Smarter Stoves
Partnership

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Heat pumps as heating replacement technology in the Western Balkan market: Factors for consideration

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This Report was prepared within the project *Smarter Stoves Partnership*, which aims to create a regional knowledge platform to replace inefficient individual heating devices in households across the Western Balkans. The project is being implemented by the RES Foundation, funded by the Austrian Ministry of Climate and European Climate Foundation (ECF). Attitudes and opinions expressed in this report are solely the views of the author and do not necessarily represent the views of RES Foundation or the project donors.

Contents

1. Heat pumps

1.1. Heat pump type: air-to-air (systems with direct expansion)

This type of heating pumps are devices that use the air as a heat source, and that energy, through the cooling medium (refrigerant gas), is transmitted directly to the air inside the rooms that we want to heat/cool. They are also used for cooling and heating space, and are definitely the most widely used type of heat pumps.

For heating space, the highest efficiency in areas with moderate cold winters (warm climate zone), while for cooling, with cold summers (cold climate zone).

Depending on the type of objects, there are:

- Residential appliances
- Commercial appliances

According to its construction, there are two types:

- SINGLE SPLIT system (one outdoor unit, one indoor unit, one or more temperature zones)
- MULTI SPLIT system (one outdoor unit, several indoor units, one or more temperature zones)

According to technology, they can be divided into:

- With constant flow of refrigerant gas
    a) ON-OFF
    b) Inverter technology
- With variable flow of refrigerant gas
    a) Inverter technology
- With a variable temperature of refrigerant gas
    a) Inverter technology

In the last 3 years, production and application of ON-OFF technology has declined dramatically mainly because the cost of producing inverter devices year after year is decreasing and the restrictions on the application of ON-OFF technology are increasingly prevalent.

Thermal power of heating/cooling units, for **residential buildings**:

a) SINGLE SPLIT SYSTEMS:
    - Heating/cooling power: 2kW - 7kW
    - Object volume: up to 180 m3
    - Number of regulated temperature zones: 1

b) MULTI SPLIT SYSTEMS
    - Heating/cooling power: 3,5kW - 12kW
    - Object volume: up to 300m3
    - Number of regulated temperature zones: up to 5

In this category there are devices with more temperature zones, greater power, which are not mentioned because they have technology, in one part, for residential facilities, and the other part for commercial facilities.

Thermal power of heating/cooling devices for **smaller commercial facilities**:

a) SINGLE SPLIT SYSTEMS:
- Heating/cooling power: 3,5kW - 18kW
- Object volume: up to 500m3
- Number of regulated temperature zones: 1

b) MULTI SPLIT SYSTEMS:
- Heating/cooling power: 7kW - 25kW
- Number of regulated temperature zones: 1
- Object volume: up to 700m3

Thermal power of heating/cooling devices for **commercial facilities**:

VRV SYSTEMS
- Heating /cooling power: up to 200kW
- Number of regulated temperature zones: up to 512

The efficiency of the work is expressed by the seasonal efficiency ratio, which shows a picture of the energy efficiency and environmental impact of the system. The method of energy efficiency is based on the EU Directive for Energy-using Products (ErP), the so-called LOT 10 Eco-design directive, which defines the minimum environmental conditions that manufacturers must install in their energy-using products.

- Seasonal Energy Efficiency Coefficient (SEER) for cooling
- Seasonal performance ratio (SCOP) for heating

According to European regulations, every product which is delivered in the countries of the European Union must be marked as follows:

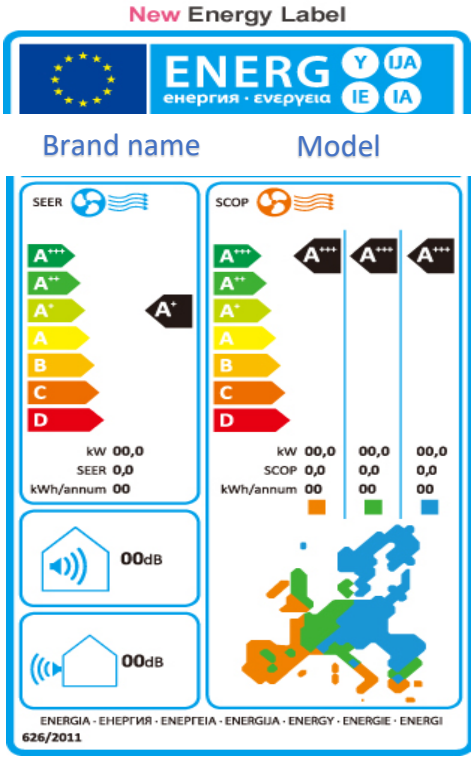


Figure 1. EU Energy label for air to air devices

The direct link between SEER, SCOP, and energy efficiency class is according to the criteria:

	SEER (Cooling mode)	SCOP (Heating mode)
A+++	SEER ≥ 8.50	SCOP ≥ 5.10
A++	6.10 ≤ SEER < 8.50	4.60 ≤ SCOP < 5.10
A+	5.60 ≤ SEER < 6.10	4.00 ≤ SCOP < 4.60
A	5.10 ≤ SEER < 5.60	3.40 ≤ SCOP < 4.00
B	4.60 ≤ SEER < 5.10	3.10 ≤ SCOP < 3.40
C	4.10 ≤ SEER < 4.60	2.80 ≤ SCOP < 3.10
D	3.60 ≤ SEER < 4.10	2.50 ≤ SCOP < 2.80
E	3.10 ≤ SEER < 3.60	2.20 ≤ SCOP < 2.50
F	2.60 ≤ SEER < 3.10	1.90 ≤ SCOP < 2.20
G	SEER < 2.60	SCOP < 1.90

Figure 2. Link between SEER, SCOP and EE class

1.2. Heat pump type: air-water

Air-water heat pumps are devices that use the ambient air as a heat source, and that energy, through the cooling medium (refrigerant), is transferred to the water. Water carries that energy with it, circulates in the building with the pipeline system and through the emitters (radiators, underfloor systems, wall systems, ceiling systems, fan coil devices) is transferred to the air inside the rooms. In addition to this application, they are also used to prepare domestic hot water and can connect with another heat sources.

For heating, the highest efficiencies in areas with moderate cold winters (warm climate zone), while for cooling, in area with cold summer (cold climate zone). Comparing with air-to-air heat pumps, they have stable operation even at extremely low temperatures.

According to the area of application, they are divided into:

- **Residential appliances** (heating heat and/or cooling thermal power up to 25kW)
  These devices have an additional division according to the water temperature they can produce in heating mode:
  - Low temperature heat pumps (up to 55^0C)
  - Medium temperature heat pumps (up to 65^0C)
  - High temperature heat pumps (greater than 65^0C)

Commercial devices

  - Low-capacity heat pumps (heat heating and/or cooling thermal power up to 200kW)
  - Medium-capacity heat pumps (heating heat power and/or cooling up to 600kW)
  - High-capacity heat pumps (heat heating and/or cooling power greater than 600kW)

According to the device construction, they are divided into:

- MONOBLOK (all required are built in the external unit)
- HYBRID – devices with factory installed other heating source (gas boiler, etc.)

The efficiency of units is indicated by the seasonal efficiency ratio, which shows a picture of the energy efficiency and environmental impact of the system. The method of energy efficiency is based on the EU Directive for Energy-Using Products (ErP), the so-called LOT 1 and LOT 2 Eco-design directive, which defines the minimum environmental conditions that manufacturers must install in their energy-using products.

- Seasonal Energy Efficiency Coefficient (SEER) for Cooling
- Seasonal performance ratio (SCOP) for heating

According to European regulations, any product for heating systems based on water delivered in European Union countries must be marked as follows:

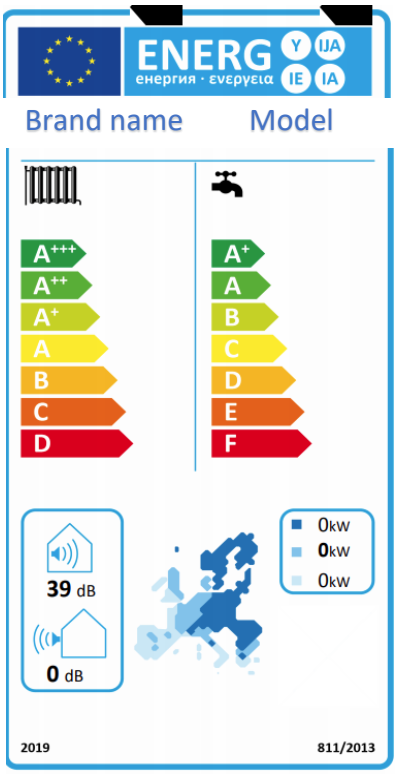


Figure 3. EU Energy label for heating system based on water

The direct link between SEER, SCOP, and energy efficiency classes is according to the criteria:

	SEER (Cooling mode)	SCOP (Heating mode)
A+++	SEER ≥ 8.50	SCOP ≥ 5.10
A++	6.10 ≤ SEER < 8.50	4.60 ≤ SCOP < 5.10
A+	5.60 ≤ SEER < 6.10	4.00 ≤ SCOP < 4.60
A	5.10 ≤ SEER < 5.60	3.40 ≤ SCOP < 4.00
B	4.60 ≤ SEER < 5.10	3.10 ≤ SCOP < 3.40
C	4.10 ≤ SEER < 4.60	2.80 ≤ SCOP < 3.10
D	3.60 ≤ SEER < 4.10	2.50 ≤ SCOP < 2.80
E	3.10 ≤ SEER < 3.60	2.20 ≤ SCOP < 2.50
F	2.60 ≤ SEER < 3.10	1.90 ≤ SCOP < 2.20
G	SEER < 2.60	SCOP < 1.90

Figure 4. Link between SEER, SCOP and energy efficency according to the criteria

1.3. Heat pump type: water-water

Water-water heat pumps are devices that use groundwater energy as a heat source, and that energy, through the cooling medium (refrigerant gas), is transferred to the water. Water carries that energy with it, circulates in the building with the pipeline system and through the with the pipeline system and through the emitters (radiators, underfloor systems, wall systems, ceiling systems, fan coil devices) is transferred to the air inside the rooms.
Water, as a heat source, is most often drained from underground flows but also from large standing water surfaces (sea and lake). In addition to this application, they are also used to prepare domestic hot water and can connect with another heat sources.

The efficiency of these systems depends very little on climate zones, but primarily on the microgeological characteristics of the soil in terms of ground water temperatures, the depths on which they are located, the permeability of the soil, composition, and degree of filtration, etc.

According to the appliances, they are divided into:

- **Residential appliances** (heating and/or cooling thermal power up to 25kW)
  These unit have an additional division according to the water temperature they can produce in heating mode:
    - Low temperature heat pumps (up to 55^0C)
    - Medium heat pumps (up to 65^0C)
- **Commercial devices**
    - Low-capacity heat pumps (heating and/or cooling thermal power up to 200kW)
    - Medium-capacity heat pumps (heating and/or cooling thermal power up to 600kW)
    - High-capacity heat pumps (heating and/or cooling power greater than 600kW)

The efficiency of units is indicated by the seasonal efficiency ratio, which shows a picture of the energy efficiency and environmental impact of the system. The method of energy efficiency is based on the EU Directive for Energy-Using Products (ErP), the so-called LOT 1 and LOT 2 Eco-design directive, which defines the minimum environmental conditions that manufacturers must install in their energy-using products.

- Seasonal Energy Efficiency Coefficient (SEER) for Cooling
- Seasonal performance ratio (SCOP) for heating

According to European regulations, any product for heating systems based on water delivered in European Union countries must be marked as follows:

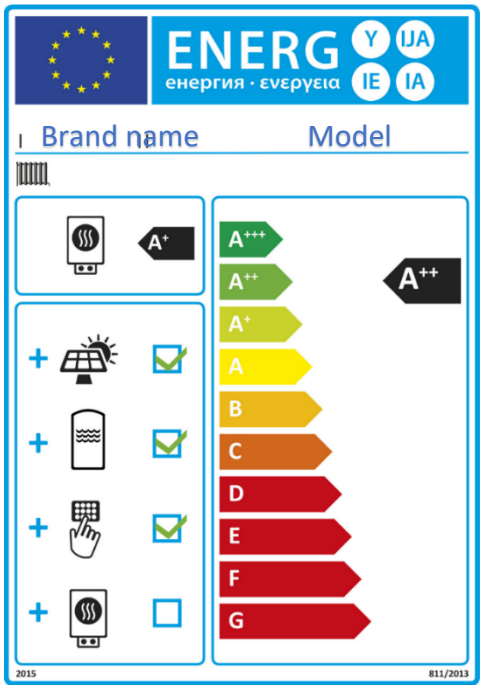


Figure 5. EU Energy label for heating systems water-water

The direct link between SEER, SCOP, and energy efficiency classes is according to the criteria:

	SEER (Cooling mode)	SCOP (Heating mode)
A+++	SEER ≥ 8.50	SCOP ≥ 5.10
A++	6.10 ≤ SEER < 8.50	4.60 ≤ SCOP < 5.10
A+	5.60 ≤ SEER < 6.10	4.00 ≤ SCOP < 4.60
A	5.10 ≤ SEER < 5.60	3.40 ≤ SCOP < 4.00
B	4.60 ≤ SEER < 5.10	3.10 ≤ SCOP < 3.40
C	4.10 ≤ SEER < 4.60	2.80 ≤ SCOP < 3.10
D	3.60 ≤ SEER < 4.10	2.50 ≤ SCOP < 2.80
E	3.10 ≤ SEER < 3.60	2.20 ≤ SCOP < 2.50
F	2.60 ≤ SEER < 3.10	1.90 ≤ SCOP < 2.20
G	SEER < 2.60	SCOP < 1.90

Figure 6. Figure 4. Link between SEER, SCOP and energy efficiency according to the criteria

1.4. Heat pump type: water-water – geothermal systems

The geothermal heat pumps are principled technologically the same as heat pumps type: water – water with a crucial difference that the circulation of water, as a heat source, is performed in a closed primary circle. In these systems, water circulates through heat exchangers placed in the ground, in closed circle. In this way, the earth's energy is used as a heat source/abyss.
Depending on the laying depth of the heat exchangers, the influence of ambient air temperature decreases.

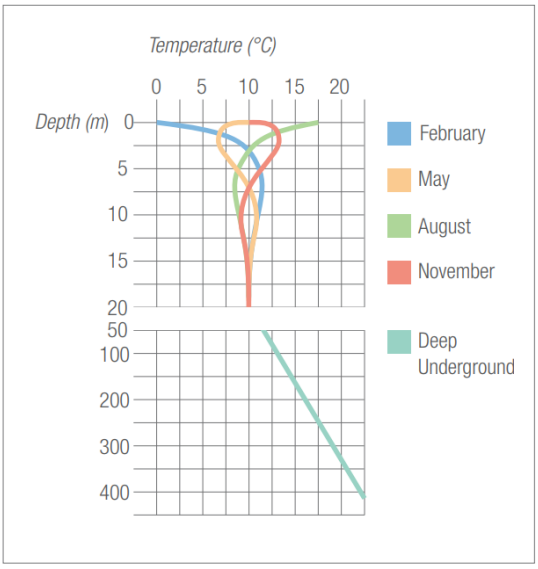


Figure 7. Geothermal pumps - influence of ambient air temperature

According to the type of heat exchanger, there are:

- Geothermal collectors (horizontal heat exchangers placed in the ground at depths up to 70cm)
- Geothermal probes (vertical heat exchangers set at depths up to a few hundred meters)

Due to a relatively stable thermal source, low maintenance costs, complex construction works, these systems fall into the category of most efficient systems, with the highest investment costs.

According to European regulations, any water-based heating products delivered in EU countries must be labeled as follows:

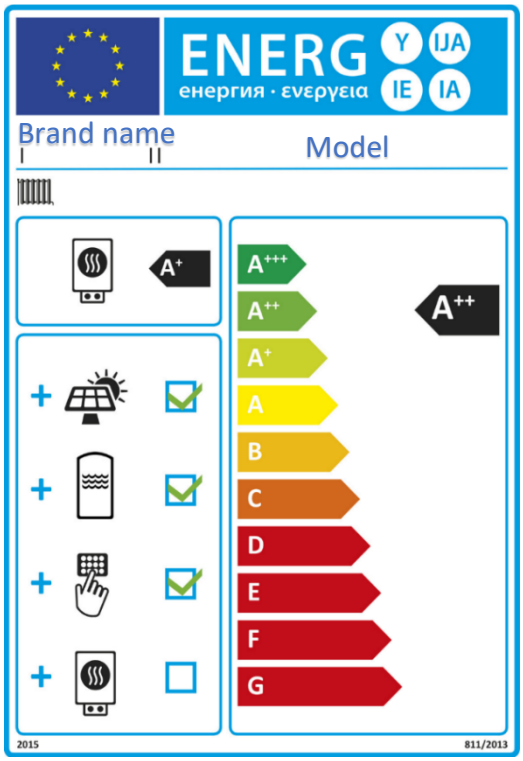


Figure 8. EU Energy label for water-based geothermal devices

The direct link between SEER, SCOP, and energy efficiency classes is according to the criteria:

	SEER (Cooling mode)	SCOP (Heating mode)
A+++	SEER ≥ 8.50	SCOP ≥ 5.10
A++	6.10 ≤ SEER < 8.50	4.60 ≤ SCOP < 5.10
A+	5.60 ≤ SEER < 6.10	4.00 ≤ SCOP < 4.60
A	5.10 ≤ SEER < 5.60	3.40 ≤ SCOP < 4.00
B	4.60 ≤ SEER < 5.10	3.10 ≤ SCOP < 3.40
C	4.10 ≤ SEER < 4.60	2.80 ≤ SCOP < 3.10
D	3.60 ≤ SEER < 4.10	2.50 ≤ SCOP < 2.80
E	3.10 ≤ SEER < 3.60	2.20 ≤ SCOP < 2.50
F	2.60 ≤ SEER < 3.10	1.90 ≤ SCOP < 2.20
G	SEER < 2.60	SCOP < 1.90

Figure 9. Figure 4. Link between SEER, SCOP and energy efficiency according to the criteria

Residential Building Completions by Building Type

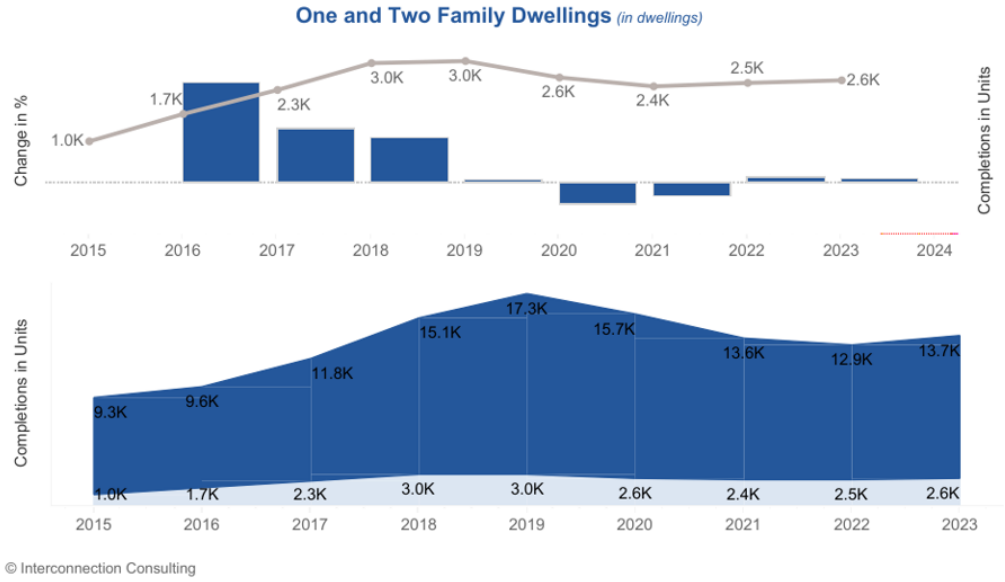


Figure 10. Residential Building Completions - One and two family dwellings

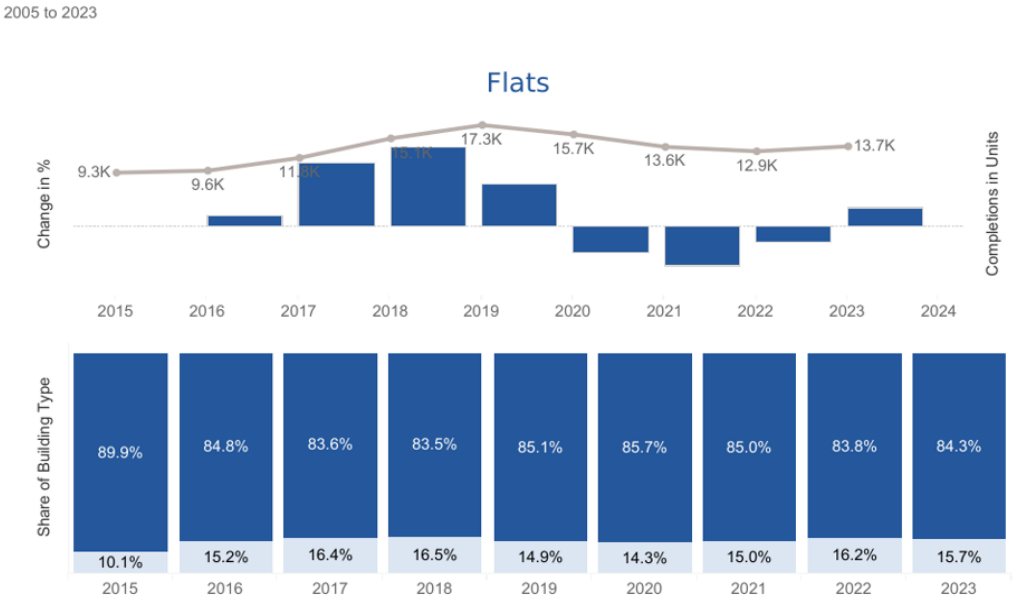


Figure 11. Residential Building Completion - flats

1.5. Heat pump type: air-to-air (systems with direct expansion)

The largest number of units sold (in terms of quantity) belongs to devices with a low price - cheaper brands. In all regions, Gree, Midea and LG electronics dominate. The premium segment is dominated by Daikin, Mitsubishi Electric (MELCO) and Toshiba on third place.

In all countries, it is characteristic that imports, sales, and after-sales support go through importers of equipment (dealers). Rare are the brands that are directly present on the market. LG Electronics in middle segment and DAIKIN in premium segment are directly presented on the market as sales office or sales agent.

Brend comparation analysis for singl/multi split systems < 7kW by quantitys

Brand	Albania Market share		Bosnia Market share		Macedonia Market share		Serbia Market share	
	2019	2020	2019	2020	2019	2020	2019	2020
GREE	20.9%	21.5%	20.6%	21.3%	26.6%	30.1%	20.2%	17.0%
Midea	14.4%	15.5%	18.9%	22.0%	15.9%	16.5%	16.1%	14.5%
LG Electronics	8.4%	8.8%	13.3%	14.8%	10.5%	11.2%	14.9%	12.9%
ALL OTHERS	43.0%	42.8%	38.2%	35.0%	32.0%	31.3%	38.8%	48.7%

Figure 12. Brand comparative analysis for single/multi split systems < 7 kW by quantities

Rising prices of electricity and fossil fuels, new regulations, global price increases and the growth of purchasing power of the population indirectly and directly affect the fact that the prices of devices on the market are constantly growing.

Average price for singl and multi split systems

System	Albania		Bosnia		Macedonia		Serbia	
	2019	2020	2019	2020	2019	2020	2019	2020
Singl split	437.00 €	441.00 €	318.00 €	321.00 €	363.00 €	372.00 €	324.00 €	327.00 €
Multi split	963.00 €	979.00 €	944.00 €	960.00 €	860.00 €	875.00 €	714.00 €	744.00 €

Figure 13. Average price for single and multi split systems

The installation costs of equipment are about 30%-40% of the value of the equipment.

1.6. Heat pump type: air-to-water

The relatively high price of technology without the possibility of subvention is the main reason that the market of air-to-water heat pumps is much smaller than the market of air-to-air heat pumps.

Serbia is the largest market in terms of the number of units sold (31%) with the highest growth rate (around 11%). One of the main drivers is the expansion of housing construction as well as the influence of COVID on the increase in demand for individual housing units (houses).

Albania and Bosnia are in second and third place, with Bosnia having the lowest growth rate as a market. Kosovo* and Montenegro are the smallest markets.

The growth of the A-V heat pump market is on the one hand stimulated by the growth of housing construction, and on the other hand it is slowing down due to the negative impact of low level of public awareness and lack of skilled labour in sizing, installing and servicing equipment.

In addition, market growth is positively affected by a reduction in the price difference of heat pump heating system technology and conventional biomass heating systems, increasing the needs for cooling the building, as well as the possibility to heat and cool the facility with one device and even prepare sanitary hot water.

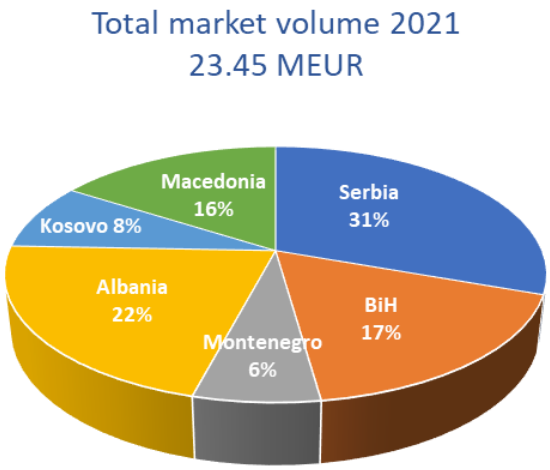


Figure 14. Total market volume 2021

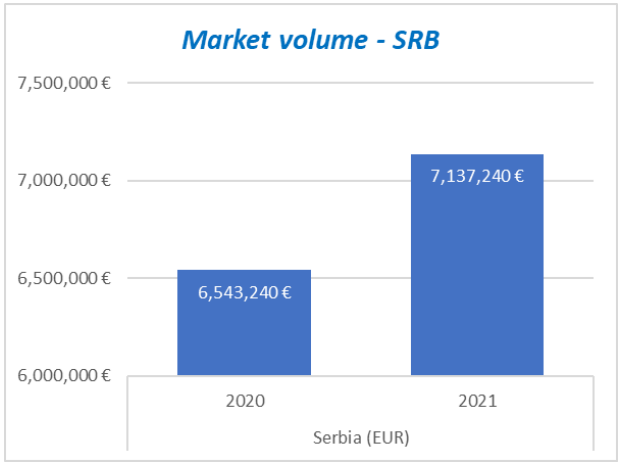


Figure 17. Market volume - Serbia

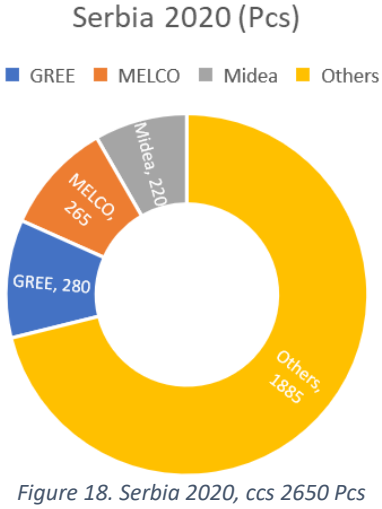


Figure 18. Serbia 2020, ccs 2650 Pcs

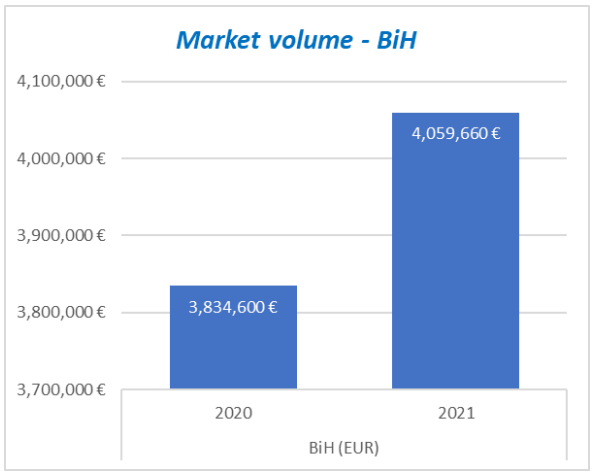


Figure 15. Market volume

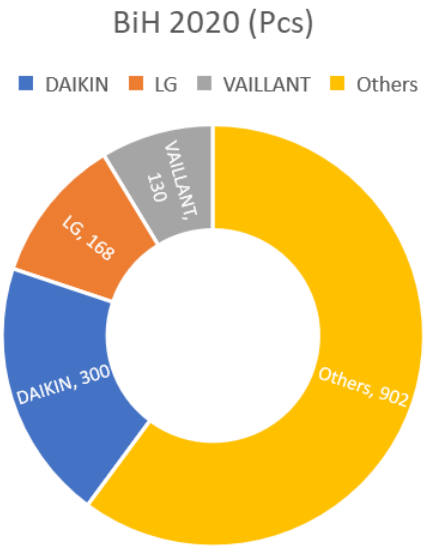


Figure 19. Bosnia and Hercegovina 2020: cca 1500 Pcs

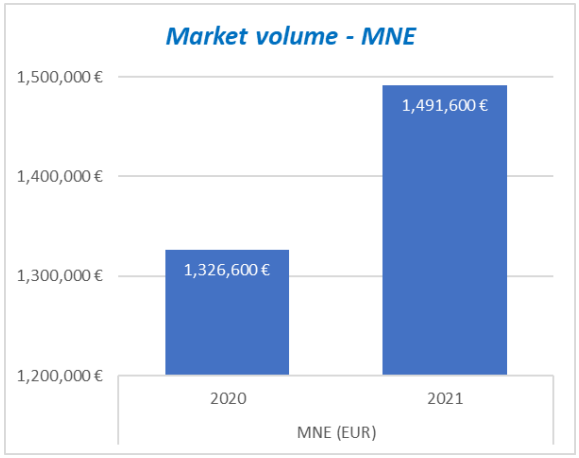


Figure 20. Market volume - Montenegro

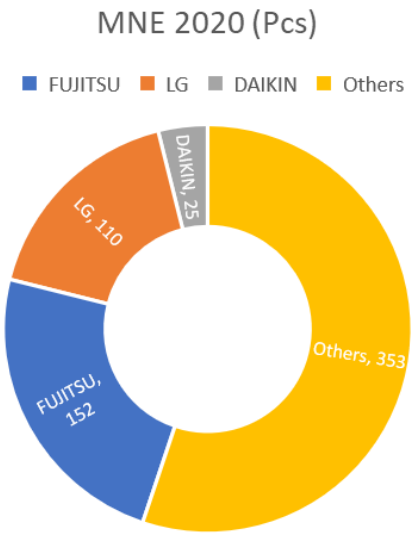


Figure 21. Montenegro 2020: ccs 640 Pcs

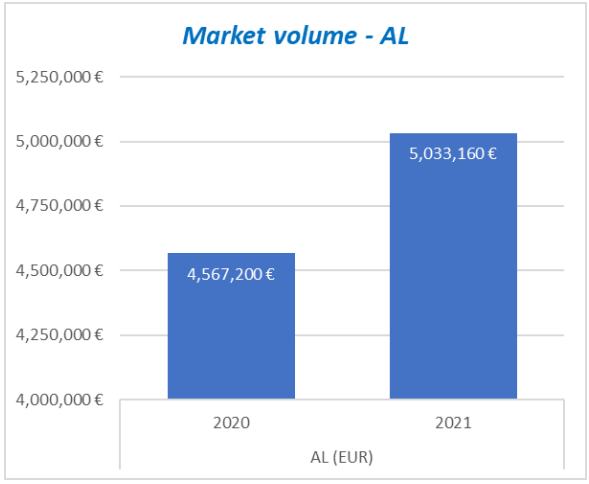


Figure 22. Market volume - Albania

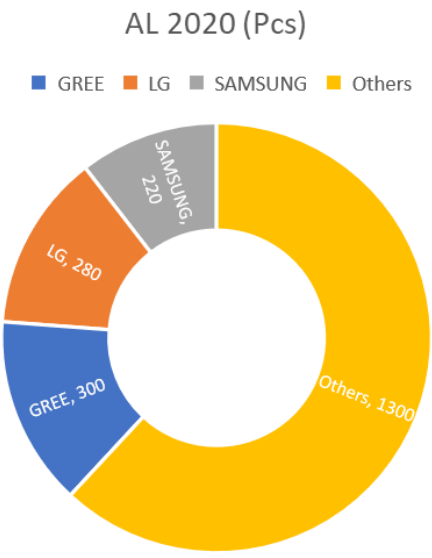


Figure 23. Albania 2020: cca 2100 Pcs

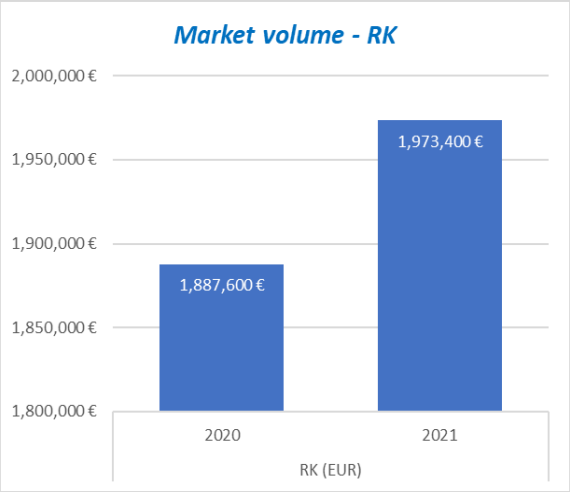


*Figure 24. Market volume - Kosovo**

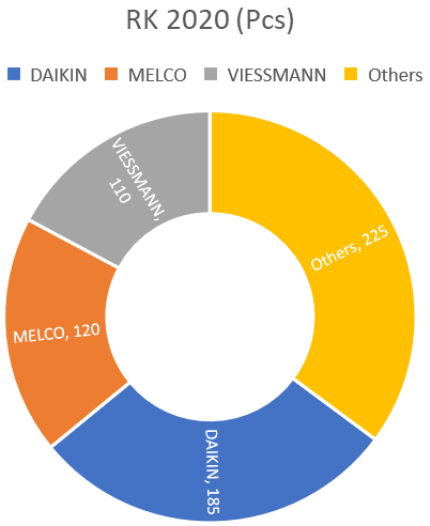


Figure 25. Kosovo: cca 640 Pcs*

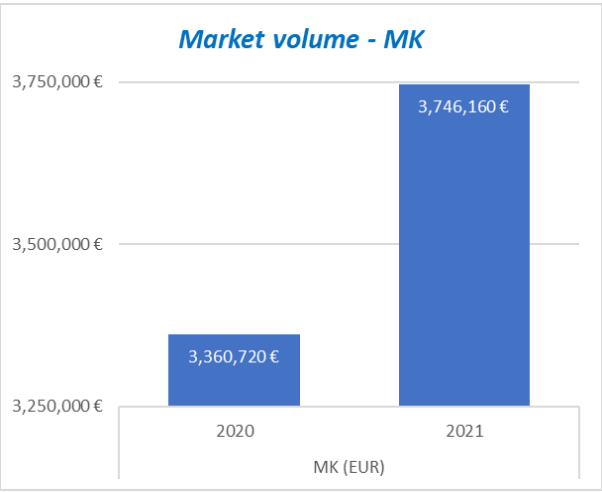


Figure 26. Market volume - North Macedonia

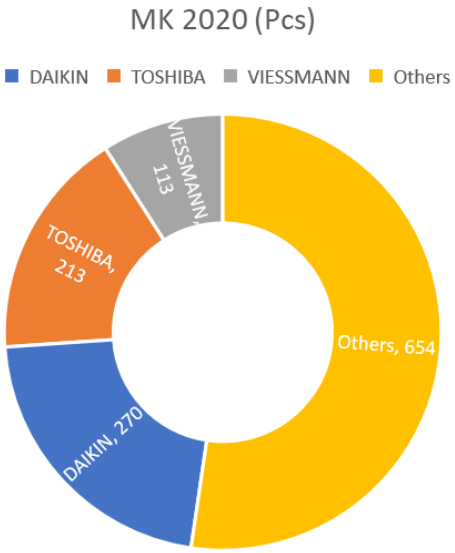


Figure 27. North Macedonia: cca 1250 Pcs

The largest number of units sold (in terms of quantity) belongs to devices with a low price. In all regions, Gree, Midea and heating pumps who coming from PRC.

Premium segment is dominated by Daikin, Mitsubishi Electric (MELCO), Vaillant, Viessman and Toshiba.

In all countries, it is characteristic that imports, sales, and after-sales support go through importers of equipment (dealers). Rare are the brands that are directly present on the market. LG Electronics in middle segment and DAIKIN in premium segment are directly presented on the market as sales office or sales agent.

The installation costs of equipment are about 20%-25% of the value of the equipment.

1.7. Heat pump type: W-W and W-W (geothermal systems) and solar systems

In all countries, the market for water-to-water heat pumps of all kinds is in drastic decline when it comes to residential buildings. The biggest reason is the high value of investment costs, the lack of specialized labour and/or the complexity of obtaining permits and approvals for the installation of the system. At the level of all countries, the total number of imported devices is less than 200. Precise data are unavailable due to the existence of companies that produce devices on their own - the so-called production in their own garage. Market leaders are IDM, Vaillant and Viessmann.

The same situation is with solar systems.

Low price of electricity and small required amount of sanitary hot water, make ROI extremely unfavourable when we talk about residential buildings. These systems have the greatest use value in commercial facilities: hospitals, schools, swimming pools, etc. The total number of residential systems sold is less than 300 per year. Viessmann, Vaillant, SONNENCRAFT are the leaders in the premium segment, while the rest are products from the East (PRC). In the commercial segment, SONNENCRAFT is the absolute leader, while Viessmann covers the rest of the market. Since 2019, there is a factory of solar collectors in Serbia, company MASTER SOLAR. This company manufactures plate solar collectors for the needs of SONNENCRAFT and it also deals with the installation of equipment in region.

Plate solar collectors make up 90% of the total systems sold.

2. Solar systems

Solar systems use solar radiation as a source of thermal energy in order to prepare domestic hot water, heat water in swimming pools, support heating systems as well as other more complex applications. Solar energy is transferred through absorbing elements to the medium (water or propylene glycol), which carries that energy to the tanks, where it is transferred to cold sanitary water or water from the heating system.
The basic characteristic of these systems is that there is no CO2 emissions during operation, that they work efficiently even in cold climate zones and are easily integrated in to existing systems.

According to the mode of operation, they are divided into:

- Pressure systems
- Pressure-free systems

According to the construction of heat receivers (collectors) are divided in to:

- Plates
- Vacuums
- Thermo-siphoning

According to the place of installation of heat receivers (collectors) are divided into:

- Installation on flat/slope roofs
- Installation in flat/slope roofs
- Facade collectors
- For horizontal/vertical installation

Cost-effectiveness and applicability of solar systems depends on many factors.

The two most important parameters showing the justification for the application and efficiency of solar systems are:

1) **The level of efficiency of the collector** – showing the efficiency of the collector and which part of the sun's radiation that comes to the surface of the absorbent can be transformed into useful thermal energy. Reference values range from 0.42 to 0.85.
2) **The degree of solar energy coverage** – showing on what percentage of energy needed to heat water in the system, can be covered by solar energy during the year. Reference values are from 35% up to 95%.

1 Market Analysis by equipment manufacturers - heat pumps

MARKET SIZE BY VOLUME FOR 2021 (MEUR)

HP type	Product groups	Serbia (MEUR)	Serbia Share (%)	Albania (MEUR)	Albania Share (%)	Bosnia (MEUR)	Bosnia Share (%)	Macedonia (MEUR)	Macedonia Share (%)
A-A	Single Split		56.7%		45.3%		53.7%		64.3%
	Multi Split		14.5%		16.7%		17.9%		14.7%
	VRF	41.20 €	18.2%	22.90 €	15.8%	18.60 €	14.5%	18.80 €	10.5%
	Other (roof top units)		0.6%		0.7%		0.4%		1.6%
A-W	Chillers (all types)		10.0%		21.5%		13.5%		8.9%

Notes:

Source: AC Interconection consulting report for 2021

Countries: Montenegro and Kosovo - unavailable data

Figure 16. Market size by volume for 2021 (MEUR)

MARKET FORECAST (MEUR)

Country	Product goup	2018	2019	2020	2021	2022
Albania	Chillers	4.26	5.25	3.92	4.26	4.47
	Multi Split	3.82	4.07	3.88	4.23	4.52
	Rooftop	0.25	0.18	0.13	0.12	0.12
	Single Split	10.46	11.07	10.80	11.77	12.38
	VRF	3.41	3.86	2.29	2.47	2.63
Bosnia	Chillers	1.78	2.52	2.73	2.88	3.09
	Multi Split	3.38	3.34	3.03	3.29	3.49
	Rooftop	0.15	0.08	0.06	0.07	0.07
	Single Split	9.25	10.05	9.44	9.92	10.67
	VRF	2.11	2.70	2.26	2.42	2.59
Macedonia	Chillers	1.18	1.36	1.68	1.76	1.85
	Multi Split	1.97	2.23	2.56	2.68	2.82
	Rooftop	0.33	0.24	0.13	0.12	0.11
	Single Split	8.50	9.77	11.27	11.96	12.41
	VRF	1.65	1.60	2.15	2.29	2.46
Serbia	Chillers	4.07	4.19	3.88	4.28	4.54
	Multi Split	6.55	6.07	4.19	4.65	5.01
	Rooftop	0.38	0.25	0.24	0.22	0.23
	Single Split	23.22	23.71	19.84	21.68	23.02
	VRF	6.27	7.62	9.41	10.32	11.11

Figure 17. Market forecast

Compared to the countries from the region that are members of the EU, the market is relatively small, relatively stable with slight growth in all segments.

The fall of the market was noticed in the period from 2019 to the end of 2020 due to the consequences of COVID-19. As early as 2021, in almost all countries the market returned to the same or even higher level.

The construction trend had a similar development in the mentioned periods.

3. Analysis of current energy costs

3.1. Electricity

According to official data, compared to markets in the region and especially compared to EU countries, the price of electricity is low and with a slight growth trend.

Data extracted on 15/08/2021 13:01:52 from [ESTAT]
Dataset: **Electricity prices for household consumers - bi-annual data (from 2007 onwards) [NRG_PC_204$DEFAULTVIEW]**
Last updated: 18/06/2021 23:00

Time frequency	Half-yearly, semesterly
Products	Electrical energy
Consumption	Band DC : 2 500 kWh < Consumption < 5 000 kWh
Unit of measure	Kilowatt-hour
Taxes	All taxes and levies included
Currency	Euro

TIME	2018-S1	2018-S2	2019-S1	2019-S2	2020-S1	2020-S2
GEO (Labels)						
Montenegro	0.1024	0.1030	0.1032	0.1028	0.0988	0.0999
North Macedonia	0.0781	0.0787	0.0783	0.0790	0.0782	0.0833
Albania	:	0.0910	0.0920	0.0933	:	:
Serbia	0.0705	0.0709	0.0706	0.0721	0.0738	0.0737
Bosnia and Herzegovina	0.0864	0.0871	0.0873	0.0875	0.0870	0.0901
Kosovo (under United Nations Securi	0.0633	0.0638	0.0600	0.0605	0.0605	0.0608

Figure 28. Electricity prices for household consumers, bi-annual data, from 2007 onwards

Many years ago, the lowest price of electricity was realized in Kosovo*. Highest prices are realised in Montenegro.

Distribution costs account for the largest share by far, when compared to the transmission costs because transmission network is used for transmitting bulk amounts of energy in long distances. The distribution network is usually the part of the system where the consumers are connected. The distribution network is denser than the transmission network, therefore, its share at the costs is expected to be higher.

Markets with lower population density require more extensive transmission network to meet their needs. Its costs are higher when compared to countries with higher population density. Smaller, densely populated countries use mostly their distribution network.

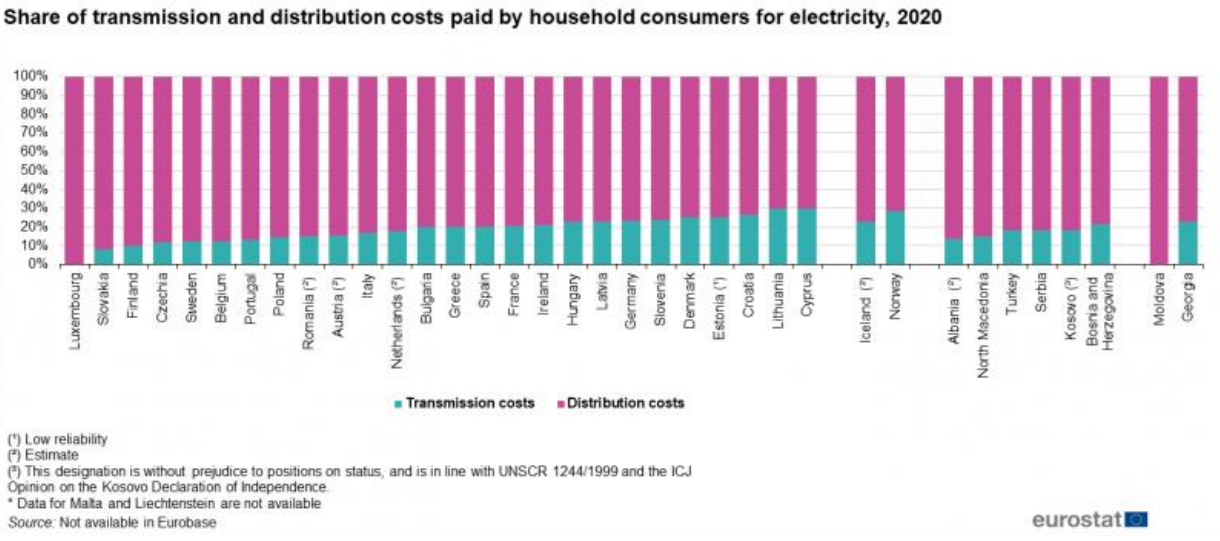


Figure 29. Share of transmission and distribution costs paid by household consumers for electricity, 2020

And if the price of electricity is low, the largest share is made by taxes and VAT.

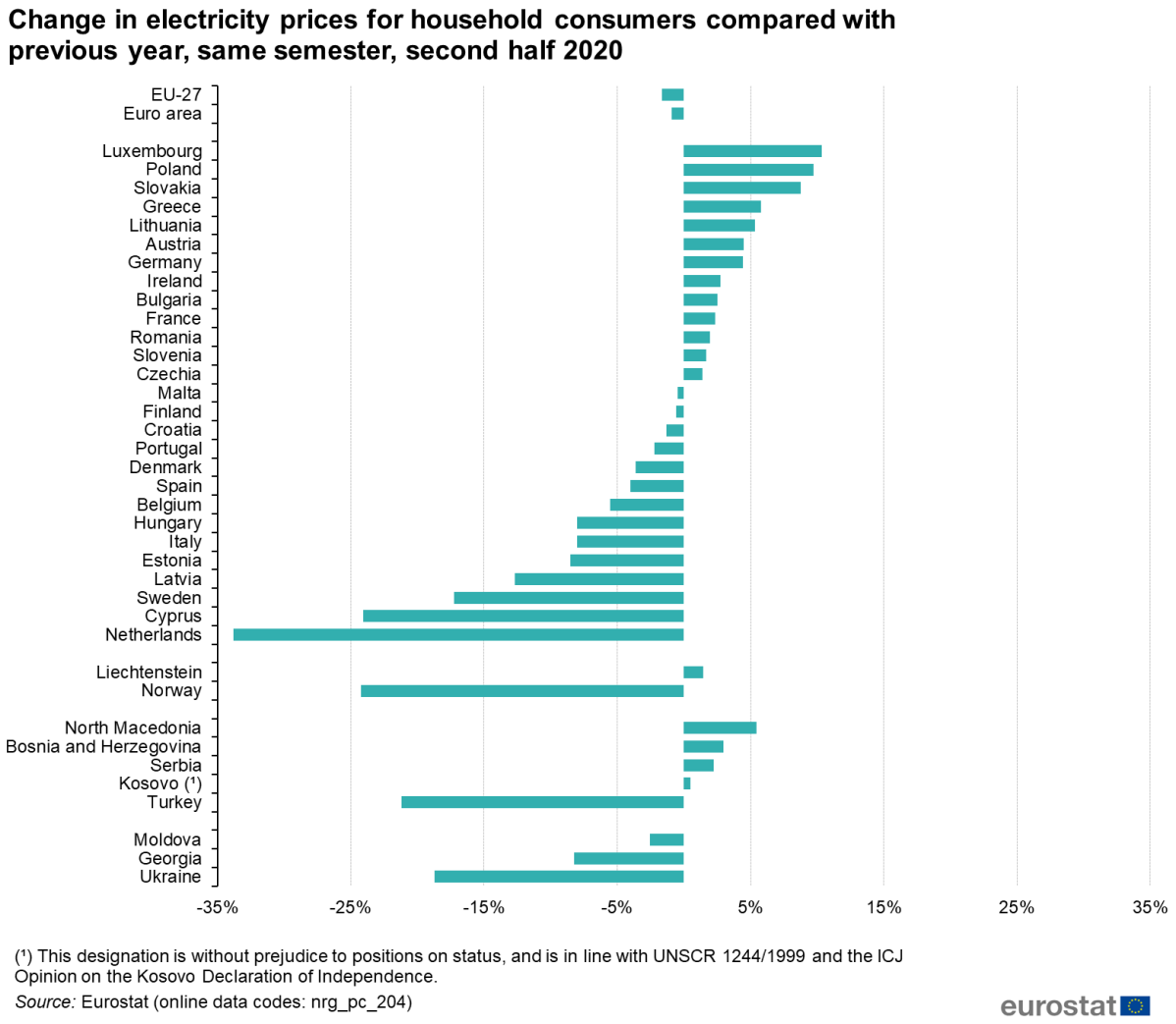


Figure 30. Share in electricity prices for household consumers compared with previous year, same semester, second half 2020

3.2. Natural gas

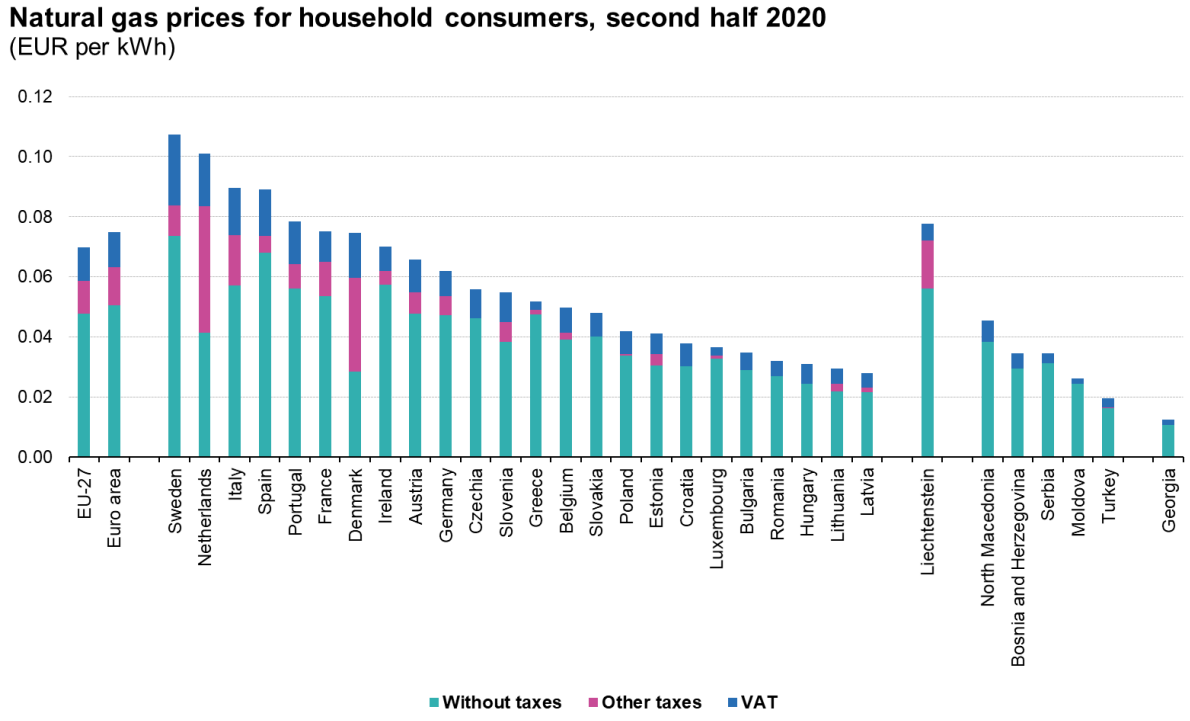
According to official data, as in other countries, the price of natural gas is declining, does not include taxes and has a relative low VAT rate.

Natural gas prices, second semester of 2018-2020
(EUR per kWh)

	Households (1)			Non-households (2)		
	2018S2	2019S2	2020S2	2018S2	2019S2	2020S2
Liechtenstein	0.0817	0.0841	0.0776	0.0596	0.0534	0.0526
North Macedonia	0.0606	0.0575	0.0454	0.0328	0.0317	:
Serbia	0.0342	0.0348	0.0344	0.0376	0.0387	0.0280
Bosnia and Herzegovina	0.0326	0.0333	0.0346	0.0357	0.0372	0.0375

(:) not available
(.) not applicable
(e) Estimate
(c) Confidential
(1) Annual consumption: 5 555 kWh < consumption < 55 555 kWh (20 - 200 GJ).
(2) Annual consumption: 2 778 MWh < consumption < 27 778 MWh (10 000 - 100 000 GJ).
Source: Eurostat (online data codes: nrg_pc_202 and nrg_pc_203)

Figure 31. Natural gas prices, second semester of 2018-2020



Note: Cyprus, Malta and Finland do not report natural gas prices in the household sector.
Source: Eurostat (online data codes: nrg_pc_202)

Figure 32. Natural gas prices for household consumers, second half of 2020

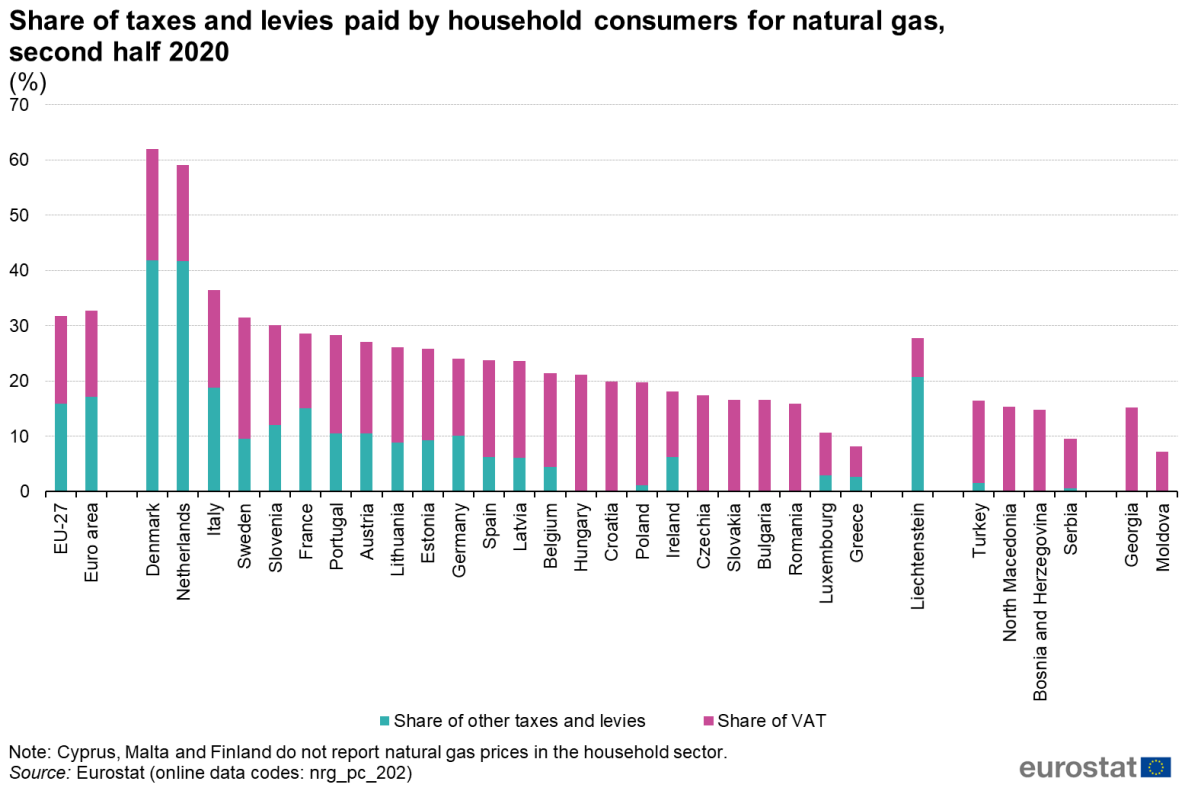


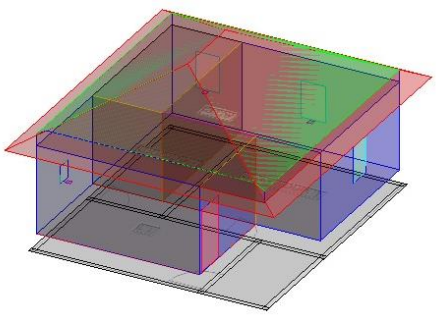
Figure 33. Share of taxes and levies paid by household consumers for natural gas, second half of 2020

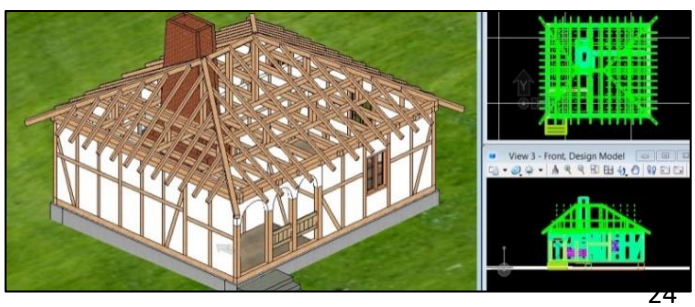
4. Price analysis: technology, operating expenses, system maintenance costs

Results of inventory of residential buildings point to the fact that a number of buildings of single-family housing compared to collective housing is significantly higher. However, if we analyse the number of dwelling units, difference in representation of single-family and collective housing is less expressed. According to the gross surface of residential space, single-family houses dominate whereas other types are present significantly lesser: apartment block, multi-family house, individual terraced houses, attached apartment building in urban blocks and high-rise buildings.

The analysed building is a typical family house, heating/cooling space 95m2, and three independent rooms.

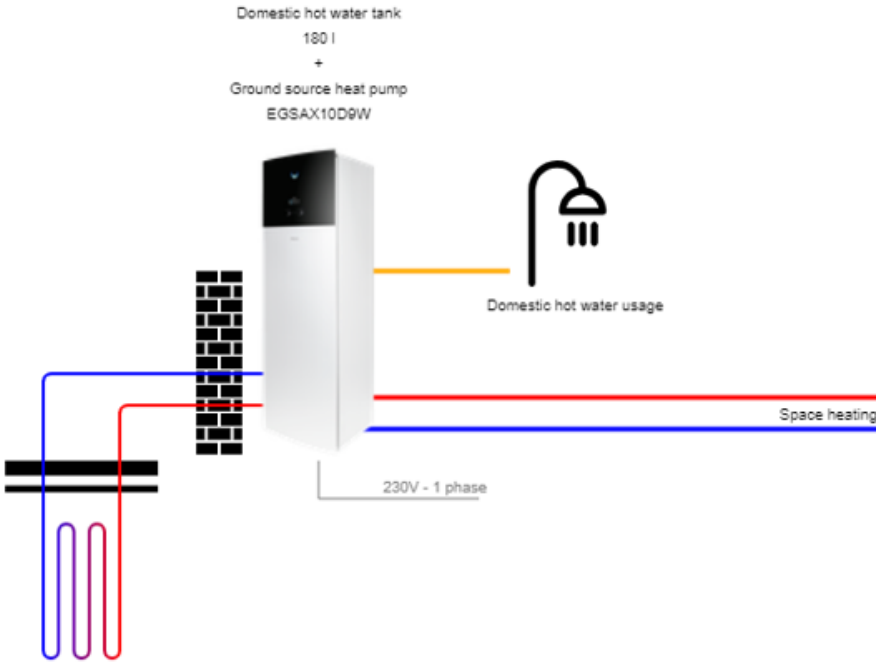
The analysis was made for four different cases of energy rehabilitation. The values of energy needs for heating and cooling of the building are shown in the table, with the remark that the values MO1 are for the building before the energy rehabilitation, so that case was not analysed.





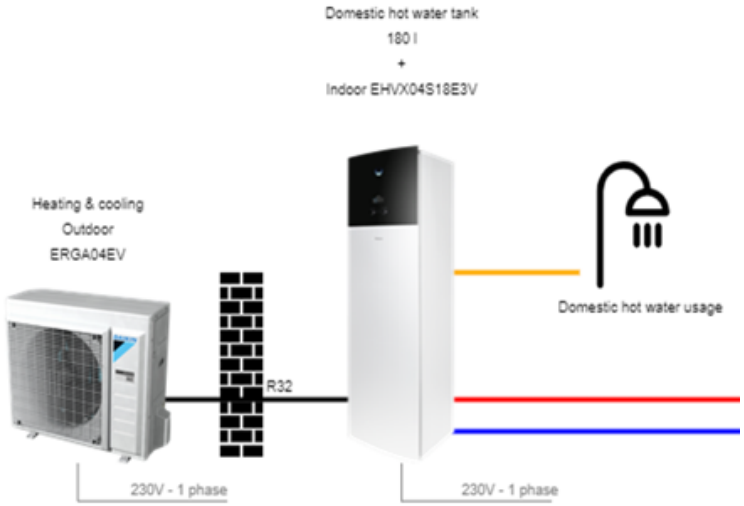
The analysis includes three solutions:

1) water-water heat pump system, geothermal (W -W)



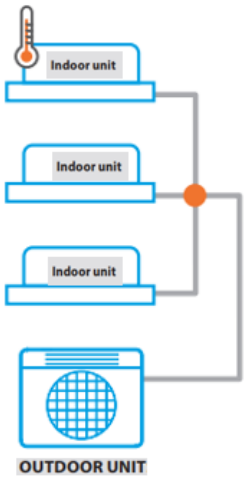
Operating costs Low
Regular maintenance costs (annual): Low
Required workforce expertise for installation of equipment: High
Life cycle of equipment: More than 15 years

2) air-to-water heat pump system (A-W)



Operating costs: Medium
Regular maintenance costs (annual): Low-Medium
Required workforce expertise for installation of equipment: Medium
Life cycle of equipment: 15 years - average

3) air-to-air heat pump system (A-A)



Operating costs: Medium/High
Regular maintenance costs (annual): Medium/High
Required workforce expertise for installation of equipment: Low
Life cycle of equipment: 15 years - average

Object	Heating loads W	Cooling loads W	Energy demand Heating kWh	Energy demand Cooling kWh	Total investition costs (EUR) Water-Water (geothermal)	Air-Water	Air-Air
MO2	4460	969	3107.26	523.63	16,115.00 €	10,030.00 €	4,310.00 €
MO3	4024	962	2648.47	578.54	16,015.00 €	9,780.00 €	4,110.00 €
MO4	3522	970	2207.64	646.6	16,015.00 €	9,780.00 €	3,910.00 €
MO5	2921	971	1714.12	747.28	16,015.00 €	9,580.00 €	3,730.00 €

Figure 34. Investment costs analysis

Object	Energy consumption heating -electricity (kWh/year) Water-Water (geothermal)	Air-Water	Air-Air	Energy consumption cooling -electricity (kWh/year) Water-Water (geothermal)	Air-Water	Air-Air
MO2	1619.6	1915	1796	154.7	368	310
MO3	1449.5	1696	1796	154.7	368	310
MO4	1304.1	1499	1617	154.7	299	283
MO5	1125.9	1270	1617	154.7	299	283

Figure 35. Energy consumption analysis

The table shows that the geothermal system has the highest investment value, but also the lowest electricity consumption. However, due to the large difference in investment value, the payback period is completely unrealistic, so air-to-air and air-to-water heat pumps are an economically viable solution. For facilities with low energy needs and/or small heating surfaces, heat pumps (A-A) are the ideal solution while heat pumps (A-W) are the ideal solution for buildings with a heating surface of up to 220 m2.

5. Human Resources: installation and maintenance of equipment

Depending on the type of device, the required qualification of the workforce is different. As mentioned earlier, the lack of skilled labour and ignorance of a foreign language has been observed in all countries, are the two biggest factors influencing market development and raising consumer awareness.

The installation of equipment is most often performed by persons who are trained and certified by the equipment manufacturer or equipment representative. Trainings are conducted theoretically and/or practically locally or abroad, depending on the type of equipment.

One of the most important conditions for exercising the warranty right of the user is that the equipment was installed / maintained by a certified person/company.

In all markets, the largest deficit is in the field of service technicians/service engineers.

REQUIRED WORKFORCE QUALIFICATION

Product goup	Production	Instalation	Commisioning	Service
Split	Low/Medium	Low/Medium	Low	Medium
Multi Split	Low/Medium	Low/Medium	Low	Medium
A-V	Medium/High	Medium	Medium/High	High
A-W	Low/Medium	Medium/High	Medium/High	High
A-W Geothermal	Low/Medium	Medium/High	Medium/High	High
Solar systems	Low/Medium	Low/Medium	Low/Medium	Low

6. Waste disposal: Lifecycle, Current standards, Trends

The service life of the equipment is on average 10-25 years, depending on the type and quality of the equipment.

Proper sizing, installation and regular maintenance of equipment greatly affect the life of the equipment. During the operating cycle, regular maintenance affects the longer life of components that are subject to wear due to continuous operation (fans, compressors, shafts, etc.). Due to the unstable voltage in the electrical network, one of the frequent failures is the electronics of the device which is the heart of the system. Due to rapid technological progress, many different type of units on the market, lack of skilled labour, electronics are generally not repaired but replaced with new ones. The replacement of the entire device is most often due to the transition to new refrigerants or due to the transition to modern technology.

Due to their construction, the most complex devices are air-to-water heat pumps whose service life is up to 20 years, with manufacturers in the premium segment.

In all countries, to some extent, the law on the disposal of electronic waste (WEEE).

Within the EU environmental acquis, waste is one of the most demanding sectors in terms of the resources – both human and financial – needed for the transposition of the relevant EU legislation, and the implementation of measures designed to achieve the outcomes

sought. Previous enlargements have shown how important it is for the European Commission to work closely with the countries throughout the accession process, helping them to transpose and correctly implement the environmental acquis by the date of accession.

The ten most important issues of regional significance that were identified as part of the National Waste Assessments carried out in each country were as follows:

- Poorly defined roles and responsibilities at various levels of government.
- Weak enforcement of laws.
- Prevalence of illegal dumping and continued use of substandard landfills.
- Low levels of fee collection and reluctance to increase fees.
- Existing policy measures are unlikely to drive materials up the waste hierarchy.
- Ineffective approach to procuring / funding widespread service changes.
- Waste collection infrastructure is unlikely to deliver against EU recycling targets.
- Poor quality of waste data.
- Gaps in application of extended producer responsibility; and
- Limited administrative and technical capacity.

Each of these issues were evident, to varying degrees, within the six markets covered by the study. The recommendations outlined in the roadmaps were aimed at addressing these issues and moving the countries towards a more sustainable system of solid waste management.

7. Sources

- http://smarterstoves.resfoundation.org/wp-content/uploads/2022/02/Sources-1.rar
- http://smarterstoves.resfoundation.org/wp-content/uploads/2022/02/Energy-prices-EUROSTAT.rar
- http://smarterstoves.resfoundation.org/wp-content/uploads/2022/02/Energy-production.rar
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