rule of thumb subsidy method (from 2012) 93 individual and public buildings have been equipped with RES H&C systems (heat pumps – water/water, air/water, ground/water, thermal collectors) with installed capacities from 50 to 1500 kW (i.e. hospital).

The Municipality of Aerodrom boasts of successful stories as well, however one of the latest is the replacement of extra light oil boiler (90kW) with pellet boiler (90kW) in one primary school within the project “Development of modern infrastructure for heating” in close collaboration with the Bureau for regional development.

Furthermore, the Municipality of Gjorce Petrov keeps up with the replacement programs for heating and cooling, as they installed a heat pump heating system – air/water (120 kW) in one sport hall in January 2020.

As part of Macedonia's obligations under the “Copenhagen Treaty”, the country has submitted a list of NAMAs³ that could be implemented for possible support within the framework of measures and cross-sectoral interventions that will enable the reduction of GHG emissions, achieving sustainable development and healthy living conditions. There is urban NAMAs for the City of Skopje for the Energy Sector. This application contains EE measures defined in the City's Sustainable Energy Action Plan, covering 21 high schools. Technical interventions that should be implemented are: high-efficiency motion sensors, where feasible, improved thermal insulation on walls and windows, installation of solar thermal collectors. The implemented measures will be supported by an energy management system and offer software solutions for remote monitoring of energy consumption and recording of climate parameters. In addition, educational activities will raise students' awareness of the benefits of efficient and renewable energy technologies. Aware of the possible scenarios, the City of Skopje in cooperation with the UNDP has developed a climate change strategy, which includes analyses, recommendations and actions, GHG Inventory, the potential for reducing emissions in key sectors for climate change mitigation and list of possible policies and measures that can be achieved. The plan covered in detail the specific measures and activities, which in the next 5 years will become part of the annual programs of activities of the sectors in the City of Skopje (Општина Карпош, 2019).

2.6.6 HC replacement outlook

In addition to energy supply, measures to mitigate climate change or change energy consumption are important, especially at residential buildings. We identified many instruments that should also be in place to encourage a higher degree of replacement of inefficient H&C systems, like an establishment of a monitoring system for energy consumption. Further on, creating financial tools for project support (Block Granting protocol for energy expenditure funds to municipalities and PPP and ESCO concept model application) as well as assistance for technical support and building partnerships is much needed. Moreover, a continuous work of the EE team in maintaining the database and more EE information campaigns for awareness raising by good practices and lessons learned would ease the establishment of private funds for financing and implementation of EE projects in schools. However, in general municipalities and the government should make an effort for greater promotion of subsidies, as many people are not aware of the existing subsidies.

Climate change mitigation measures in households can be in the form of mandatory and voluntary measures and incentives, as well as promotion and technical support based on international best practices.

They specifically include:

- **Replacement of firewood stoves (at least 30%) with highly efficient models (solar systems, pellet boilers, heat pumps)** for reduction of energy consumption at the municipal level and reduction of the CO₂ emissions level in the atmosphere by over 30% compared to the current level;
- **Measurement of heat consumed by end-user and consumption-based charging of users connected to the heating system in Skopje;**
- Financial support to individuals for EE improvement in households (especially with energy poverty), as well as efficient lighting which will reduce consumption by 50% and application of building energy performance standards and labelling of electrical equipment.

The conclusion for Macedonia is that the country has potential to proceed the replacement campaigns and to raise the awareness about the benefits of RES heating systems. As mentioned, and listed, the country and the municipalities have strong legal framework. Also, there are financial instruments in state, but not sufficient to maximize the replacement effect. However, many aspects can be improved by continuing the successful stories, as the municipalities are doing so far. The replacement campaigns would definitely contribute in the process of overcoming the existing and possible barriers in the heating sector.

2.7 Šabac, Republic of Serbia

2.7.1 Overview of policy instruments for sustainable heating and cooling system replacements

The Energy Development Strategy of the Republic of Serbia until 2025, with the projection until 2030 (RS, 2015), is the basic strategic document that defines the directions of energy development in Serbia and also covers the goals that are planned in the heating and cooling sector. Serbia's accession to the Energy Community (2006) initiated the adoption of acts at the national level that support greater participation of renewable energy in the total energy balance. The most widely used form of renewable energy in heating and cooling sector are biomass, geothermal energy and solar energy.

The strategic priorities defined in this document are:

- energy security,
- development of the energy market,
- the development of sustainable energy, especially as it emphasizes the importance of increasing the share of renewable energy, selecting optimal financing models for the use of renewable technologies and the importance of using renewable energy for environmental protection.

The potential of renewable energy in the Republic of Serbia is as follows:

Table 19: Renewable energy potential in Serbia (RS, 2016)

Renewable energy	Available technical potential (in use) millions of toe / yr	Available technical potential (in use) millions of toe / yr
Biomass	1,054	2,394
Geothermal energy	0,000	0,180
Solar energy for heating	0,000	0,194
Total all renewable energy	1,968	3,682

Unfortunately, this strategy document recognizes only district heating systems so that there are no clear guidelines regarding the transition to renewable energy for facility owners who do not use built district heating networks.

The current situation in the district heating sector is as follows:

- district heating system was built in 60 municipalities in Serbia,
- the total installed capacity is 6,900 MWth,
- fossil fuels are used for the production of thermal energy: 48% natural gas, 23% coal, 29% liquid fuels,
- the use of renewable energy is negligible and has been recorded in only 4 municipalities (Sremska Mitrovica 14 MW sunflower shell, Belgrade 1 MW wood pellet, Pancevo 500 kW thermosolar collectors and Sabac 500 kW wood chips).

The focus in the district heating sector is to increase the share of wood biomass with the aim of reducing dependence on imported fuels and increasing security of heat supply as well as contributing to mitigating the negative effects of climate change. The problem is complex and for this reason the

Ministry of Mining and Energy, the Ministry of the Environment and the Ministry of Agriculture of the Republic of Serbia, Office for Public Investment Management (established by the Government of the Republic of Serbia) and local self-government, are founders of companies whose activity is district heating.

Building on the Energy Development Strategy, a National Renewable Energy Action Plan (NREAP (Ministry of Energy, Development and Environmental Protection, 2013)) has been adopted at national level to reduce the share of fossil fuels, primarily liquid fuels and coal, and to increase the share of renewable energy to 27% in gross final consumption by 2020.

Following the implementation of the Renewable Energy Action Plan, the results and estimates of gross final consumption of energy from renewable sources are as follows:

Table 20: Objectives of production of gross final energy from renewable sources and reduction of greenhouse gas emissions (RS, 2016)

	2018	2019	2020	2021	2022	2023
Heating and cooling sector, production of gross final energy (in thousands of toe)	1.143	1.152	1.167	1.175	1.181	1.188
Heating and cooling sector, expected net reduction of greenhouse gas emissions (in t CO ₂ eq)	3.815.117	3.845.157	3.895.224	3.921.947	3.941.954	3.965.318

Note - The targets for 2021, 2022 and 2023 will be revised in accordance with the future National Renewable Energy Plan (RS, 2020) to be adopted in 2020.

The responsibility for the functioning of the heating and cooling sector has been transferred from the state level to the local government level (municipalities). In this sense, municipalities also define, through local development plans, district heating development plans, construction zones for facilities that are connected to the district heating network, or the use of another energy source is allowed. In 2018, the City of Sabac City Assembly adopted the document Energy Policy of the City of Sabac (Grad Šabac, 2018), defining goals that are in line with national energy development goals. Priority is given to achieving the following goals

Local energy policy encourages the development of the local market for energy services and the implementation of green technologies, increased participation of ESCO in the heating and cooling sector, as well as the implementation of energy efficiency measures to support the introduction of green technologies. The town of Sabac is the founder of a local energy company whose main activity is district heating (in the near future and cooling). The intention is to transform this enterprise into a 4th generation flexible district heating system that is strategically committed to renewable energy and will use biomass, geothermal energy and wastewater as a heat source. The development of the heating (and cooling) sector in this direction is based on estimates of biomass potentials made during 2016. A study (Malidzan and Vitorovic, 2016) prepared by GIZ DKTi's office showed that the potential of biomass in the Sabac area is:

- forest biomass (firewood and residues) 70.208 t / a or 238.000 MWh / a of primary energy,
- agricultural residues from an area of 36,341 ha (maize, wheat, soybeans) or 187,500 MWh / a of primary energy

At the end of 2018, the Faculty of Mining, University of Belgrade, conducted a study (Ivezić, 2018) on the utilization of waste heat from a municipal sewage treatment plant, which showed that the

construction of a 7.2 MWth heat pump plant would be possible to provide more than 40% of the current district heating system needs.

The strategic decision to develop heating (and cooling) in Sabac in the direction of using renewable energy is based on these studies as well as on the commitment to invest in energy efficiency measures that will further help to increase the share of renewable energy towards achieving the goal of an energy independent local community.

2.7.2 Financial and legislative promotion

Apart from the strategic documents, there are no funding schemes in Serbia that would contribute to a faster replacement of old and inefficient fossil fuel-fired appliances. However, some of the measures (RS, 2020) have been recognized and are expected to be implemented in Period 2020-2023.

At national level, the possibility of introducing tax and financial incentives is being considered to motivate citizens to use energy efficient boilers, stoves, biomass stoves. The implementation of this measure is planned to begin in 2020. This measure should be implemented by the Government of the Republic of Serbia, the Ministry of Finance, the Ministry of Mining and Energy with state financial institutions. In order to implement the measure, it is necessary to analyze the financing model as well as the effects that would be achieved, as well as to change the regulations on the manner and criteria for the allocation of incentives.

The same measure would apply to the use of geothermal energy, with the involvement of the Ministry of Agriculture - Water Directorate.

The Ministry of Agriculture and the Ministry of Mining and Energy, together with the Government of the Republic of Serbia, the Ministry of Finance and state financial institutions, should consider using financial and tax incentives to use energy crops from 2021 onwards. As mentioned in the previous measures, it is necessary to analyze the financing model and the effects that would be achieved, and also to change the regulations on the manner and criteria for the allocation of incentives. The specificity of this measure is that the analysis should also focus on the choice of planting type, planting method and soil types on which energy crops would be planted.

For all these measures, working groups have already been set up at the national level with the task of analyzing measures and incentives and of offering financing schemes for the replacement of existing fossil fuel-fired appliances and technologies with more efficient green technologies.

At the national level, a budget fund for energy efficiency has been set up which, in addition to financing energy efficiency measures in the building sector, would also be used to replace old inefficient appliances with new more efficient ones that use renewable energy. The National Budget Fund has not yet started operating at full capacity, but it is intended to apply a voucher model that customers will use when purchasing new devices that meet the ecodesign criteria and use renewable energy. In 2019, the Government of the Republic of Serbia introduced a fee of EUR 1.27 per 1,000 m³ of natural gas for owners of gas boilers and of EUR 12.71 per 1 MWh for all electricity customers.

At the local level, the city of Sabac established a local budget fund for energy efficiency as a budget line within the city budget, which, in addition to co-financing energy efficiency measures, was also used to co-finance district heating connections in Sabac and to co-finance the procurement of new efficient wood pellets boilers. A decision was made in 2018 to set up the fund, but the fund is not operational.

In addition to the aforementioned financial support schemes at national and local level, there are funding schemes for the purchase of new efficient renewable energy devices as well as energy efficiency measures implemented by the banking sector on the basis of agreements with national authorities. One such is the EBRD Green Economy Financing Facility (GEFF, 2020) line supported by the

European Bank for Reconstruction and Development with partner banks. GEFF in the Western Balkans provides finance for green economy investments in the residential sector as well as businesses that provide energy efficiency and renewable energy products and services to households.

The regulatory framework at the national level obliges building owners to pay attention to the efficiency of the heating and cooling systems when building or reconstructing. The technical regulations (RS, 2011) prescribe a minimum degree of usefulness of heating and cooling devices, as well as the obligation to include in the energy efficiency studies of buildings the information on the degree of utility of the device, the type of fuel, fuel and energy consumption for heating and cooling, as well as CO₂ emissions.

When placing on the market, there is an obligation to label heating and cooling devices according to energy classes. The obligation of periodic inspections and maintenance of heating devices with installed capacity of 50 kW and larger and cooling devices with installed capacity of 12 kW and higher is stipulated, keeping records of performed inspections and recommendations for improving energy efficiency.

The aforementioned measures prescribed by the technical rules and norms aim to motivate owners of old and inefficient devices to install new, more efficient appliances, and with the availability of financial schemes for tax breaks and subsidies to install renewable energy devices.

At the local level in the town of Šabac, the planning documentation defines zones where there is an obligation to connect new facilities to the district heating network and zones where it is possible to use natural gas or other fossil fuel.

The City of Šabac has adapted local acts and initiated collective action such as thermal insulation of existing buildings to reduce energy consumption for heating and cooling, as well as connection of buildings to the built-in district heating system free of charge to encourage homeowners with individual fossil fuel firing plants to switch to district heating

Table 21: Instrument assessment for City of Šabac

Instrument	Type	Level	Encourages replacement	Directs the purchase	Impact
financial incentives for biomass boiler replacement using National Funds for energy efficiency	F	N	X	X	very high
financing biomass boiler using EBD GEFF or other similar incentives	F	N,L	X	X	high
financial incentives for biomass boiler replacement using Local budget fund for energy efficiency	F	L	X	X	very high
connection to DH grid free of charge	F	L	X	X	high
definisiranje gradskih zona u kojima je moguće priključenje novih objekata na DH grid	R	L		X	high
eco design and energy class labeling of new air conditioner and boilers and heating devices	R	N	X	X	High
periodical test and maintenance of HC devices	I	N	X	X	high

Instrument	Type	Level	Encourages replacement	Directs the purchase	Impact
education and training of stakeholders	I	L	X		moderate
open data of air quality metering (PM 2.5 and PM 10)	I	N	X		moderate

Type: regulation (R), improvements (I), financing (F)

Level: national (N), regional (R), local (L)

Impact: very low, low, moderate, high, very high

2.7.3 Drivers and barriers

The success of individual or collective actions to replace fossil fuel boilers or biomass boilers or to connect them to district heating and cooling systems depends on the motivation of the citizens who own the buildings. The actions that need to be taken to start the replacement process are awareness and education of stakeholders. Pollutant and greenhouse gas emissions data need to be opened. Organizing public forums, through the media, through the education system and workshops with managers of multi-family residential buildings, educates them on the need to switch to renewable energy in order to mitigate the negative effects of climate change, preserve the environment, and in particular prevent air pollution, which is a burning problem in Serbia. Understanding more efficient appliances and green technologies will help citizens make an informed decision about replacing fossil fuel boilers and inefficient wood burning boilers with more efficient appliances and renewable energy. It is a good choice to connect to a district heating network where possible because district systems are flexible and efficient and the share of renewable energy increases.

The transition to renewable energy should be accelerated by the implementation of pilot projects and informing citizens about examples of good practice. These activities will be coordinated by a working group consisting of representatives of the local administration, decision makers, representatives of the local energy company as well as representatives of the installers, local NGOs that support actions aimed at environmental protection and representatives of the energy cooperative "Sun Roofs" founded by the citizens of Sabac.

The next step is the financing initiatives for boiler replacement initiated by the banking sector, which offers favorable low-interest rate credit lines and long-term repayments such as the GEFF EBRD, as well as applying for the local budget fund for Sabac. The specificity of the participation of the energy cooperative "Sun Roofs" is that it offers a financing model by raising money through crowdfunding campaigns.

Collective actions implemented in Sabac are thermal insulation of residential multi-family buildings in order to reduce energy consumption and connection to the district heating system without compensation. Collective actions accelerate the transition from fossil fuels to renewable energy.

However, based on the experience to date, barriers have been identified that relate to the technical aspects of the replacement as well as the financing method. Technical problems are the lack of quality devices on the market, the training of installers and the still unstable biomass market, ie the lack of logistics for the supply of quality biomass. A key issue is the standardization of biomass (wood pellets) being marketed.

The mode of financing, as a barrier to the replacement process, has been identified through insufficient funding identified in the local budget fund, insufficient experience in the allocation of funds and sometimes insufficiently transparent criteria for the allocation of funds.

On the other hand, the problem of homeowners in multi-family residential buildings is that they are not visible to the banking sector. Housing communities, even though they have legal treatment, are not creditworthy clients from the banking sector's perspective. In Sabac, as in Serbia, it has not yet been reported that any housing community has successfully applied for funding from the banking sector.

Barriers have also been identified on the technical regulation side when heat pumps are replaced or solar collectors are used, approval procedures can be too complicated and facility owners are often unfamiliar with technical regulations.

2.7.4 Key considerations for defining policy sets

The City of Sabac has adopted a local energy policy and is encouraging a market for energy services so that there are currently no institutional barriers at the local level and decision makers understand and encourage replacement as a process of public interest. Increasing the share of renewable energy requires a complex, cross-sectoral approach. A key factor is an efficient and effective model for financing the replacement of old appliances with new, more efficient ones that use renewable energy. In this context, a set of regulatory and financial measures need to be adopted to keep the national budgetary fund and the local budgetary fund open to citizens. The most important thing is to define incentive schemes precisely, to define the criteria for allocation of funds and to provide sources of financing of budget funds.

Working groups at the national level are expected to fully harmonize the regulations of the Republic of Serbia with the international commitments taken to increase the share of renewable energy, especially in the HC sector, as well as the consistent implementation of the adopted regulations.

The biggest threat to the success of the replacement process is related to funding schemes and involvement of the banking sector, which should finance the purchase of new, efficient devices and the introduction of renewable energy in the HC sector.

The municipal administration would be more active and successful if the financing scheme ensured greater involvement of the national budget fund or the reimbursement of funds invested in replacement activities through transfers from the state government to the local level.

2.7.5 Success stories

An example of good practice is the installation of a biomass boiler in the suburban settlement Letnjikovac. In the existing boiler room from which two public buildings are heated, an elementary school and a vocational training center, two 2 x 400 kW oil fired boilers were used. Within the CoolHeating project²⁴, a model for switching to wood chips has been prepared and further development of the project is planned in two stages. In the first phase, 500 kW wood chips boiler is already installed in 2018, another 500 kW wood chips boiler will be installed (planned realization for 2020), a small district heating network will be built, to which six more public buildings will be connected at this location. In the second phase (2021-2022), it is planned to install a third 1 MW boiler on a wood chips and build a 4 km district heating network. It is possible to connect 250 single-family buildings located 'near the network. In this way, the suburban settlement Letnjikovac could become an "energy independent island". The procurement of the already installed wood chips boiler was co-financed by the joint funds of the city of Šabac, the national budgetary fund for energy efficiency in the public sector and the UNDP office in Serbia. Another 500 kW wood chip boiler and 700 m grid including 6 heat substation is object of BioSol project²⁵ (Interreg project where City of Šabac and City of Nova Gradiška have been participating, crossborder cooperation between Serbia and Croatia). The financing model is co-financing BioSol project and City of Šabac. The second phase of project is being prepared by the local DH company ("Toplana-Šabac").

The model of a small district heating network that uses renewable energy is applicable in suburban and rural areas. The project can also be implemented on market principles with the participation of ESCO or an energy cooperative founded by the local population.

Another example of good practice is a collective action initiated by a local energy company. The goal is to connect buildings adjacent to the existing district heating network free of charge. This is an innovative practice in Serbia because the current local acts stipulate that all costs of construction of the connection and installation of the thermal substation shall be borne by the building owner and hand over the constructed infrastructure without compensation to the energy company providing heat distribution and supply. It is very important to meet the goals of the REPLACE project because the district heating network is being transformed into a 4th generation network with renewable energy sources and energy storages. This will extinguish a large number of small fossil fuel boilers.

²⁴ CoolHeating, Horizon 2020, <https://www.coolheating.eu/en/>

²⁵ BioSol – Interreg IPA CBS <https://www.interreg-croatia-serbia2014-2020.eu/project/biosol/>

2.7.6 HC replacement outlook

Financing schemes, analyzing and adapting local and national regulatory acts, encouraging collective action and citizens' initiatives, as well as providing better information on renewable technologies, climate change effects and environmental protection, should be considered to support measures to replace old inefficient heating and cooling devices with renewable technologies.

Measures that would speed up the replacement of fossil fuel boilers are:

- development of a market for energy services that would stimulate competition, offer more quality devices and improve the quality of services,
- development of new financing models for the purchase of new, more efficient heating and cooling devices, including ESCO financing model,
- establishment of a guarantee fund that would provide more secure business for the banking sector and make it easier for citizens to access financial resources.

Access to financing instruments and more favorable credit conditions for the purchase of new devices have been identified as a key factor that could accelerate the replacement of old devices and the introduction of new technologies.

Measures under consideration but not yet in force are:

- incentives through tax policy changes,
- establishment of local budget funds to finance the replacement of old and inefficient devices,
- launching “one-stop-shops” in which citizens can obtain all the necessary information on the procedures for replacement of devices, financial instruments of support, biomass market and quality standards, qualified installers and expert support in obtaining investment and technical documentation,
- Introducing climate change education on energy efficiency measures into school programme.

2.8 Slovenia

2.8.1 Overview of policy instruments for sustainable heating and cooling system replacements

12,990 tonnes of PM₁₀ emissions were generated in 2017, which is a 2.5% decrease over the previous year, while PM₁₀ emissions from households were lower by 5.3%. Buildings-related emissions represent the vast majority of all emissions in the Other sectors. Overall, buildings emit the majority of PM₁₀ and PM_{2.5} emissions, which is the results of the use of old and inefficient boilers in households, used for heating (Figure 16).

The policy instruments in Slovenia on the national level are presented by the area they address: environmental protection, organization and operation of a public chimney sweeping and building construction. For each are the main instruments are pointed out and described.

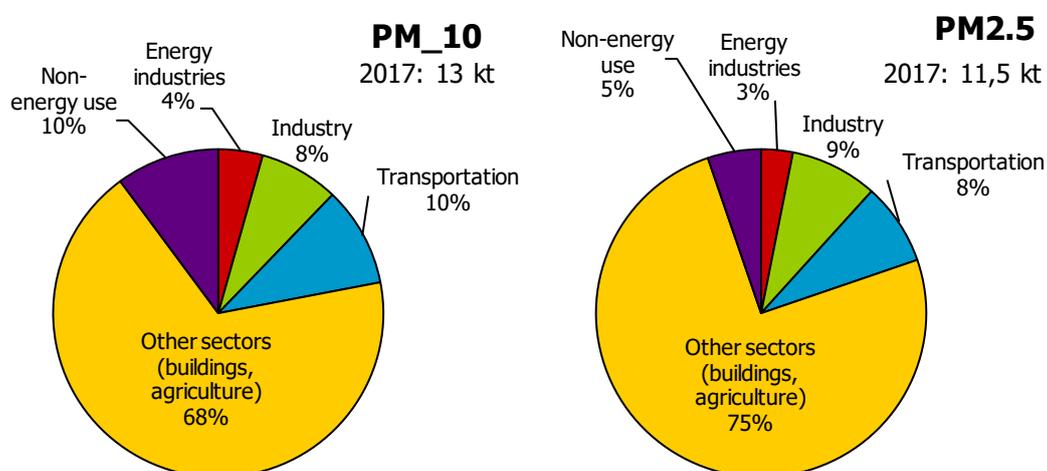


Figure 16: Origins of PM₁₀ (left) and PM_{2.5} (right) emissions in 2017 by sectors

2.8.1.1 Environmental protection

The emissions of substances into the air that may be released into the air from small combustion plants are regulated by instruments in Table 22.

Table 22: List of policy instrument from the aspect of environmental protection

Policy instrument	Link
Decree on the emission of substances into the atmosphere from small combustion plants (OJ 46/19)	https://www.uradni-list.si/glasilo-uradni-list-rs/vsebina/2019-01-2272?sop=2019-01-2272
Decree on the emission of substances into the atmosphere from medium-sized combustion plants, gas turbines and stationary engines (OJ 17/18, 59/18)	http://www.pisrs.si/Pis.web/pregledPredpisa?id=URED7472
Commission Regulation (EU) 2015/1185 of 24 April 2015 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for solid fuel local space heaters	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2015.193.01.0001.01.ENG
Commission Regulation (EU) 2015/1189 of 28 April 2015 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for solid fuel boilers	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2015.193.01.0100.01.ENG

In the last twenty years, remarkable progress has been made in the development of combustion plants, thereby reducing flue gas emissions and increasing the efficiency of combustion. This enabled lowering of emission limits for new boilers. In the future, further development of small combustion plants and flue gas cleaning equipment is planned with a view to further reduce flue gas emissions, especially CO, CxHy and dust.

Article 11 of the Decree **OJ 46/19** sets emission limits for total dust and CO for small combustion plants, with a rated thermal output of 4 kW or more and less than 1 MW, using wood other than one-room small combustion plants, basic furnaces or open fireplaces.

- the total dust concentration limit is 40 mg/m³ for appliances with automatic fuel injection and 60 mg/m³ for appliances with manual fuel injection,
- the carbon monoxide concentration limit is:
 - o 500 mg/m³ for automatic refueling installations,
 - o 700 mg/m³ for installations with manual fuel injection with a rated thermal output of less than or equal to 500 kW,
 - o 500 mg/m³ for installations with manual fuel injection with a rated thermal input greater than 500 kW.

For new single room appliances limit values for dust are 40 mg/m³, only for pellet stoves it is lower, For stoves without water heat exchanger it is 30 mg/m³ and for pellet stoves with water heat exchanger it is 20 mg/m³.

The Decree was accepted in 2019 and it contains an article, that aims to replace old, inefficient boilers. Article 25 states, that a solid fuel boiler other than a one-room combustion plant and was manufactured, may be used:

- a) if the emissions of substances into the air do not exceed the limit values referred to in Article 11 or
- b) up to a maximum of 20 years from the year it was made (For these boilers a higher limit value is allowed – for boilers installed before 2011, limit value for dust is 150 mg/m³, for boilers installed after 2011 limit value is 100 mg and if pellets or briquettes are used 60 mg/m³).

For single room stoves if emission are inline with the limit values for new stoves they can be used in other cases they have to be substituted at the latest after 20 years from the year they were installed.

Due to the obliged yearly boiler and stoves inspections by chimney sweepers, the households are going to be informed if their combustion plant does not meet the minimal requirements and if they are obliged to replace it.

EU eco-design regulations set efficiency and emission limit values that have to be fulfilled for the boilers and stoves to enter the market. Limit values are the same as are set in the Slovenian legislation.

2.8.1.2 Organization and operation of a public chimney sweeping

Chimney sweeping in Slovenia is an effective way not only to ensure the quality of combustion plant operation, but to have an overview of all combustion plants through Small Combustion Plants register. This enables to identify combustion that are i.e. inefficient, located in dense areas. The first inspection of the plant must be carried out in accordance with the Chimney Servicing Act on each newly installed or reconstructed chimney flue.

The purpose of the first inspection is to determine

- whether the boiler installation complies with all legal regulations covering this area, the manufacturer's instructions for the installation of combustion plants etc.
- whether proper access to maintenance, servicing and inspection facilities is provided,
- whether the proper combustion and technical conditions for efficient energy use and environmental protection are provided, which means proper combustion of fuel and
- registration of the boiler into the register of small combustion plants.

Upon completion of the inspection, the chimney sweep will issue a first inspection report. In the event that the chimney service finds deficiencies or inconsistencies, it issues a "remedy warning" and a deadline for correcting them. This time limit may not exceed 60 days. After the expiration of the latter, the user of the smoke and flue appliance is obliged to inform the chimney sweep service, which carried out the first inspection with him, in order for the latter to check the elimination of the defects.

In accordance with Slovenian legislation, **a combustion plant that is not recorded in the register cannot not be used.**

During the inspection, it shall be verified that the installations operate in accordance with all regulations and with the provisions of the documentation on the basis of which the permit for use of the installations or the building in which the combustion plant is located is issued. The inspection shall be completed by the chimney sweep by the production and submission of the emergency inspection report to the competent inspector. In the case of deficiencies, the chimney sweep must set a deadline in the emergency review report.

Table 23: List of policy instrument from the aspect of chimney sweeping organization

Policy instrument	Link
Decree on the method, subject and conditions for the performance of the compulsory public utility service of measurement, inspection and cleaning of combustion installations, flue ducts and ventilation shafts for the purpose of environmental protection and efficient use of energy, health protection and fire protection	http://www.pisrs.si/Pis.web/pregledPredpisa?id=URE D3574
Chimney Sweeping Services Act	http://www.pisrs.si/Pis.web/pregledPredpisa?id=ZAK O7154

2.8.1.3 Building construction

The field of building construction and thus also the installation of heating installations is defined by instruments in Table 24.

Table 24: List of policy instrument from the aspect of building construction

Policy instrument	Link
Building Act	http://www.pisrs.si/Pis.web/pregledPredpisa?id=ZAK O7108
Energy Act	https://www.uradni-list.si/glasilo-uradni-list-rs/vsebina/2019-01-2673?sop=2019-01-2673
Rules on efficient use of energy in buildings with a technical guideline	http://www.pisrs.si/Pis.web/pregledPredpisa?id=PRA V10043
Rules on fire safety in buildings	http://www.pisrs.si/Pis.web/pregledPredpisa?id=PRA V5628
Rules on minimum technical requirements for the construction of apartment buildings and apartments	http://www.pisrs.si/Pis.web/pregledPredpisa?id=PRA V10213
The Slovenian national action plan for nZEB	https://www.energetika-portal.si/fileadmin/dokumenti/publikacije/an_snes/an_snes_slovenija_en.pdf
Energy Efficiency Action Plan 2020	https://www.energetika-portal.si/fileadmin/dokumenti/publikacije/an_ure/an_ure_2017-2020_final.pdf
National Energy and Climate Action plan (draft version, January 2020)	https://www.energetika-portal.si/fileadmin/dokumenti/publikacije/nepn/dokumenti/nepn-v.4.1_jan_2020.pdf

The Slovenian building codes PURES (Rules on efficient use of energy in buildings with a technical guideline), are valid for all types of new buildings, residential and non-residential, while for public buildings (public investments) 10% more severe minimum requirements are imposed. However, new public buildings are front-runners in energy efficiency due to the financial incentives available for early NZEB as well as due to the Decree on green public procurement that included low primary energy among the selection criteria for bids.

The Slovenian national action plan for nZEB imposed the technical definition of nZEB based on the cost-optimal study. The primary energy as a core performance indicator of NZEB is limited to 75 / 80 / 55 kWh/m².year for new single- and multi-family houses and for non-residential buildings, respectively, and complemented by the requirement of a 50% share of RES in the final energy use. RES may be selected in consideration of their availability and acceptable NZEB technologies. In the future, the use of RES will be increased due to the growing share of RES in district heating systems which are subject to comply with the 2020 energy efficiency targets set in the Energy Act. Due to strict nZEN requirements for new build and renovation, the main emphasis of Slovenia is routing the investor's decision towards biomass boilers and heat pumps in decentralized heating systems.

The Slovenian National Energy and Climate Action (NECP) plan is currently at the adoption phase, but the draft version sets put ambitious plans in sense that the combustion of heating oil and coal for heating must be avoided as far as possible in order to ensure that climate protection targets for 2030 are met. The following targets were set out:

- **Phase-out for oil and coal in space heating:** With the adoption of NECP, installation of coal boilers is forbidden, while for fuel boiler the requirement enters in force after 2023.
- **Preparation of a heating strategy:** The aim is decarbonization of the heating market. Such strategy will present on national and local level:
 - Paths and possibilities of a complete heat supply based on renewable energy sources (biomass technologies, district heating, direct solar usages, geothermal energy and ambient heat), including measures and roadmaps
 - Promotion of local and district heating (also micro and mini)

2.8.2 Financial and legislative promotion

The main financing instruments for HC replacements are subsidies by Eco fund. The Eco Fund (Eko Sklad, Slovenian Ecological Fund) provides funding for investments in RES through public calls. The calls promote different technologies. Various incentive options are open for RES (such as: the installation of central heating devices that use wood biomass, distribution heating systems using wood biomass, heating pumps [water- and geothermal energy], and power plants using aerothermal technologies and solar technologies. Usually each technology has specific requirements that are detailed in the call document (e.g. standards the heating boiler that need to be met in order to be eligible for co-financing, the volume of the heating boiler, emission values etc.). The financial incentives for households are listed in Table 25.

Table 25: Incentives related to HC equipment by Eco Fund

Measure	Incentive
Installation of biomass boilers for central heating	50%, up to 4.000 EUR – replacement of old boiler 60%, up to 5.000 EUR – replacement of old boiler in municipalities with air quality ordinance
Installation of gas condensing boiler for central heating of old household	50%, up to 2.000 EUR
Installation of heat pump for central heating	40%, up to 4.000 EUR – installation of ground/water sources heat pump 40%, up to 2.500 EUR – installation of air sourced heat pump 50%, up to 5.000 EUR – installation of ground/water sources heat pump in municipalities with air quality ordinance 50%, up to 3.200 EUR – installation of air sourced heat pump in municipalities with air quality ordinance
Installation of a sub-station for connection to the district heating	50%, up to 3.000 EUR
Holistic building renovation	50%

Slovenian household can receive from 20 to 60% grants when dealing with the replacement of the old HC equipment. Although there are some direct instrument to support households which deal with energy poverty, but their impact in marginal. National census show that vast majority of investors in households take Eco fund grants to cover their investments, so their impact has been identified as very high.

Table 26: Instrument assessment for Slovenia

Instrument	Type	Level	Encourages replacement	Directs the purchase	Impact
Subsidies for biomass boiler	F	N	×		Very high
Subsidies for gas condensing boiler in centralized heating systems	F	N	×		Very high
Subsidies for heating system optimization in the multi-family houses	F	N	×		Moderate
Subsidies for connection to the district heating networks	F	N	×		High
Subsidies for heat pumps	F	N	×		Very high
Inspections of heating systems	I	N	×		High
Combustion plants regulation and emission law	R	N		×	Moderate

Table 27: Instrument assessment for Slovenia that address energy poverty

Instrument	Type	Level	Encourages replacement	Directs the purchase	Impact
100% subsidy for the boiler replacement	F	N	×		Moderate
100% subsidy for the energy renovation of multi-family house (thermal envelope, boiler)	F	N	×		Moderate
Reducing the energy poverty of citizens	F	N			Moderate

Type: regulation (R), improvements (I), financing (F)

Level: national (N), regional (R), local (L)

Impact: very low, low, moderate, high, very high

2.8.3 Drivers and barriers

The table below lists the identified drivers and barriers for HC replacement in Slovenia from the aspect of consumer, policy, market and technology.

Table 28: Drivers and barriers for HC replacement in Slovenia

Aspect	Driver	Barrier
Consumer	<ul style="list-style-type: none"> - legislative measures - financial incentives - private financing for public buildings with the model of energy contracting - public information - energy advisory network 	<ul style="list-style-type: none"> - outdated heating systems are only replaced when they are no longer functional or are about to fail. - households unprepared for significant investment - difficulties to get loans/incentives for households dealing with energy poverty - split-incentives in multi-family buildings - questionable long-term future of gas networks - high prices of district heating in some cities - lack of knowledge
Policy	<ul style="list-style-type: none"> - continuous subsidy programmes for households 	<ul style="list-style-type: none"> - intermediaries and industry are confronted with uncontinuous subsidy programmes - lack of understanding from local decision makers
Market	<ul style="list-style-type: none"> - established network of chimney sweepers 	<ul style="list-style-type: none"> - lack of strong ESCO companies - old building stock - gap of skilled installers
Technology	-	<ul style="list-style-type: none"> - incautious installation of heat pump in densely populated areas on district heating network areas

2.8.4 Key considerations for defining policy sets

The identified key considerations that would have to be taken into account for defining new policy sets for the REPLACE actions.

- Better awareness of end consumers on the age and efficiency of their old boilers and the alternatives.
- Consistent and technology-neutral information for end consumers from energy advisors, installers and chimney sweepers
- Regulatory provisions that give a clear planning horizon and milestones for a complete phase out of fossil fuelled and inefficient heating systems
- Timely education of much more trustful and competent installers to overcome the predicted lack of installers to realize ambition lying ahead with a sustainable decarbonisation of the heat market
- Further ensuring financial incentives to stimulate the proper boiler replacement;

2.8.5 Success stories

Increased contributions for energy efficiency for the purchase of fuel oil

In 2010, Slovenia has decided to reduce the share of fuel oil in the national energy balance. This was achieved through the increased contributions introduced by the new regulation. Out of the eight energy sources, fuel oil was the most taxed contributing to higher fuel oil prices. The contribution was expected to raise around € 91 million per year and this amount was meant to subsidize the production of electricity from renewable sources, mainly from solar power plants.

Higher fuel oil prices encouraged the households to replace their old, inefficient fuel oil boilers with more efficient one sooner. On the other hand, the financial incentives for purchase of new boilers helped those households to smoothen the transition. The overall result was that many fuel oil boiler were actually replaced, which reflected on the national GHG emissions reductions (Figure 17).

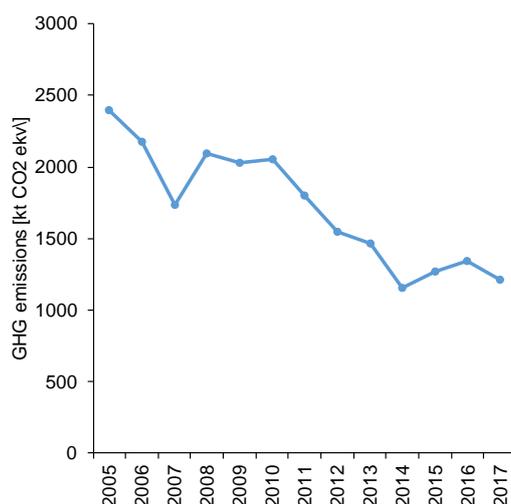


Figure 17: GHG emissions in Slovenia for building sector in the period 2005-2017

Financial incentives for biomass boilers and heat pumps

Eco fund's incentives are considered important driver when installing a new heating generator in households, since national survey show that vast majority of all investors use these financial incentives. Since 2010, over 20,000 incentives have been given for installation of a heat pump and over 17,000 for biomass boilers (Figure 18).

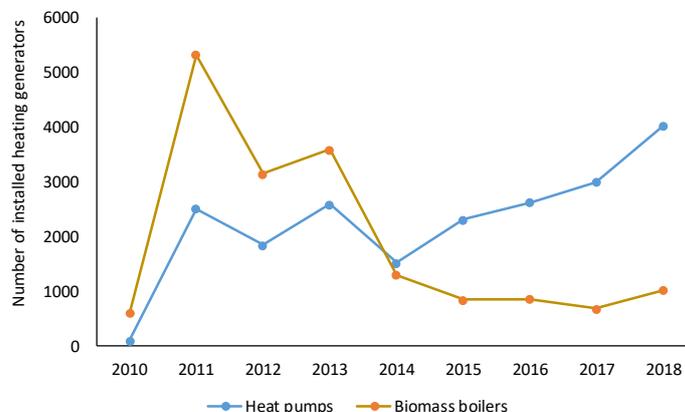


Figure 18: Number of granted incentives for installation of a new heating generator

Collective purchase of cooling equipment

In 2019 the Slovenian Consumers Association made a group purchase of air-conditioning equipment. More than 6,300 consumers have joined the campaign, one of the activities being carried out under the H2020 Clear 2.0 project, with authorized contractors installing 628 air-conditioners offered by the group purchase so far.

The campaign is over; last assemblies are taking place. Great response shows that consumers have positive feeling towards this kind of activity and, above all, they trust us, which is a confirmation for us that consumers know how to unite and achieve a good offer. The price of a product, which is usually a very important factor, did not play a major role this time - we put quality at the forefront. As part of the group purchase, Consumers Association offered quality, efficient, reliable and also environmentally friendly air conditioners that have been rated *very well* or at least *well* by independent comparative testing.

Register of small combustion plants

On the basis of the boiler's inspections by chimney sweepers, a register was established and offers data i.e. on age of installation, address and source for combustion (Figure 19). By 2019, 449 licensed chimney sweepers enlisted 280,000 combustion plants. It is estimated that little over 85,00 of those are inadequate in terms of efficiency. The register offers a unique insight into small combustion plant national stock, which enables to analyse potential or scenarios for further phasing-out fossil fuel based plants with more targeted approach.

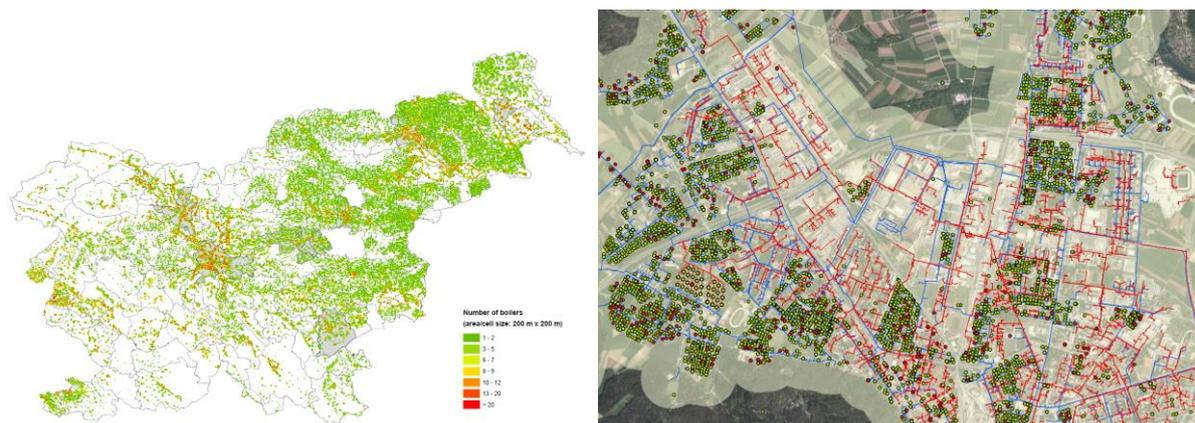


Figure 19: Geo-representation on national (left) and local (right) level of small combustion plants

2.8.6 HC replacement outlook

Residential sector represents 23% of final energy consumption and comparing to 2009, the consumption decreased for 20,9%. There was a 45% share of renewable energy sources in 2017, where wood fuels prevail among consumed energy sources. The shift in the heating systems replacement structure was very different between dense and sparse areas. In sparse areas the majority of the households replace their old, inefficient boiler on biomass or fuel oil with a new boiler or heat pump. While on the other hand the majority of investors turned their heating system to either sub-stations or gas condensing boilers in dense areas. There's almost 100 district heating systems in 212 municipalities in Slovenia (Figure 20), and through the European directives and national legislations, the district heating system will have to increase their share of RES in the heat production annually. By doing that and taking into account the fact the energy use for heating in buildings will decrease (due to energy renovation), the distributors will have to find new ways to motivate households for DH systems and investment in sub-stations. This is in line with the draft version of National Energy and Climate Plan, where the future of heating systems in dense areas relies on district heating systems and if there are none – heat pumps are going to take the leading role as a sustainable solution for heating.

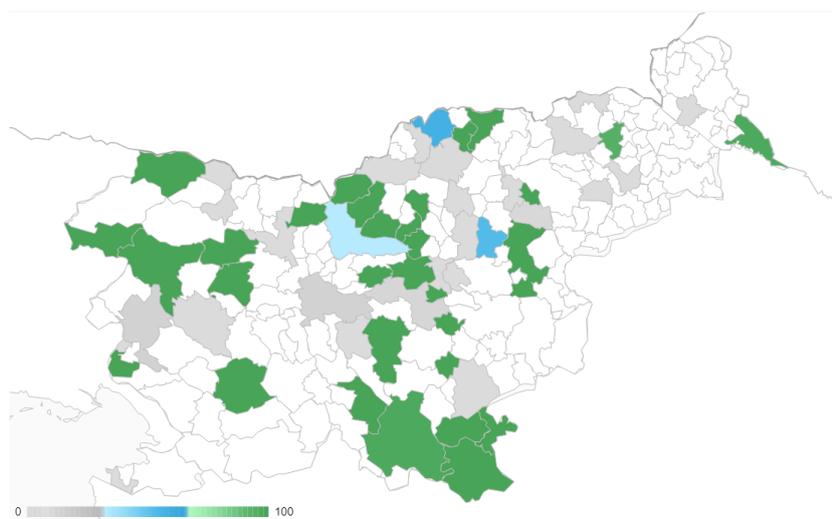


Figure 20: Municipalities with district heating network and share of RES in the heat production

In the last decade, a lot of of the oil heating systems in private households throughout Slovenia have been replaced by other heating systems, the majority around 2010 due to intentionally increased energy prices for fuel oil. Furthermore, there is a plan to completely phase-out inefficient boilers,

which emit more than requirements allow. According to the Decree on the emission of substances into the atmosphere from small and medium combustion plants, old and inefficient heating systems will no longer be installed in buildings:

- from 2032 for buildings, where the heating systems was installed before 2012 and
- from 2040 for all other heating systems if the emissions of substances into the air do not exceed the limit values.

The following factors will be key to building sector decarbonisation:

- renovation of buildings from energy and other aspects,
- the share of renewable energy in centralized and decentralized heating systems
- information-supported construction
- sustainable construction
- user behavior

Targets for net zero emissions in buildings by 2050 lead to significant fuel restructuring. Fossil fuel technologies will be replaced by either RES technologies or heating sub-stations and district heating connections. However, energy efficiency in buildings depends not only on the construction and renovation, but also on the use, management, awareness and education of its users. Hence, REPLACE activities are essential for further phasing-out fossil fuel based combustion plants by more informed-decision making process as well on national level as well as on a level of each household.

2.9 Castilla y Leon, Spain

2.9.1 Overview of policy instruments for sustainable heating and cooling system replacements

The list below gathers several Spanish strategies, policies and plans on the national and regional level of relevance for the REPLACE program, including the scope and a brief description on how they are relevant for this project.

Table 29: Spanish strategies, policies and plans on the national and regional level

Thematic scope	Strategy, policy or plan	Territorial scope	How it relates to REPLACE
Renewable Energy	The Renewable Energy National Action Plan (PANER) 2011-2020	National	<p>(PANER) 2011-2020, sets national targets for renewable energy in accordance with Directive 2009/28/EC. By 2020, renewable energy will account for 20.8% in gross final energy consumption, as well as 17.3%, 39.0% and 11.3% respectively in energy consumption in the heating/cooling, electricity and transport sectors. PANER 2011-2020 envisages a package of more than 80 measures.</p> <p>DHC-(PANER) 2011-2020 performs an analysis of the current state of the various renewable technologies and sets targets for 2020, with the corresponding proposals for improvement, support frameworks and impact assessment in terms of economic, employment, etc., of direct application to urban DHC (especially biomass thermal, geothermal and solar thermal).</p> <p>The Plan makes some general considerations on the vital importance of the development of such infrastructures for the improvement of the energy efficiency of buildings, suggesting that these facilities prevail normatively over individual ones, provided that it is technically and economically feasible.</p> <p>It also incorporates some normative proposals to promote this technology, such as the need to adapt building certification procedures to the food case with centralized networks or the inclusion of these systems in the Buildings Thermal Installations Regulations (RITE)</p> <p>https://www.idae.es/uploads/documentos/documentos_11227_PER_2011-2020_def_93c624ab.pdf</p>
Renewable Energy/ Biomass	National Rural Development Program, 2014-2020 Castilla y León Rural Development Program	National Regional	<p>National program (consolidated text, last update 12/01/2019) that is constituted for the realization of the supra-autonomous cooperation project whose objective is the study of possible improvements to be implemented in priority associative entities or agrifood SMEs in aspects related to the sustainable supply of biomass, and what are the requirements established in Article 4 of the RD 254/2016.</p> <p>The regional program is developed through 17 measures and 36 sub-measures; one of the focal points is improving forest mass exploitation for the production of energy and heat and to avoid fires.</p> <p>http://www.jcyl.es/web/jcyl/AgriculturaGanaderia/es/Plantilla100/1284319661743/1246464862173/ /</p>

Thematic scope	Strategy, policy or plan	Territorial scope	How it relates to REPLACE
Renewable Energy/Biomass	Regional Sectorial Plan of Bioenergy in Castilla y León	Regional	<p>The Plan establishes quantitative objectives for the year 2020. Its degree of application is indicative.</p> <p>These objectives are grouped into two fundamental phases: Supply phase, which implies the value of each type of biomass understood as an energy resource from Castilla y León, regardless of where it is used or consumed, and whose total value should reach 6.758.000 tons per year in 2020, and Demand phase, which implies projects and installations carried out within the region that use biomass, whose total value should reach 2.900 thousand tonnes of oil equivalent per year in 2020.</p> <p>The predictions made at the beginning of the decade had different grade of approximation depending on if the figure was related with thermal, transport or electrical uses.</p> <p>https://energia.jcyl.es/web/jcyl/Energia/es/Plantilla100Detalle/1267710822752/Programa/1284151659081/Comunicacion</p>
Energy Efficiency	Energy Efficiency Directives (2012/27/EU, 2018/2002/EU), Cogeneration Directive (2004/8/EC) and Energy Services Directive (2006/32/EC)	European	<p>DHC- Under the Energy Efficiency Directives (2012/27/EU, 2018/2002/EU) which reinforce the cogeneration directives (2004/8/EC) and energy services (2006/32/EC) it identifies:</p> <ul style="list-style-type: none"> -Cogeneration and climatization urban installations as facilities of high savings potential, as well as the need to establish the instruments to include medium and small producers. -The obligation to recover waste heat (cogeneration) generated by power plants and industrial plants. -Promoting the energy services market; ESEs are consolidated as a basic instrument of achieving savings <p>These directives have been transposed to the Spanish legislation</p>
Energy Savings and Energy Efficiency	Energy Savings and Energy Efficiency Action Plan, 2017-2020	National	<p>It responds to Directive 2012/27/EU and has ensued the adoption by all Member States of two targets for energy saving and energy efficiency: the first, indicative (primary energy consumption reduction 24.7% compared to the trend scenario in 2020) and fixed by each Member State and, the second, mandatory (final energy saving 571 ktep/year between 2014-2020)</p> <p>DHC- The plan provides specific measures to promote cogeneration, a key technology in urban climatization facilities, as one way for energy-saving</p> <p>https://ec.europa.eu/energy/sites/ener/files/documents/es_neeap_2017_es.pdf</p>
Energy Efficiency	Energy Efficiency Strategy of CyL-2016-2020	Regional	<p>The objectives of the Energy Efficiency Strategy of CyL-2016/20 set specific and measurable goals (reduce by 30% primary energy consumption and decarbonize energy consumption by 30%) that will allow the transformation of the autonomous energy system into a more decarbonized position, more efficient, with higher quality of supply and added value for the economy of Castilla y León.</p> <p>https://energia.jcyl.es/web/jcyl/Energia/es/Plantilla100/1284777945631/Programa/ /</p>

2.9.2 Financial and legislative promotion

The instruments assessment regarding REPLACE for Castilla y León is introduced in the following table.

Table 30: Instrument assessment for Castilla y León, Spain

Instrument	Type	Level	Encourages replacement	Directs the purchase	Impact
Energy Transition Laws	R	N/R	X		Moderate
Renewable energy promotion	R	N/R	X		High
Awarding Energy Saving Certificates	R	R	X		Moderate
Decarbonisation strategies	R	N/R	X		Moderate
Promotion of renewable energy cooperatives	R/F	N/R	X		Moderate
Third party financing	F	N/R	X		Moderate
Project financing and leasing of services	F	N/R	X		Moderate
Financial incentives for biomass boiler replacement	F	N	X	X	High
Subsidies for biomass boiler replacement	F	R	X	X	High

Type: regulation (R), improvements (I), financing (F)

Level: national (N), regional (R), local (L)

Impact: very low, low, moderate, high, very high

Listed below are safety, sanitary and technical regulations that set the necessary framework for the installation, operation and energy performance of thermal equipment in buildings.

Table 31: Safety, sanitary and technical regulations

Thematic scope	Normative & Regulation	Territorial scope	How it relates to REPLACE
Thermal installations in buildings	RITE, Regulations on Thermal Installations in Buildings	National	RITE, sets out, the thermal installations minimum performance requirements for heating, cooling, ventilation and ACS (sanitary hot water) production and periodic inspection of energy efficiency. The highest efficiency requirements are reflected in higher performance of thermal installations, better insulation in equipment and conductions of thermal fluids, the use of renewable energies and energy recovery systems, as well as the incorporation of mandatory consumption accounting systems in collective facilities. Establish minimum requirements for boiler efficiency and forbidden coal since 2012. https://energia.gob.es/desarrollo/EficienciaEnergetica/RITE/Paginas/InstalacionesTermicas.aspx

Thematic scope	Normative & Regulation	Territorial scope	How it relates to REPLACE
Energy efficiency in buildings	CTE, Building Technical Code	National	<p>The Building Technical Code (CTE) -RD 314/2006 17th March- establishes and develops Quality Basic Requirements of buildings and their facilities, and that demonstrate that the Building Basic Requirements are met. The Building Technical Code-CTE, is updated by RD 732/2019, 20th December.</p> <p>The CTE increases energy efficiency requirements for new buildings, and for old buildings enlargement/ rehabilitation, which have requested for a construction license after March 2014. This update is a first approach phase to Directive 2010/31/EU objective to achieve nZEB- nearly Zero-Energy Building</p> <p>https://www.codigotecnico.org/index.php/menu-documentoscte.html</p>
Energy Efficiency in Buildings	EPC, Energy Performance Certification of Buildings	National	<p>EPC establishes the basic requirements of buildings and defines the obligations of the actors involved in the building process and establishes the responsibilities and guarantees of protection to users. Software tools for the realization of energy certification of existing buildings (CE3 and CE3X programs) and new ones (Unified Tool Program, HULC) are available to the public</p> <p>https://energia.gob.es/desarrollo/EficienciaEnergetica/CertificacionEnergetica/DocumentosReconocidos/Paginas/procedimientos-certificacion-proyecto-terminados.aspx</p>
Other normative and regulation but not specific for energy efficiency:			
Hygienic-sanitary	Royal Decree 865/2003, hygienic-sanitary criteria for the legionellosis prevention and control.	National	<p>Sets the minimum maintenance that must be carried out and registered, as well as carry out the defined preventive measures to reduce the risk of Legionella proliferation</p> <p>https://www.boe.es/buscar/doc.php?id=BOE-A-2003-14408</p>
Safety	Royal Decree 552/2019, safety regulations for refrigeration facilities	National	<p>Regulation (EU) No 517/2014 on fluorinated greenhouse gases repealing Regulation (EC) No 842/2006 requires a reduction in hydrofluorocarbons (HFCs) quantities that companies can market in the European Union</p> <p>New Royal Decree 552/2019- Safety Regulation for refrigeration installations only allows, for practical purposes, in climatization installations for thermal welfare conditions of people in buildings, the use of high safety refrigerant (L1).</p> <p>http://normativa.infocentre.es/sites/normativa.infocentre.es/files/noticias/frigorificas.pdf</p>
Safety	Royal Decree 513/2017, Facilities Regulations on	National	<p>The evolution, both in technique and normative framework, makes it essential to update and revise the requirements set out in the previous Regulation (Royal Decree 1942/1993, of 5 November) of fire protection for facilities</p>

Thematic scope	Normative & Regulation	Territorial scope	How it relates to REPLACE
	fire protection.		https://www.boe.es/buscar/doc.php?id=BOE-A-2017-6606
Technical requirements for pressure equipment	Royal Decree 2060/2008, regulations on pressure equipment and complementary technical instructions	National	<p>Approves the Pressure Equipment Regulation and the following additional technical instructions:</p> <ul style="list-style-type: none"> - ITC EP-1 on boilers - ITC EP-2 on electric power generation plants. - ITC EP-3 on refineries and petrochemical plants - ITC EP-4 on cryogenic deposits. - ITC EP-5 on bottles of autonomous respiratory equipment. - ITC EP-6 on transportable containers <p>https://www.boe.es/buscar/doc.php?id=BOE-A-2009-1964</p>
Low voltage	Decree 842/2002, updated as of October 30, 2019, Electrotechnical Regulation for Low Voltage and the complementary technical instructions	National	<p>The purpose of this Regulation is to establish technical conditions and guarantees to be met by electrical installations connected to a low voltage network.</p> <p>It establishes technical conditions and guarantees that electrical installations connected to a low voltage network must meet (at low voltage limits), such as having an installation certificate or carrying out periodic inspections according to the installation characteristics.</p> <p>https://www.boe.es/buscar/doc.php?id=BOE-A-2004-6072</p>
Emissions	<p>Royal Decree 317/2019, regulating certain aspects related to the exclusion of low-emission installations from the greenhouse gas emissions trading scheme.</p> <p>Royal Decree 100/2011, updating the catalogue of potentially</p>		<p>Provides conditions of supporting documentation to be excluded from the emissions trading scheme for low-emission installations: Small emitters are considered to be installations which have notified the competent authority , a figure of < 25,000 tons of carbon dioxide equivalent, and that, when carrying out combustion activities, have combustion activities rated thermal power of < 35 MW.</p> <p>https://www.boe.es/buscar/doc.php?id=BOE-A-2019-6351</p> <p>Aims at updating the catalogue of potentially polluting activities of the atmosphere, as well as establishing certain basic provisions for the application and minimum common criteria in relation to emission control measures</p> <p>https://www.boe.es/buscar/doc.php?id=BOE-A-2011-6238</p>

Thematic scope	Normative & Regulation	Territorial scope	How it relates to REPLACE
	<p>polluting activities of atmosphere</p> <p>Law 13/2010, regulates the greenhouse gas emissions trading scheme, to improve and extend the general emissions trading scheme</p> <p>Royal Decree 815/2013, Regulations on industrial emissions and development of Law 16/2002, of July 1, on pollution integrated prevention and control.</p>		<p>Regulates the greenhouse gas emissions trading scheme, to improve and extend the general emissions trading scheme.</p> <p>https://www.boe.es/buscar/doc.php?id=BOE-A-2010-18651</p> <p>This regulation aims to develop and implement the Consolidated Text of the Law on Pollution Integrated Prevention and Control, as well as to establish a legal regime applicable to industrial emissions, in order to achieve high protection of the environment as a whole. It also, lays down provisions to prevent and, where this is not possible, to reduce pollution caused by public or privately owned installations.</p> <p>https://www.boe.es/buscar/doc.php?id=BOE-A-2013-10949</p>
Energy Rehabilitation	Energy Rehabilitation in the Spanish Building Sector in Spain- ERESEE 2020-	National	<p>The ERESEE 2014 has been an important starting point for the promotion of the energy rehabilitation of the building in Spain, as well as a roadmap that allows to guide the different agents involved in the rehabilitation processes.</p> <p>The new ERESEE 2020 ²⁶ aims to support the renovation of the Spanish buildings, residential and non-residential buildings, both public and private, for its transformation into a National building park with high energy efficiency and decarbonized before 2050, facilitating the economically profitable transformation of existing buildings into almost nZEB-nearly Zero-Energy Building</p>

²⁶ As stated in Directive (EU) 2018/844

2.9.3 Drivers and barriers

Drivers²⁷

1. Taxation: a new taxation (by the Ministry of Finance) would be necessary in the residential sector in order to internalize the positive externalities involved in improving the energy efficiency and renewables of buildings related to this sector;
2. Legislative measures: for financing and support the housing rehabilitation focus on energy efficiency and renewable energies. Additionally, the revision of the Horizontal Property Law in order to provide the community of owners with a legal form that allows them to access easily the private financing available in the market. The legislative measures proposed by the Autonomous Communities in the field of their competences in housing or others are also relevant.
3. Public support programs: aid programs for grants and financing for existing residential buildings that are rehabilitated, improving the energy rating. Within these public support programs, there are programs (“Renove Plans”) aimed at actions or interventions that do not affect the whole building but rather individual homes of private owners for the renovation of gaps, boilers and heaters, among others. The management of the Renove Plans is carried out directly by each Region and the aid varies from one Region to another https://www.tramitacastillayleon.jcyl.es/web/jcyl/AdministracionElectronica/es/Plantilla100Detalle/1251181050732/_/1284817366552/Propuesta
4. Private Financing: i.e Energy service companies (ESEs) finance through Energy Performance Contracting. Business line with enormous growth potential in Spain due to its very low implementation in spite they have received an important support. This fact is reinforced by the promotion policies currently under development, especially in certain Regions such as Catalonia
5. Training: The training of the agents involved in the process of energy REPLACE : Public authorities that manage public funds and regulations; Consumer organizations as trainers of owners /tenants and agents of awareness campaigns; Intermediaries (professionals, energy advisors..) provide /receive training from their expertise; Other as financial institutions, which are key agents for the revitalization of new investments in energy efficiency;
6. Information: guides and manuals, observatories, forums and workshops, maintaining a web platform aimed at companies and agents in the sector that includes good practices;
7. Communication: specific information and communication campaigns, which may include targeted campaigns to the creation of regional or local energy REPLACE offices, considering that, perhaps, this is the main tool to develop some of the renewable technologies.

²⁷https://ec.europa.eu/energy/sites/ener/files/documents/spain_draftnecp.pdf, page 109

Barriers

Table 32: Barriers

<p>CONSUMERS Complexity/ Uncertainty</p>	<ul style="list-style-type: none"> - Uncertainty in cost and performance of different heating decarbonisation pathways (electricity or biomass, solar..) - Uncertainty about long term (& medium term) comparative costs –decisions without information. - Uncertainty about the quality and reliableness of the installers. - Complexity – too many technologies, all want to be used. Understanding such complexity is a barrier - Confusion in market regarding ‘best’ solution undermines confidence e.g. in DH - Future energy price trends. Energy is one of the structural problems of the Spanish economy. Foreign energy dependence causes the economy to suffer continuous price fluctuations. In Spain, only one third of the energy consumed is produced.
<p>CONSUMERS Costs</p>	<ul style="list-style-type: none"> - High investment cost of the low carbon space heating options, compared to other options. - DHC Technologies are too expensive for real life use: particularly transmission & storage in limited spaces - Gas from the grid is easy to access and use. Gas is affordable, at least at present. Gas grid is very optimized - Existing technology affordable people know about it, who to call when it is gone - Mature conservative Industry is driven by lowest cost and reliability. - Fuel costs increases fuel poverty. The National Strategy against Energy Poverty 2019-2024²⁸ proposes short, medium, and long term actions for the energy rehabilitation of homes and replacement of old appliances and equipment with efficient hardware as boilers.

28 <https://www.miteco.gob.es/es/prensa/ultimas-noticias/el-gobierno-aprueba-la-estrategia-nacional-contra-la-pobreza-energ%C3%A9tica-2019-2024/tcm:30-496260>

<p>CONSUMERS Human Factor / Consumer</p>	<ul style="list-style-type: none"> -Lack of availability of information, ability to invest, availability of debt financing (especially condominiums) - Massive replace will be required, how to get consumers on board; incentives such as tax reduction based on CO₂ reduction - Customer interaction with smart systems needs to be improved (information) - Low public trust in heating / cooling services, etc. delivered by utilities - Potential lack of convenience - District heating not in customer control – need resilience - Lack of knowledge of opportunities. Understanding barriers/enablers. Lack of adequate information on the advantages of RES H/C technologies - Consumers want heating systems that deliver heat with the same easiness that their gas boiler does - Low awareness of renewable powered heating technologies. - Low perception of the dangers of explosion, deflagration and poisoning associated with fossil sources - Low perception of the risk of shortages associated with fossil sources. - Rural/urban solutions need to develop solution that work for rural areas with low density, fuel poor homes – biomass could be a solution - Consumer concerns/resistance to signing up to Urban District Heating - District Heating = long term investment perceived as risky owing to multiple uncertainties - Public attitudes to thermal comfort. Lack of evidence and engagement with low C options. Needs large scale trials and engagement programmes – expensive - Benefits of DHC providing local flexibility in terms of heating/cooling are not clear for customers - Lack of incentives to builder/landlord to be more energy efficient - Lack of perception of biomass sustainability
<p>POLICY side Policy + Regulation</p>	<ul style="list-style-type: none"> - Practical, legal, regulatory regarding hardware and its operation - Bioenergy – policy failure: social rejection, obstacles to biomass DH, existence of renewable businesses with less uncertainty such as photovoltaics or wind energy - Heat is not regulated - Local authorities – Lack of understanding from energy key decision makers - No benefit to builder/landlord to be more energy efficient - Cost - Incentivizing the right people, challenge of landlords - Investment policy research doesn't keep with needs - Additional implementation of subsidies is needed - Split incentives, variations between the interest of the pair: owner, tenant. (T2.1 except split-incentives which are tackled in T2.2) - Competition with apparently cheap fossil fuels

MARKET side Infrastructure	<ul style="list-style-type: none"> - Lack of availability of efficient, reliable and affordable equipment - Big investment cost that gets recovered gradually as usual in energy market - Coordination of heating/electricity systems. Vision (supply and demand) of the 2 systems in an integrated way. - Building stock old. In Spain there are 25.7MM housings (year 2018), 57% built before 1980 time without EE regulations, and 20% (more than 6MM) are over 50 years old - Deep energy retrofits (replaces) offer a way of reducing demand for heating/cooling, but there is currently no market for energy retrofits. - Medium-long term system-wide, to recover the investment, so it must be well planned and anticipate the risks very early - Geographical effects. Loss of heat / cold occurs in distribution networks. To reduce this, the "demand" must be concentrated and close to the "offer" -Central DHC. In addition, some energy sources (geothermal,) must be really close to the Central. - Competition between renewables.
MARKET side Storage	<ul style="list-style-type: none"> - Heat Storage crucial however current framework(s) doesn't reward heat storage - Dislocation of thermal sources and demands for energy services - District heating temperature of operation – lower T means more recovery, but in building delivery options possible issues – legionella etc.. - Heat Storage: corrosion or impurities problems - Biomass Warehouse costs - Biomass Warehouse space
MARKET side Efficiency	<ul style="list-style-type: none"> - Gap between engineering potential and building industry attainment - Building stock (Built buildings) is poorly insulated and lacks space for heat storage - Role and value of energy efficiency and heat recovery not understood - Energy efficiency crucial – building construction – need the buy - in of developers and construction industry
MARKET side Non-Domestic sector	<ul style="list-style-type: none"> -Business models for waste heat recovery, people want to sell heat but how?... and a what temperature, moment, quantity and price / inflation. - How to get a market for waste heat - How to decarbonize heat in non-domestic sector? - Poor understanding of non-domestic, lack of statistics, high diversity in spite of its potential size
MARKET side Skills	<ul style="list-style-type: none"> - Skills gap in terms of installing, commissioning and controlling of heating/cooling systems - Advanced heating/cooling storage is too complex for installers, specifiers - Lack of people(capacity). Lack of availability of qualified installers - Lack of design and installation best practices/standards

2.9.4 Key considerations for defining policy sets

Table 33: Key considerations for defining policy sets (part 1)

CONSUMERS	<ul style="list-style-type: none"> - “INFORMATION point” single, based on ICT tools, focused on energy REPLACE in buildings (eg one stop shop model by region), and covering the energy REPLACE in buildings value chain.
Complexity/ Uncertainty	<ul style="list-style-type: none"> - Stakeholders that should participate here: <ul style="list-style-type: none"> + Private Financing (which grants credits to the owners of the hardware to be replaced); + Intermediaries (installers, chimney sweepers, building developers, energy advisors); + Consumer Organizations (which are responsible for bringing together the information needs of consumers); + Public Authorities (run Public support programs, ...) - In the “INFORMATION Point” single the owner of the hardware to be replaced should obtain a free road map indicating the measures to be taken over time, indicative budget, and estimated savings (energy savings-year, economic savings-year, emission savings-year) - Communication: specific information and communication campaigns, which may include targeted campaigns to the creation of regional or local energy REPLACE offices
CONSUMERS Costs	<ul style="list-style-type: none"> - Taxation: a new taxation savings system would be necessary in the residential sector in order to internalize the positive externalities involved in improving the energy efficiency of buildings; - Legislative measures: The legislative proposals by the Autonomous Communities for financing and support the energy REPLACE focus on energy efficiency and renewable energies (i.e. biomass) - Public support programs: (i.e. “Renove Plans”) aimed at actions or interventions that do not affect the whole building but rather individual homes of private owners for the renovation of gaps, boilers and heaters, among others. - Private Financing: i.e Energy service companies (ESEs) finance through Energy Performance Contracting could be a possibility but it is needed a deep analysis on the suitability in Spanish renewable market. This fact is reinforced by the promotion policies currently under development. - Specific measures or individual actions on energy poverty in the field of competence of Local and regional Entities

Table 34: Key considerations for defining policy sets (part 2)

<p>CONSUMERS Human Factor / Consumer</p>	<ul style="list-style-type: none"> - >“Information point” single, advantages of RES H/C technologies - >“ Incentives”for consumers, such as tax reduction based on CO₂ avoided, energy efficiency improved or energy diversification by renewables has been acquired -“Information, Training” focus on Customer interaction with smart and “easy to understand” systems -“Information, including good practices” focus on heating / cooling hardware and services, District heating -“Communication, including awareness” focus on efficient heating technologies, biomass sustainability -“Biomass based sustainable business models”: Rural / urban solutions need to develop solution that work for rural areas with low density, fuel poor homes. - In any case, the segmentation in terms of message, extension, time, etc. according to potential clients, communication campaigns will be the key element of its success.
<p>POLICY side Policy + Regulation</p>	<ul style="list-style-type: none"> - Given that Spain is a country with many agricultural and forestry resources, these sectors should be strengthened and focused towards greater production and use sustainable of biomass. Eg Training for companies in sustainable business models, new technologies that improve productivity, ... to improve efficiency from the beginning of the production chain. - Public support programs There is a lot of bureaucracy and especially lack of flexibility, when it comes to pre-project (proposal), during-project and post-project (justification of expenses and presentation of results). Specific simplification measures should be taken at national and regional level, but also in european level due that many times the funds correspond to european programs At the same time, harmonization would be advisable, that is, all regions and the national State itself should have the same procedures, computer applications for aid applications, reporting procedures, justification of expenses,.... This would improve the efficiency of officials, who would devote more effort to the analysis of results and impacts of subsidized projects and, less effort to the movement of papers, for control. - It would be convenient to regulate in a practical way, the sale of heat and the energy management that includes storage, demand management, technology hibridation, forecasting systems, etc. applied to electricity, transport and heat/cold - Institutional strengthening of regulators, training in aspects of sustainable bioenergy - Development of incentives (subsidies, financing, taxation,..) that benefit to builder / landlord to be more energy efficient. - Huge strengthening of installation, operation, maintenance, design, consultancy, marketing, sellers, financing, etc. companies of renewable energy, that especially makes them competitive now and in the future attracting and satisfying both potential and current consumers. -Do not compartmentalize too much the analysis and design of public actions according to resources (wind, biomass, etc.) or uses (electricity, heat, etc.). In certain situations to heat water it is better to use a photovoltaic module than a conventional thermal solar panel. The important thing is to heat water at a competitive price without using fossil fuels. The technology or the concrete resource is less important.

Table 35: Key considerations for defining policy sets (part 2)

MARKET side Infrastructure	<ul style="list-style-type: none"> - National technologies that are cheaper than current ones (i.e. multi-biomass boilers) and better adapted to the national biomass, should be developed. Availability of efficient and reliable and affordable equipment - Coordination of heating / electricity systems. Vision (supply and demand) of the 2 systems in an integrated way - Building stock old. In Spain there are 25.7MM housings (year 2018), 57% built before 1980 time without EE regulations. The potential market is large, but REPLACE costs are high. Greater incentives (subsidies, financing) for rehabilitation (including boiler replacement) are necessary - Competition between renewables. Governments must give clear signals of what the priorities are
MARKET side Storage	<ul style="list-style-type: none"> -Heat storage Technologies that are cheaper than current ones, should also be developed and comercialized
MARKET side Efficiency	<ul style="list-style-type: none"> -Reduce the gap between engineering potential and building industry attainment. strengthening of building industry, training in aspects of energy efficiency -Energy efficiency crucial – building construction –need the buy-in of developers and construction industry
MARKET side Non-Domestic sector	<ul style="list-style-type: none"> -Business models for waste heat recovery, people want to sell heat but how?
MARKET side Skills	<ul style="list-style-type: none"> -Improving skills gap in terms of installing, commissioning and controlling of heating/cooling systems -Improving design and installation best practices/standards/

2.9.5 Success stories

Case study PAREER CRECE in Spain

Objective: Energy refurbishment of existing buildings, encourages and promotes the implementation of renovation actions that favour energy savings, the improvement of energy efficiency, the use of renewable energies and the reduction of carbon dioxide emissions.

Possible beneficiaries:

- Owners of existing buildings intended for any use, whether they are natural persons, or have legal personality of a private or public nature
- Communities of owners or groups of communities of owners of residential buildings for residential use, constituted as Horizontal Property.
- Owners who collectively own buildings and have not granted the title constituting horizontal property.
- The operating companies, lessees or concessionaires of buildings.
- Energy services companies.

Description: The program aims to achieve the objectives set out in Directive 2012/27 / EU, regarding energy efficiency, and in the 2014-2020 Action Plan monetary assistance without consideration complemented by a repayable loan given by the Institute for Diversification and Energy Saving (IDAE).

The budget of the program reaches 200 million Euros and aids are distributed according to the following chart:

Table 36: Budget of the program

TYPES OF ACTION		MAXIMUM MONETARY AID WITHOUT CONSIDERATION (% of total investment)		MAXIMUM REFUNDABLE LOAN
		Base Aid	Additional Aid by social criteria, energy efficiency or integrated action	
ENERGY EFFICIENCY	Improvement of the energy efficiency of the building envelope	30%	Depending on the use of the building and according to what is established in Annex I, for the type of action. Up to the limits of the State aid regulations or ERDF co-financing rate in the Autonomous Community where the project is located, according to Annex V.	60%
	Improvement of the energy efficiency of thermal and lighting installations	20%		70%
RENEWABLE ENERGIES	Replacing conventional energy with biomass in thermal installations	25%	Depending on the use of the building and according to what is established in Annex I, for the type of action. Up to the limits of the State aid regulations or ERDF co-financing rate in the Autonomous Community where the project is located, according to Annex V.	65%
	Replacing conventional energy with geothermal energy in thermal installations	30%		60%

Key partners: Energy and Industry Ministries, European Funds, Public and Private Building Owners, Installers, ESCOs, the construction sector.

Case study- Renewable Energy fund (subsidy) in Castilla y León, Spain

Objective: Facilitating the financing of projects to improve energy efficiency and sustainability in both rural and urban areas inside the limits of Castilla y León, via a direct subsidy.

Possible beneficiaries:

- Individuals who own an isolated single-family home or grouped in a row
- Communities of owners or groups of communities of owners of residential buildings for residential use.

Description: This aid focuses in actions for the improvement of energy efficiency and sustainability of homes, providing financing to replace mainly old coal and oil boilers and this actions are:

- Improvement of the thermal envelop of households: improvements in the isolation, replacing joinery and glazing of the gaps the installation of bioclimatic devices and shading.
- Installation, improvement or replacement of heating, cooling, domestic hot water production and ventilation systems

- Installation of generation equipment or that allows the use of renewable energies such as photovoltaic, biomass or geothermal solar energy that reduces conventional thermal or electrical energy consumption.
- Those that improve compliance with the parameters established in the Basic Document of the Technical Building Code DB - HR, protection against noise.
- Those that improve compliance with the parameters established in the Basic Document of the DB-HS Building Technical Code, health consideration.

In homes, the set of actions of letters a), b) and c) above must achieve a reduction of global annual energy demand of at least 35%

The monetary amount given will be determined based on the cost of the eligible action corresponding and the number of computable elements, without exceeding in any case the total of 300,000.00 Euros of subsidy or 10% of the total budget of the project.

The maximum amount of the total subsidy to be granted per residential building will be the lower amount resulting from applying each of the following limits:

- 8,000 euros for each dwelling and 80 euros for each square meter of constructed area of commercial premises.
- 40% of the cost of the eligible action

Key partners: Regional Government and Energy Agency, Building and homes owners, Installers and their Associations, Municipalities, the construction sector.

REPLICATE the approach in other EU countries

The approach could be adapted to REPLACE and replicated in other EU countries, as the programs are based and follow the objectives of Directive 2012/27/EU, the success of the replication will depend on the quality of the approach in this key categories:

Target of the program: Focus on households (single-family houses and house blocks) or very small business with consumption patterns (and heating/cooling needs) similar to households as consumers have similar mind-sets and information levels.

Promoting specific equipment for heating and air conditioning considered in REPLACE:

- Heat pumps and solid biomass boilers/ovens or derived heat from combined biomass heat and power plants.
- Solar thermal panels, photovoltaic systems, or combinations of both.
- Heat storage systems (e.g. small-scale, large-scale, buffer tanks, seasonal storages).
- District heating (DH, based on flexible natural gas and steam CHP plants with heat storage).
- Innovative mobile heating units.

Identification and collaboration with partners: Public Authorities (Regional and local institutions, energy agencies, which run public support programs, ...), Private Financing (which could provide additional funding to the target groups); Intermediaries (installers, chimney sweepers, building developers, energy advisors); Consumer Organizations (which are responsible for bringing together the information needs of consumers)

2.9.6 HC replacement outlook

The list below gathers Energy and Climate Strategic Framework post-2020 period of relevance for the REPLACE program, including the scope and a brief description on how they are relevant for this project.

Table 37: Energy and Climate Strategic Framework (part 1)

Thematic scope	Strategy, policy or plan	Territorial scope	How it relates to REPLACE
<p>Energy and Climate Strategic Framework post-2020 period, includes: (i) Climate Change and Energy Transition Law (ii) Energy and Climate Integrated National Plan (PNIEC) 2021-2030, and (iii) Fair Transition Strategy that will establish the guiding principles for focus public authorities actions in order to facilitate the fulfilment of the commitments made in energy and climate change and move towards an low carbon economy in line with the Paris Agreement</p>			
Climate Change and Energy Transition	"Climate Change and Energy Transition Law"	National	<p>"Law on Climate Change and Energy Transition" to comply with the objectives set out in the Paris Agreement and in the framework of the European Union in the medium and long term on climate and energy issues. The Law will act as a legal framework in the medium and long term and it establishes a certain framework for public administrations, the private sector and citizens, and allows them to plan their actions both from the point of view of management, and from the planning of the production and the demand management .</p> <p>Energy transition, is about improving the welfare of citizens by using less energy and with a smaller climate footprint. In Spain this transition has already begun, in 2015 our country had a larger penetration of renewables than most of our surrounding countries, reaching 17.3% compared to 5.8% in the Netherlands, 8.2% in United Kingdom, 14.6% in Germany and 15.2% in France.</p> <p>For complying with the next round of targets by 2030 our Energy policy has thus set the following priorities: energy efficiency, deployment of renewables, prices for consumers, sustainability of energy systems and interconnections.</p> <p>http://www.congreso.es/public_oficiales/L13/CONG/BOCG/B/BOCG-13-B-48-1.PDF</p>
Energy and Climate	"Energy and Climate Integrated National Plan" (PNIEC) 2021-2030	National	<p>The Energy and Climate Integrated National Plan" (PNIEC) must reflect each Member State's contribution to the achievement of the commitments presented by the Commission at Community level regarding:</p> <ul style="list-style-type: none"> the reduction of greenhouse gas emissions (at least 40% with respect to 1990 levels); renewable energies +(27% of renewable energy sources in final energy consumption); energy efficiency (at 30% improvement in energy efficiency); and electrical interconnections (15%). <p>https://ec.europa.eu/energy/sites/ener/files/documents/spain_draft_necp.pdf.</p>

Table 38: Energy and Climate Strategic Framework (part 2)

Thematic scope	Strategy, policy or plan	Territorial scope	How it relates to REPLACE
Renewable Energies with focus on Biomass	Renewable Thermal Strategy 2020-2030 (not approved yet)	Region Castilla y León	Castilla y León is the first Spanish Autonomous Community in renewable energy production with 22% of the national overall. The Regional Ministry of Economy and Finance will launch the Renewable Thermal Strategy 2020-2030 that will boost the development of clean energies, with a particular focus on the development of energy production from biomass as renewable fuel.
Transition	Fair Transition Strategy	National	Spanish economy ecological transition will require the transformation of the country's large economic sectors. For example. More than 1,100,000 Spaniards work in the construction sector, more than 6% of those occupied. In Europe, the building sector is responsible for 40% of CO ₂ emissions, 30% of raw material consumption, 20% of water consumption, 30% of waste generation and a significant part of land occupancy. In Spain, the park of constructed buildings consists of 25 million houses with 90% of these built before the last building technical code (CTE) and 60% before any regulations in energy efficiency. The need for sector transform can become one of the greatest employment opportunities. The transition will require specific professional training and new profiles along the entire chain: architects and engineers, energy auditors, sustainable construction product manufacturing industry, developers, inspectors https://www.miteco.gob.es/es/cambio-climatico/participacion-publica/5borradorestrategiatransicionjusta_tcm30-487304.pdf
Agriculture / Biomass	Common Agricultural Policy	National	Policy aimed at achieving concrete results, linked to three general objectives: a) The promotion of an intelligent, resilient and diversified agricultural sector that guarantees food security; b) The intensification of environmental care and climate action, contributing to achieving the EU's climate and environmental objectives; c) Strengthening the socio-economic fabric of rural areas. These general objectives are broken down into nine specific objectives, based on the three pillars of sustainability and complemented by a common transversal objective of modernizing the agricultural sector through knowledge, innovation and digitalization in rural areas. https://www.mapa.gob.es/es/pac/post-2020/

Table 39: Energy and Climate Strategic Framework (part 3)

<p>Other Initiatives</p>	<p>Strategy for the Decarbonization of our Economy by 2050</p>	<p>National</p>	<p>Strategy for the Decarbonization of our Economy by 2050</p> <p>"Long Term Strategy for a Modern, Competitive and Climate Neutral Spanish Economy in 2050" <i>PEDIRSELA aIDAE</i></p> <p>As required in Paris, Spain prepares a 'Strategy for the decarbonization of our economy by 2050', which will include Spain's contribution to the goal of climate neutrality and contribute to the fulfilment of the objectives of the Roadmap of the European Union towards a low carbon economy by 2050, which shows that the greenhouse gas emissions of the European Union should be reduced between 85% and 90%, with respect to 1990. This means that the 2050 scenario is a scenario where most of the production sectors have to be decarbonized.</p> <p>https://www.miteco.gob.es/es/ministerio/servicios/participacion-publica/Estrategia_2050.aspx</p> <p>Climate Projects</p> <p>"Climate Projects" are domestic projects to reduce greenhouse gas emissions in diffuse sectors, which generate economic activity in sectors associated with the fight against climate change, facilitating the fulfilment of the emission reduction objectives while generating growth and employment. The Carbon Fund for a Sustainable Economy (FES-CO2) acquires the reductions generated by these projects in the first 4 years of activity, thus encouraging the start-up of new low-carbon activities in our country. Since 2012 five Climate Project calls have been resolved in which over 250 projects have been selected that they will represent a total reduction of CO emissions to more than 7.4 million tons. The Fund plans to hold periodic calls for the implementation of annual projects.</p> <p>Sectors of activity potentially beneficiaries of FES-CO2: Agriculture and livestock. Transport. Residential, commercial and institutional. Waste management. Fluorinated gases. Small Mining Industry.</p> <p>https://www.miteco.gob.es/es/cambio-climatico/temas/proyectos-clima/1informacionbasicaconvocatoria2019_tcm30-489595.pdf</p>
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Table 40: Energy and Climate Strategic Framework (part 4)

<p>Other Initiatives</p>	<p>"National Plan of Adaptation to Climate Change" (NPACC)</p> <p>AdapteCCa</p>	<p>National</p>	<p>"National Plan of Adaptation to Climate Change" (NPACC)</p> <p>Climate change will affect energy demand patterns in Spain and will also condition energy production. Spain was one of the first European countries to establish, in 2006, a strategy for adaptation, through the "National Plan of Adaptation to Climate Change" (NPACC). This Plan is the framework instrument in which all the adaptation actions carried out in Spain are included. The ultimate objective of the NPACC is the integration of adaptation in the planning and management of all sectors vulnerable to climate change, in order to minimize the impacts and, where appropriate, benefit from new opportunities. The NPACC is implemented through work programmes, which specifically defines the activities to be carried out. To date, two work programmes have been developed, the first valid in 2006-2009; the second, 2009-2013 and, at present, the Third Work Programme (2014-2020) is under way.</p> <p>https://www.miteco.gob.es/es/cambio-climatico/temas/impactos-vulnerabilidad-y-adaptacion/3er_programa_trabajo_pnacc_tcm30-70400.pdf</p> <p>AdapteCCa https://www.adaptecca.es/ Information exchange platform on impacts, vulnerability and adaptation. Complementarity and synergies with the European Adaptation Platform, Climate-ADAPT(http://climateadapt.eea.europa.eu/).</p>
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3 | Conclusion

Deliverable D2.1 deals with an overview of the overall framework conditions on sustainable heating and cooling system replacements and opportunities to enhance the impact of replacement activities. Valuable results for each region are:

- Overview of the policy instruments for sustainable heating and cooling system replacements.
- Description of legal and regulatory framework conditions.
- Qualitative assessment of the financial instruments.
- Assessment of drivers and barriers from consumer, policy and market side.
- Key considerations.
- Success stories
- HC outlook.

While REPLACE 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 replace it with HC, **only Austria and Slovenia have incorporated a phase-out plan for coal and fuel oil** used for heating in legislation. Furthermore, Land Salzburg in Austria has prepared a plan to phase-out natural gas until 2040, while Slovenia intends through National Energy and Climate Plan prohibit the purchase of new gas condensing boilers.

Financial incentives play instrumental part for HC replacements in all target regions. Some have implemented higher incentives when replacing fuel oil (Austria), while some offer incentives on both national and regional level (Austria, Castilla y Leon and Skopje), which results in higher co-financing rate and thus higher motivation for investors. Slovenia has established *Ordinance on the air quality plan* in 8 municipalities, which are highly densely populated areas, where financial incentives are higher than the rest (up to 60% of the investment) in order to motivate households to replace old and inefficient boiler and thus contribute to local environment with decreased CO₂ and PM emissions.

The assessment of **market barriers for HC replacement activities** has highlighted **diverse findings**:

- **Prevailing installation of air/water heat pumps over boilers** in not sufficiently efficient buildings, which leads to higher power demand and loads in winter. In countries like Austria where electricity supply relies on RES this can cause irregularities which need to be solved with higher seasonal storage in the summer time.
- Rhodope, both regions in Croatia, Skopje and Sarajevo identified **high investment prices** as one of the major barriers. Furthermore, there's a **lack of qualified installers, designers and energy auditors**. This forces the residents to often carry out the installation works themselves.

The main barriers for HC replacement in south-eastern region are related to (1) lack of subsidies for, (2) lack of boiler inspection and (3) insufficient establishment and applicability of the energy audit system. The solution would be lie in (1) development of new subsidizing models, (2) financial support for energy efficiency measures in low-income households and (3) forming an energy advisors network, which has proven very beneficial in other regions.

The main direct drivers for HC replacement are considered as a success story in respective countries. Austria, Germany and Slovenia have direct financial incentives for HC replacements, as well as Croatia. The rest of South-eastern countries don't, but some co-fund this investment through special programmes that are partially funded by EU Structural and Investment Funds. Indirect drivers, such on-site consulting, energy advisory network and certified installers support the investors for more informed decision-making and guarantee proper functioning of the systems. Many regions are still in the development phase of direct and indirect drivers, hence REPLACE should boost up these activities.

The **key considerations** that would have to be taken into account for defining new policy sets **for the REPLACE pilot regions** are:

- **better awareness of end consumers** on the age and efficiency of their old boilers and the alternative options they have,
- consistent and technology-neutral information for end consumers
- **stable and predictable funding schemes**
- better data on both existing boiler stock and actually implemented new heating equipment
- **education of competent installers** to overcome the predicted lack of installers to realize ambition lying ahead with a sustainable decarbonisation of the heat market
- **establishment and implementation of replacement campaigns** that effectively address and overcome main barriers of a fuel switch for renewable energy based heating systems

It can be distinguished between **national and local success stories** that contributed to the reduction of inefficient HC equipment. On national level, the obligations to replace most heating systems that are older than 30 years (Germany) or exceed PM emission (Slovenia) is expected to have a large impact. Already political measures like the **CO₂ pricing or increased contribution for energy prices will also drive the owners away from oil heating to more sustainable solutions.**

On a local level, municipal activities like energy concepts and energy use plans or municipal district heating systems have a good reach out and have proven a considerable impact. Municipalities can also play a role model, show citizens which solutions work and consult. **Energy consultants**, financed by national or municipal funds, **actively address homeowners** and provide energy consultancy for free in Austria, Germany, Slovenia and Spain. Local energy company in Šabac has carried out a collective action of building connection to adjacent district heating network for free of charge, while Canton of Sarajevo has started in 2019 with a model of energy contracting for residential buildings, a unique and efficient way to motivate investors for decision-making of HC equipment.

This deliverable summarizes the activities carried out in the task T2.1 – RHC Requirement Analysis. It presents an overview of national and regional policy instruments, implemented and planned measures related to sustainable HC equipment. Along with assessed drivers and barriers for higher replacement rates, the outcomes will serve as a basis in preparation for more efficient and targeted REPLACE campaigns.

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