Air-to-water heat pumps convert the energy from the outdoor air into heat

+12.6%

the increase of the heat pump market in the EU28 between 2018 and 2019

HEAT PUMPS BAROMETER

A study carried out by EurObserv'ER.

EurObserv'ER

The heat pump market of the European Union of 28 continued its upward trend in 2019 buoyed by the political determination of some Member States to decarbonize their heat requirements and by the increasing demand for summer relief from the recurrent heat waves. According to EurObserv'ER, about 3.9 million HPs were sold in 2019, which amounts to 12.6% annual growth. The European Union now has an installed base of about 40 million HPs, all technologies taken together, producing renewable heating and cooling.

12.7 Mtoe

the estimate renewable energy provided by heat pumps in the EU28 in 2019

40.0 million HPs

total number of heat pumps in operation in the EU28 in 2019

HEAT PUMPS BAROMETER – **EUROBSERV'ER** – NOVEMBER 2020

Drilling a ground source heat pump borehole

The various types of HP systems need to be distinguished to understand the heat pump market trends. There are three major families named in reference to the source tapped for the thermal energy. Air-source HPs (ASHP) are those that "capture" the thermal energy in the ambient air. The second group – ground-source HPs (GSHP) – cover those systems that "capture" the thermal energy in the ground and lastly hydrothermal HPs draw calories from the water (groundwater, lakes, etc.). EurObserv'ER amalgamates the hydrothermal HP indicators with those of the ground-source HPs in the interests of simplicity and because of their technological similarity.

To distribute heat, GSHPs use either an underfloor heating circuit or low-temperature radiators (when the building's insulation is appropriate), or high-temperature radiators (when the insulation level is poorer). In the last instance, we describe them as water-borne heat pumps. There are more heat distribution methods with ASHPs. Some of them – of the air-to-water type – use water to distribute the heat like GSHPs. Others use systems that blow hot air, known as air-to-air HPs, almost all of which operate reversibly. In hot climate countries or regions the cooling function tends to be their main use. This explains why some European Union markets cannot be compared directly as HP uses, types of technologies and capacity ranges differ by the local climate zone. The situation raises issues for making statistical comparisons between the various EU markets especially as reversible air-to-air HPs are also extensively used for heating in the Northern European countries of Sweden, Denmark, and Finland.

EHPA (the European Heat Pump Association), which defends the heat pump industry's interests publishes an annual European Heat Pump Market and Statistics Report. It only includes part of the reversible ASHP market figures in its statistics along the lines of their installation climate zones, justifying its choice by its policy to track the market for HPs essentially used for heating and so distinguish it from the market for HPs essentially used for cooling. As it happens, the association reckons that the use of reversible ASHPs is essentially for heating purposes in the cold climate countries (Estonia, Denmark, Finland, Lithuania, Sweden, etc.). Nonetheless, EHPA applies a 10% adjustment factor to the market data to exclude units used exclusively for cooling purposes. For countries with average climates (Belgium, the Netherlands, Poland, and so on) EHPA has decided not to account for ASHPs on the basis that there is insufficient data available to quantify their actual heating and cooling use. As for the warm climate zone countries (South of France, Italy, Portugal, and Spain), it only takes into consideration a small proportion of the ASHPs sold (a 9.5% share) that it reckons are really used for heating purposes.

EurObserv'ER has adopted a different approach because it primarily draws on questionnaires filled in by the ministerial statistical services that identify the base that should be incorporated, namely those systems whose seasonal performance factors (SPF) are high enough to be included in the target calculations for the European Renewable Energy Directive. For example, countries such as France, the Netherlands, Italy, Spain, and Portugal factor in a considerable number of reversible ASHPs in their statistics on the grounds that they consider them to meet the performance criteria set by the European Directive. HPs that do not meet these criteria are not accounted for. Now, other countries such as Germany and Austria do not produce figures for this type of HP in their official statistics. However, the issue of their inclusion could be raised depending on surveys conducted to identify the quality of their HP base.

Reversible ASHPs account for a large share of European Union systems sales, not only in the south but in the north of Europe. Their unit capacity is generally much lower than that of water-borne HPs. Incidentally, the amount of renewable

The 4 phases of heat pump operation

Heat pumps use the same technology as refrigerators, namely they take heat from one place and transfer it to another. HPs designed to heat dwellings offer an average yield of about 350%, i.e. they can produce 3.5 kWh of heat for every kWh they use. Thus, HPs use the laws of thermodynamics to extract calories from the outdoor air, water or the ground using a heat-transfer fluid via a 4-phase thermodynamic cycle. In the first, a compression phase, the heat-transfer fluid in gaseous state is compressed. This has the effect of increasing the gas temperature and pressure. The second phase is a condensation phase. The heat-transfer fluid in a hot, pressurized gaseous state circulates in an exchanger, known as a condenser, where it gives up its heat that will be used to heat the dwelling or domestic hot water. By giving up its heat, the fluid, which is still pressurized, changes state and becomes liquid. The third is an expansion phase. The liquid fluid flows into an expansion valve which drops its temperature and pressure drastically. The fourth and last phase, is the evaporation phase. The liquid, low-pressure fluid flows into another exchanger known as the evaporator. As its temperature is much lower than that of its environment (the outdoor air or ground), the fluid will take thermal energy from this medium. The fluid in the evaporator will warm and be converted from liquid to gaseous state, ready for a new four-phase cycle (compression, condensation, expansion, evaporation). The efficiency of an HP, its coefficient of performance (COP), is governed by the temperature difference between the condensation and evaporation phases. An HP will be less efficient and thus use more electricity during very chilly weather but will be much more efficient over the winter period than a simple electric convector. Reversible HPs can also operate in cooling mode, by taking the heat inside a dwelling and transferring it to the outside. HPs are less efficient at cooling down buildings during heat waves and use more electricity to do so.

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energy produced by HPs differs from type to type. Their output depends on the source of auxiliary energy used to operate the compressor (electricity or natural gas), the source of thermal energy tapped (ground, water, or air), the application (heating or cooling), the time used and the climate zone of their installation. In March 2013, the European Commission published a methodological guide setting out its guidelines for reporting the renewable energy share produced by the various heat pump technologies in line with article 5 of the 2009/28/EC directive to help the member countries measure the renewable energy output of their HP bases. The detailed version of the Eurostat SHARES tool, whose purpose is to harmonize the way the share of energy produced from renewable sources is calculated, specifies the calculation details to be made by each Member State to determine the amount of renewable energy produced by their HP base.

A MARKET ON AN UPSWING

The electrification of thermal, heating, and hot water needs has become a priority strand of energy policy for the Member States to meet their climate commitments, especially for those with a very low-carbon electricity mix. Thus, the heat pump market is one of the main technologies to benefit from public policies. Some member countries have already announced their intention to ban the use of oil-fired and even gas-fired heating for residential heating in the future in order to achieve carbon neutrality in 2050. Thanks to some European countries' adoption of more binding thermal regulations, HP systems have become the main heating method in new build. Cases in point are France and the countries of Northern Europe. Sweden is the pioneer in this area, as its electricity mix is almost exclusively low-carbon (renewable energies and nuclear), while oil and especially gas have been practically eliminated from the residential heating segment.

The heat pump market continues to prosper buoyed by both heating and cooling needs. According to EurObserv'ER, about 3.9 million HPs were sold during 2019, all capacities and technologies taken together, which amounts to 12.6% annual growth (3.5 million units sold in 2018). The market data, leaving aside the UK which officially left the European Union on 1 January 2020, is given in **tables 1, 2 and 3**. It should be stated that the 2018 market figure was consolidated and turned out lower than our previous published figure. The consolidation can essentially be put down to the publication of more accurate market data by Spain on its eligible HP base for renewable energy market production, after applying the minimum efficiency criteria defined by the Renewable Energy Directive. According to the Spanish Ministry for Ecological Transition and Demographic Challenge, Spain's market count was 446 926 eligible ASHPs (capacity equal to 3 168.5 MWth), while the total ASHP sales figure is put at 914 534 (including 879 285 air-to-air HPs). EurObserv'ER had used the total air-to-air HP market in its last publication, for want of detailed information, while at the end of the day only one out of two HPs was eligible for inclusion as producing renewable energy. These figures are representative of the residential and service sector markets above all (that cover a power range extending from a few kW to more than twenty kW), the medium- and high-capacity HP market is much smaller (as fewer than one thousand industrial and heating network HPs are sold in the EU).

ASHPS SHOW THE WAY

Air-to-air ASHPs (usually reversible) still account for most of the sales in the European market, with according to EurObserv'ER, almost 3.3 million systems sold in 2019, which is just over 300 000 units more than in 2018 (a 10.4% rise). It should be stated that the three biggest markets (Italy, Spain, and France) together account for 81.2% of Europe's newly-installed reversible air-to-air systems. Italy is the biggest market for reversible ASHPs, with about 4% growth in this market segment equating to about 1.6 million units sold, according to the Ministry of Economic Development's estimates and forecasts.

The water-borne ASHP market expressly caters for heating. Its sales have increased steadily since 2013 and tended to pick up since 2017. They actually increased by 33.0% between 2018 and 2019, with 485 831 units sold (identified in 23 EU countries), having already increased by 19.2% between 2017 and 2018. Growth in this segment during 2019 was particularly high in France (80.1%), driven by very strong incentives (see below), Italy (37.2%), Poland (90.8%), the Czech Republic (27.0%), and Finland (26.3%). At least 11 countries recorded double-digit growth rates in this market segment.

Likewise, the GSHP market (also water-borne) expressly addresses heating needs, though on a smaller scale. For two years, market growth has surged, increasing by 7.9% year-on-year, with 93 673 units sold, compared to 4.5% between 2017 and 2018. Yet, market growth is uneven in the main European countries positioned on this market segment. Considerable drops in annual sales volumes were posted in Germany (10.1% down) and Austria (14.8% down). The main reason for the positive growth in this market segment is the booming Dutch market (which grew by 86.2% over its 2018 level) (see below), and double-digit growth in the Polish (15.1%), Finnish (12.4%) and Belgian (38.6%) markets.

Tabl. n° 1

Market of aerothermal heat pumps in 2018 and 2019 (number of units sold).*

	2018				2019			
	Aerothermal HP	of which air-air HP	of which air-water HP	of which exhaust air HP	Aerothermal HP	of which air-air HP	of which air-water HP	of which exhaust air HP
Italy	1 550 000	1 507 000	43 000	0	1 611 560	1 567 280	44 280	0
France	591 700	498 120	93 580	0	815 400	646 870	168 530	0
Spain	480 285	454 595	25 690	0	446 926	411 677	35 249	0
Netherlands	106 267	76 933	29 334	0	153 578	120 761	32 817	
Belgium	71 069	64 041	7 028	0	103 058	94 380	8 678	0
Sweden	103 672	75 000	10 788	17 884	97 380	70 000	10 994	16 386
Finland	67 621	59 395	5 024	3 202	85 378	79 033	6 345	0
Germany	76 720	0	61 720	15 000	83 270	0	66 770	16 500
Portugal	60 948	60 308	640		74 827	74 335	492	
Malta	62 881	62 881	0	0	71 933	71 933	0	0
Denmark	47 508	39 488	7 855	165	57 998	48 853	8 945	200
Slovakia	34 944	31 149	3 773	22	48 593	45 640	2 916	37
Poland	19 905	9 265	10 630	10	31 314	11 018	20 286	10
Czechia	24 542	7 500	16 977	65	29 130	7 500	21 563	67
United Kingdom	23 615	0	23 615	0	28 219	0	28 219	0
Austria	15 157	0	14 862	295	18 175	0	17 947	228
Estonia	15 010	13 700	1 280	30	15 010	13 700	1 280	30
Ireland	4 457	0	4 398	59	14 038	6 533	7 045	460
Slovenia	3 200	0	3 200	0	3 200	0	3 200	0
Hungary	2 850	2 850	0	0	2 850	2 850	0	0
Lithuania	3 466	1 911	1 555	0	679	610	69	0
Luxembourg	206	0	206	0	206	0	206	0
Greece	140	140	0	0	133	133	0	0
Total EU 28	3 366 163	2 964 276	365 155	36 732	3 792 855	3 273 106	485 831	33 918
Total EU 27 (after January 31, 2020)	3 342 548	2 964 276	341 540	36 732	3 764 636	3 273 106	457 612	33 918

** Estimate. Note: Datas from italian, french and portuguese aerothermal heat pump market are not directly comparable to others, because they include high part of reversible heat pumps whose principal function is cooling. Only heat pumps that meet the efficiency criteria (seasonal performance factor) defined by Directive 2009/28 / EC are taken into account.* **Source: EurObserv'ER 2020.**

Tabl. n° 2

Market of geothermal (ground source) heat pumps in 2018 et 2019** (number of units sold)*

	2 018	2 019
Sweden	24 162	25 343
Germany	21 137	19 000
Netherlands	6 504	12 112
Finland	7 995	8 988
Poland	5 831	6 710
Austria	5 513	4 699
France	3 080	3 300
United Kingdom	2 310	3 026
Belgium	1 872	2 595
Denmark	2 310	2 251
Estonia	1 750	1 750
Czechia	1 647	1 417
Italy	775	753
Greece	n.a.	571
Hungary	300	335
Ireland	291	316
Spain	219	198
Slovakia	332	149
Luxembourg	89	89
Lithuania	615	43
Portugal	47	28
Slovenia	0	0
Total EU 28	86 779	93 673
Total EU 27 (after January 31, 2020)	84 469	90 647

** Hydrothermal heat pumps included. ** Estimate.* **Source: EurObserv'ER 2020.**

THE EUROPEAN INSTALLED BASE TOPS 40 MILLION HPS

Putting a figure on the number of HPs in service is a tricky exercise that is contingent on the decommissioning assumptions adopted for each county and the availability of statistics supplied by the Member States or HP industry associations. EurObserv'ER puts the European Union installed HP base to date at about 40.0 million units (38.3 million ASHPs and 1.7 million GSHPs). This figure is not restricted to heating uses, but covers both cooling and heating uses, for systems whose performance factors meet the Renewable Energy Directive criteria. HPs that do not meet these criteria have not been included. By way of illustration, the 2020 EHPA "European Heat Pump Market and Statistics" report, puts the total HP base in service during 2019 fulfilling the main function of heating at about 13.2 million in Europe, which implies that cooling is the main application of about two-thirds of the HP base.

SPOTLIGHT ON A FEW REPRESENTATIVE MARKETS

Finland reaches the million HP threshold

In the northernmost European Union country, heat pumps have crowded out the other heating systems. The Finnish Heat Pump Association (SULPU) statistics report that at the end of 2019 the country, which has only 5.5 million inhabitants, had reached the threshold of one million installed HPs. The EurObserv'ER count attests to an installed base of about 965 000 units but does not include the HPs installed at the tail end of the 1990s. The 2019 national sales figure was 98 205, which amounts to 29.9% growth (75 616 units sold in 2018). Air-to-air HPs dominate sales at 79 033 units (33.1% more than in 2018). Their unit capacity was essentially less than 6 kW. Water-borne HPs shared the rest of the market, namely GSHPs with 8 988 units sold (12.4% more than in 2018), air-to-water HPs with 6 345 units sold (26.3% more than in 2018) and exhaust air-to-water HPs (EAHP) with 3 839 units sold (19.9% fewer than in 2018). Exhaust air-to-water HPs pump calories from the vitiated air extracted from buildings via CMV (controlled mechanical ventilation). The association emphasizes that the recovery seen in the GSHP growth can be attributed to new models fitted with inverters that improve system performance.

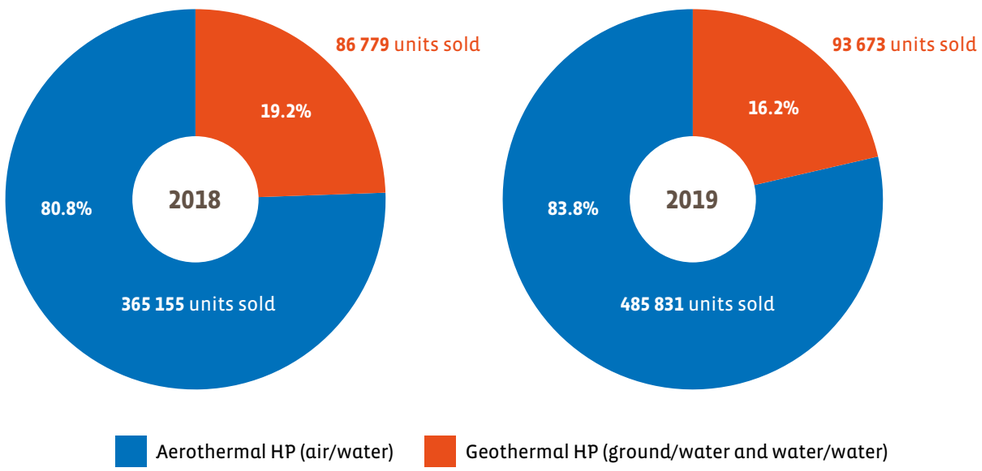
SULPU points out that the 2019 installation level is worth about 600 million euros in value. The average price of a GSHP is 28 000 euros, 15 000 euros for an air-to-water HP, 9 000 euros for an EAHP, 2 400 euros for an air-to-air HP. It also claims that the output of the Finnish HP base is more than 10 TWh and covers 15% of the country's residential and service sector heating requirements. Some 70-80% of new build housing is equipped with GSHPs or EAHPs, and every year about 8 000 oil-fired boilers are replaced by GSHPs or EAHPs. The association points to great development potential as there are still some 150 000 oil-fired boilers in use. Air-to-air HPs that dominate HP sales are primarily installed in homes already heated by electricity, as well as second homes. An increasing number of multi-occupied buildings on heating networks are installing EAHPs, which according to SULPU, reduces urban heating consumption by up to 50%. New business models based on third-party investment are developing in industry and in major multi-occupied buildings. They are characterized by the investment being made by a supplier who is paid for the heat or cooling production depending on the manufacturer's or condominium's need. The advantage for customers is having a lower energy bill once the installation is completed without having to foot the bill for the installation.

Sweden's market is expected to pick up in 2020

The Swedish HP market had a lacklustre year in 2019. According to SKVP (Svenska Kyl & Värmepumpföreningen), despite sales dropping off in the 4th quarter, growth in the water-borne HP segment (GSHP and air-to-water) remained positive. GSHP segment sales increased by almost 5% between 2018 and 2019 with 25 343 units sold, whereas the air-to-water HP segment only gained 2% with its 10 994 units. However, sales of EAHPs dropped off by 8.4% over the year with 16 386 units sold, and also air-to-air HP sales that contracted by about 6.7% … with roughly 70 000 units sold. According to Per Jonasson, former CEO of SKVP, the drop in EAHP sales is a direct

Graph n° 1

Market share between geothermal[1] and air-water heat pumps with hydronic system[2] in 2018 and 2019 in the EU28*



*1) hydrothermal HP included. 2) An hydronic heat pump system uses water or another liquid as a heat transfer fluid in heating and cooling systems (with radiators or a heating floor). *Estimate.* ***Source: EurObserv'ER 2020.***

Tabl. n° 3

*Total number of heat pumps in operation in 2018 and 2019 in the European Union**

	2018			2019		
	Aerothermal heat pumps	Ground source heat pump	Total PAC	Aerothermal heat pumps	Ground source heat pump	Total PAC
Italy	19 569 000	14 150	19 583 150	19 600 000	14 100	19 614 100
France	6 178 756	157 950	6 336 706	6 994 156	161 250	7 155 406
Spain	3 711 035	10 595	3 721 630	4 157 961	10 793	4 168 754
Sweden	1 261 328	537 878	1 799 206	1 349 857	551 776	1 901 633
Portugal	1 536 059	909	1 536 968	1 610 677	909	1 611 586
Germany	684 439	376 902	1 061 341	762 336	392 784	1 155 120
Finland	751 242	118 976	870 218	836 620	127 964	964 584
Netherlands	509 650	60 379	570 029	660 806	71 065	731 871
Denmark	332 520	65 149	397 669	380 995	68 997	449 992
Malta	361 944	0	361 944	425 237	0	425 237
Belgium	218 535	13 209	231 744	321 593	15 804	337 397
United Kingdom	173 727	33 851	207 578	201 946	36 877	238 823
Austria	108 059	106 843	214 902	126 246	109 695	235 941
Bulgaria	214 971	4 272	219 243	214 971	4 272	219 243
Estonia	146 737	15 875	162 612	161 747	17 625	179 372
Czechia	123 327	25 005	148 332	150 440	26 316	176 756
Poland	81 636	53 486	135 122	112 950	60 196	173 146
Slovakia	45 993	3 815	49 808	94 586	3 964	98 550
Slovenia	31 100	10 648	41 748	34 300	10 648	44 948
Ireland	22 398	4 406	26 804	36 436	4 722	41 158
Hungary	9 950	2 410	12 360	12 800	2 745	15 545
Lithuania	3 466	3 268	6 734	4 145	3 311	7 456
Greece	1 270	3 129	4 399	1 403	3 700	5 103
Luxembourg	1 628	742	2 370	1 834	831	2 665
Total EU 28	36 078 770	1 623 847	37 702 617	38 254 042	1 700 344	39 954 386
Total EU 27 (after January 31, 2020)	35 905 043	1 589 996	37 495 039	38 052 096	1 663 467	39 715 563

** Estimate. Note: Datas from italian, french and portuguese aerothermal heat pump market are not directly comparable to others, because they include the heat pumps whose principal function is cooling. Only heat pumps that meet the efficiency criteria (seasonal performance factor) defined by Directive 2009/28 / EC are taken into account.* ***Source: EurObserv'ER 2020.***

A hybrid heat pump is a system designed for the new build or renovation markets. It comprises an air-to-water heat pump and a condensing gas boiler to provide heating and domestic hot water production.

consequence of the new build construction slowdown, while the general drop in sales in Q4 is definitely linked to the unseasonably warm temperatures. All in all, HP sales remained positive at 7.8 billion Swedish krona (754 million euros), i.e. a 3.5% improvement on 2018.

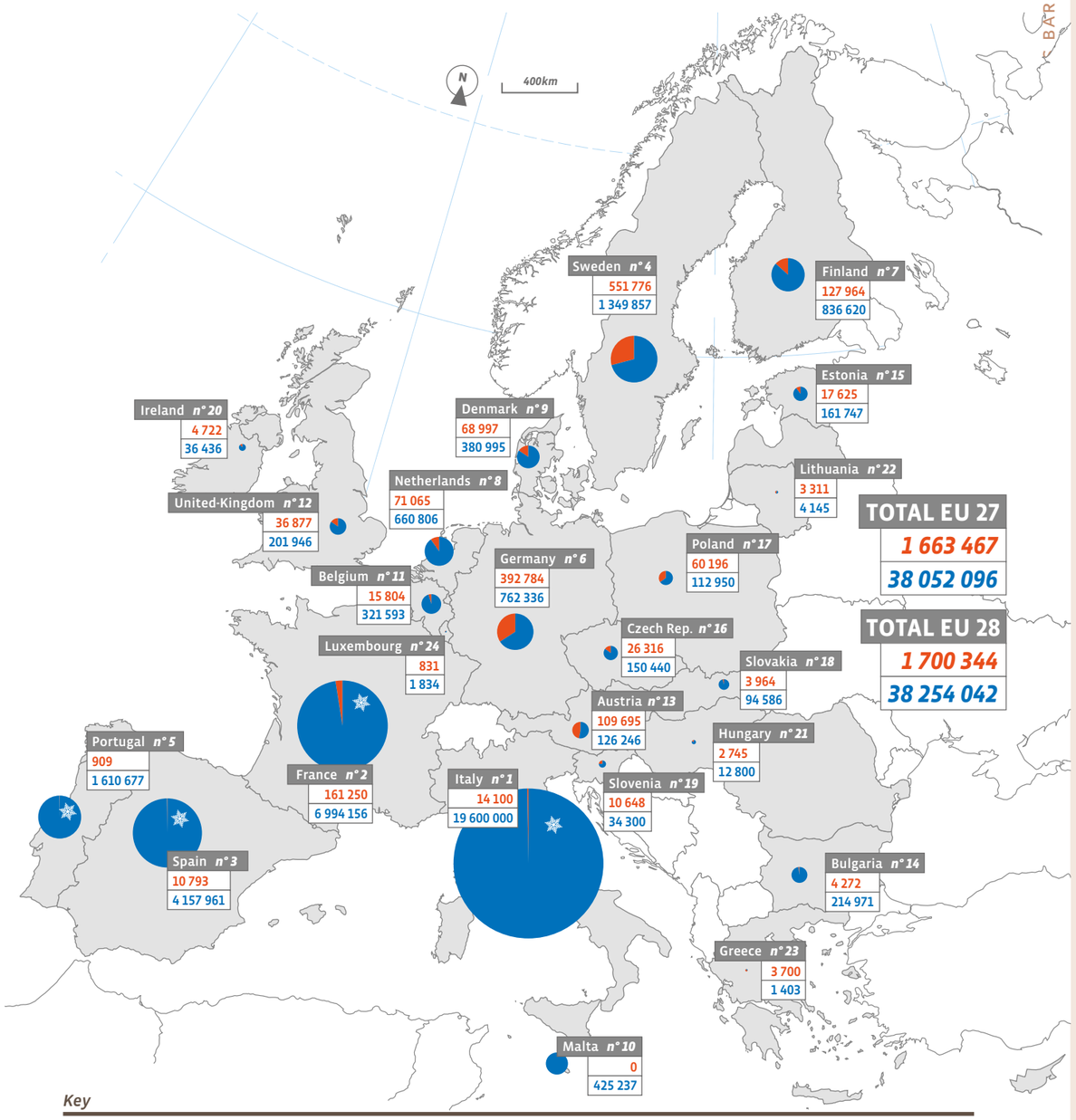
SKVP's interim data for the first three quarters of 2020 shows that the COVID-19 health crisis has not particularly affected the sector. Sales in the air-to-water and exhaust air HP segments were clearly up over the 9 months (by 30% and 11% respectively). The only segment to contract was GSHP (by 9% over 9 months). During the three quarters, HP sales picked up by 9% in value to 5.9 billion Swedish krona (570 million euros). It is hard to predict the impact that COVID-19's second wave will have on the last quarter. According to EHPA, the market share of HPs earmarked for heating in Sweden is already about 90-95% in residential houses (with one or two families) and 70% in the renovation sector.

HPs are replacing gas-fired boilers in the Netherlands

The Dutch heat pump market is on a clear upswing. According to Statistics Netherlands, the number of air-to-air HPs sold in 2019 increased by 57.0%, to 120 761 units. Sales of air-to-water HPs increased by 11.9% to 32 800 units, and GSHPs sales increased by 86.2% to 12 112 units. Statistics Netherlands ascribes this significant growth to the ISDE (Sustainable energy investment subsidy scheme) incentive system which was rolled out in 2016. Businesses and individuals can request grants to offset the cost of energy-saving equipment such as heat pumps, solar hot-water heaters, biomass boilers and wood pellet burners. The programme runs from 1 January 2016 until 31 December 2020 with a pre-announced budget for each subsidy year. It was 100 million euros in 2018 and 2019. The subsidies awarded for heat pumps are € 1 100 for ASHPs with a capacity of 1 kW plus 100 euros for each additional kW (ergo, a 6-kW ASHP is eligible for a grant of 1 600 euros). In the case of GSHPs (water-to-water or ground-to-water), the grant is € 2 500 for ≤10-kW systems and € 2 500 for >10-kW GSHPs plus 100 euros for each additional kW. The grant is increased by € 150 for systems with the A+ energy label and by € 300 for systems with the A++ energy label. The heat pump base has doubled in just four years as a result of the policy, rising from 370 842 systems (all technologies) in 2016 to 731 871 systems in 2019. At the same time the installed HP capacity has increased by 66.8%, from 3 819 MW (including 1 312 MW of GSHPs) to 6 371 MW (including 1 599 MW of GSHPs).

The trend stems from the decision to curtail the use of natural gas in residential accommodation by 2050, and also to stop extracting natural gas by 2022... eight years earlier than initially planned. The Dutch government announced its decision in February 2020 because the

Aerothermal and geothermal heat pump park in operation in European in 2019 (installed units)*



Key

Geothermal heat pumps

Aerothermal heat pumps

14 100 *Total number of aerothermal heat pumps in operation in the country*

19 600 000 *Total number of geothermal heat pumps in operation in the country*

Datas from italian, french, spanish and portuguese aerothermal heat pump market are not directly comparable to others, because they include the heat pumps whose principal function is cooling.

** Estimate.* ***Source: EurObserv'ER 2020.***

over-exploitation of the Groningen natural gas field, the biggest deposit in Western Europe, has triggered a series of small surface-level earthquakes that caused enormous damage to buildings in a highly-populated area. According to the Royal Meteorological Institute of the Netherlands (KNMI), more than 80 earthquakes shook the region in 2019. The country's climate imperative is in the same vein as the decision. The Dutch Climate Law of 2019 aims to reduce CO_2 emissions by 40% by 2030 and by 95% by 2050 compared to their 1990 level. The construction of new houses connected to the natural gas grid has been prohibited since July 2018, leaving property developers to come up with alternative heating solutions such as installing HPs or connecting them to district heating networks.

The French HP market is on the up and up

Observ'ER describes HP market growth in 2019 as spectacular. Air-to-water heat pump sales increased by 80.1%, rising from 93 580 units in 2018 to 168 530 in 2019, with more than half (53%) in dual service – namely, providing heating and domestic hot water production. Air-to-air HP sales also increased by a healthy 30%, rising from 498 120 units in 2018 to 646 870 in 2019 (11% offering dual service). Furthermore, ASHP sales picked up by 38% in 2019, rising from 591 700 units in 2018 to 815 400 in 2019. This data does not include thermodynamic hot-water heaters exclusively dedicated to producing domestic hot water, whose sales have steadily risen in recent years (by 13% between 2018 and 2019) to reach 118 300 units in 2019 (105 140 units in 2018). GSHP sales have also risen by 7.1% but their numbers are relatively low (3 300 systems sold in 2019 compared to 3 080 in 2018).

This growth can be ascribed to the policies to promote powerful electrical heating solutions and dissuade individuals from replacing their fossil fuel heating appliances like-for-like. Since the start of 2019, the French government has strengthened its Coup de pouce Chauffage mechanism to encourage householders to change their fossil fuel heating systems (oil, coal, and gas) over to renewable energy heating methods. Now all households can take up the mechanism regardless of income. However, the premium levels are calculated to provide low-income households with more aid, so means testing is applied. The scheme will end on 31 December 2020. The premium is generous, as for water-borne HPs (air-to-water, water-to-water) it can be as much as 4 000 euros for low-income households and 2 500 euros for other households. The "Coup de Pouce" premium can also be cumulated with the eco-PTZ loan and the CITE (Energy transition tax credit), the latter having been replaced by the new MaPrimeRenov' incentive system in 2020.

The 2019 scramble for HP systems can also be put down to 1-euro offers by private HP companies. Very low-income applicants are eligible for the scheme and can combine the aid given by the National Housing Improvement Agency (ANAH) through its "Habiter Mieux Agilité" programme that covered 50% of the cost before tax of works, with the Coup de pouce Chauffage premium. These offers ended in 2020, when the bundling of ANAH's "Habiter Mieux Agilité" premium stopped. The 2020 system is still highly attractive, for by accumulating the various aid packages (energy premium based on energy-saving certificates) and the Coup de pouce Chauffage premium, some installers offer very low-income households HPs that require them to invest just 1 500 euros.

As for new constructions, early in January 2020, the French government revealed its policy by specifying the calculation parameters to be used in the new RE 2020 thermal regulations. The conversion factor imposed between primary and final energy for electricity will be reduced to 2.3 in the forthcoming RE 2020 regulation as against 2.58 for the current RT 2012 thermal regulation. The CO_2 emission factor of the electricity used for heating will be determined by the monthly usage method and its value will be updated to 79 g/kWh instead of 210 g/kWh. According to heating industry players, these prescriptions confirm the government's plan to promote electrical appliances for heating and domestic hot water production. The RE2020 regulation was due to come into force in January 2021 but has been postponed until the summer because of the pandemic.

Tabl. n° 4

Representative Heat Pump Companies in the European Union.*

Group	Brand	Country
BDR Thermea	De Dietrich	France
	Sofath	France
	Chappée	France
	Remeha	Netherlands
	Oertli Thermique	France
	Brotje	Germany
Bosch Thermotechnology	Bosch	Germany
	Buderus	Germany
Daikin Industries	Daikin Europe	Belgium
	Rotex	Germany
Atlantic	Atlantic, Atlantic-Fujitsu (co-branding)	France
Nibe Industrier AB	Nibe Energy System	Sweden
	CTC	Sweden
	Technibel	France
	KNV	Austria
	Alpha-Innotec	Germany
	Waterkotte	Germany
Vaillant Group	Vaillant	Germany
	Saunier Duval	France
Viessmann Group	Viessmann	Germany
Stiebel Eltron	Stiebel Eltron	Germany
	Thermia	Sweden

** Non exhaustive list* ***Source: EurObserv'ER 2020.***

The new-generation high-temperature heat pumps for the residential sector (air-to-water) can reach outlet water temperatures of up to 70° C when outdoor temperatures are very low, down to 15° C.

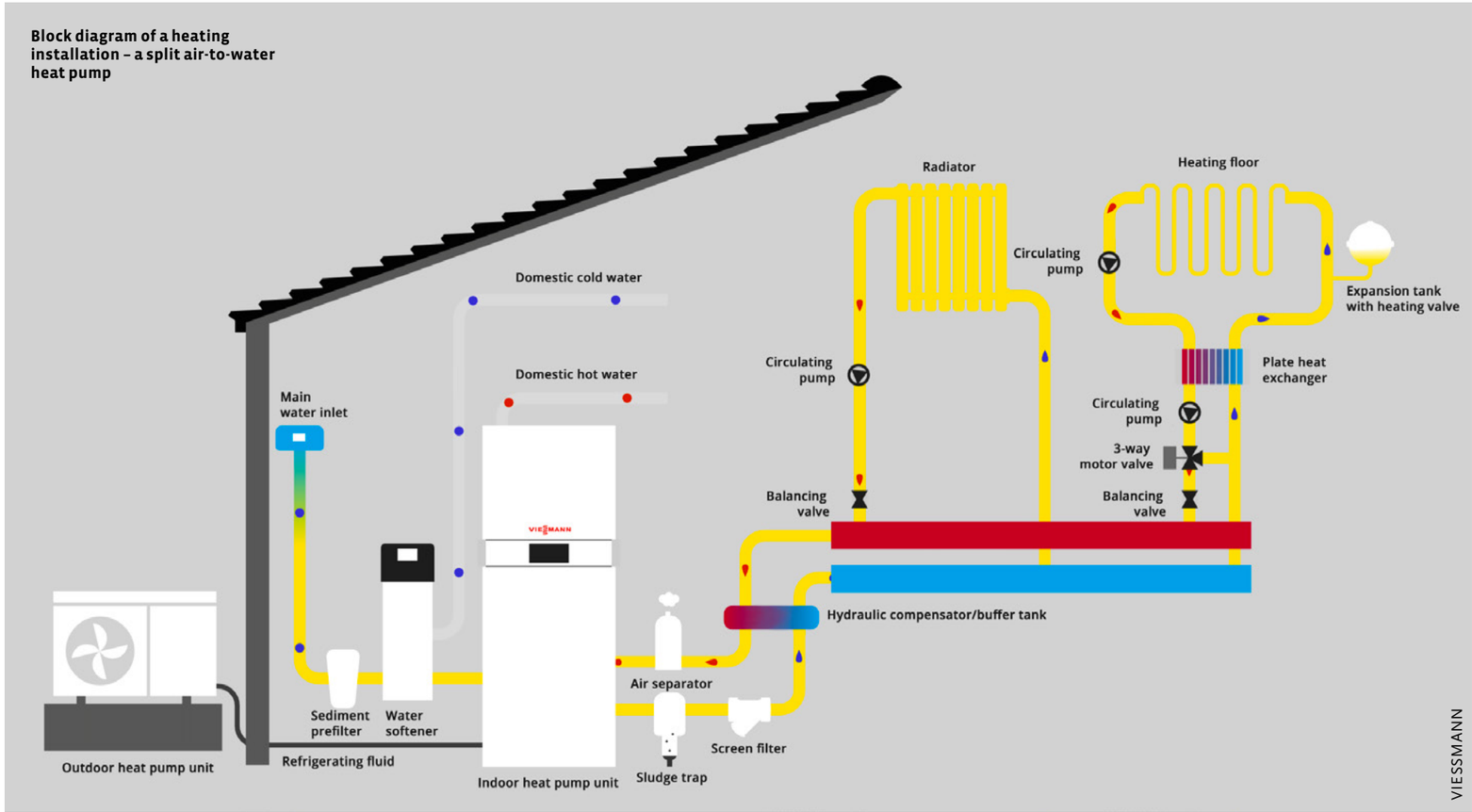
AN INDUSTRY ON THE DECARBONIZATION FRONT LINE

The European HP manufacturing sector is controlled not only by major world-known names in heating (Nibe Industrier, BDR Thermea, Bosch Thermotechnology, Viessmann, etc.), but by global and major European refrigeration and air-conditioning players that have taken up positions in the heating market segment such as Japan's Daikin Industries and Mitshubishi Electric, France's CIAT, together with some HP specialists that have succeeded in developing their businesses without being bought out, such as Stiebel Eltron. These major groups sell environmentally-friendly solutions for climate comfort for all kinds of dwellings including heating and air-conditioning solutions for the manufacturing sector. They tend to deploy their business across several brands, as a result of their intense historical M&A activity, absorbing companies of various sizes positioned in specific geographic markets and segments. In recent years, a few major consolidations have taken place between the main HP players. The underlying reasons may be the expansion of heat pumps into new key markets, sustainable growth prospects guaranteed by stricter regulatory frameworks, clearly stated decarbonization targets and the rollout of favourable legislation (regulatory framework and financial and fiscal incentives), both in the new build and renovation market segments. The flurry of buy-outs and takeovers of the sector's big names has kept the heat pump manufacturing sector on its toes.
In 2018, the German group Stiebel Eltron took over Danfoss Värmepumpar AB, more commonly known through its Thermia heat pump brand name (No. 3 supplier in the Nordic heat pump market with annual sales of about 68 million euros), from the Danish company Danfoss A/S. Stiebel Eltron aims to develop its business in other markets dominated by glycol water/water heat pumps through this acquisition. Consolidation continued in 2020 when an agreement was signed in March for the Swedish company NIBE Industrier AB to acquire the German heat pump manufacturer Waterkotte. The latter was founded in 1976, specialized in the individual home market segment, and also larger-dimension heat pumps for commercial and industrial applications (product range extending from 4-1 000 kWth and annual sales of about 26 million euros. According to the press release that announced the acquisition, it will help the Swedish group to bolster its presence in the European market and especially in Germany, whose market is expanding because of changes to legislation that aim to promote the more sustainable heating and air-conditioning systems and provide new expertise to manage larger-scale projects that call for high-capacity HPs. NIBE Industrier AB has also strengthened its foothold in the Dutch market by signing an agreement to take a 51% shareholding of the Dutch company Nathan Holding B.V. and the remaining shares in two stages. Nathan, founded in 1984, is a distributor for the Benelux countries specializing in sustainable heating and cooling solutions. The company's annual turnover is about 50 million euros with a net profit ratio of just over 6%. Nathan distributes the HPs of another Nibe AIT Deutschland subsidiary, which owns the German Alpha-Innotec heat pump brand. This transaction aims to allow Nibe to take full advantage of the Dutch market's very strong growth, and also the Belgian and Luxembourg markets. At the end of 2019, Nibe finalized its acquisition of the Serbian hot-water heater manufacturer Tiki Group (sales worth 35 million euros) that was part of the Gorenje group, to boost its presence in the Eastern European markets. In 2017, the group also finalized its integration of the Italian company Rhoss, one of the main Italian ventilation and air-conditioning equipment manufacturers for commercial and industrial applications, which became a wholly-owned subsidiary early in 2019.

RENOVATION, A GOLD MINE FOR THE HP MARKET

Air-to-air heat pumps are among the most popular technologies in the new-build market because they are ideally suited to well-insulated dwellings, particularly those whose only exchanges with the outside are those permitted by their ventilation system. Water-borne heat pumps are also ideal for recently-built, well-insulated houses that have underfloor heating systems or low-temperature water-filled radiators that require the water to be heated to 40-50°C, no higher. In buildings of this type, heating system operation is optimized at low temperature and thus very frugal with energy. Development of this market is also assisted by the transition from non-inverter to more efficient inverter heat pump technologies. The latter have the advantage of eliminating the energy losses arising from the stops and starts of non-inverter HPs while reducing compressor temperature rises. The HP market is also capitalizing on the photovoltaic self-consumption boom which implies lower HP energy operating costs for summer cooling and heating, especially at the end of the winter and in the autumn, when good sunshine conditions prevail. However, today's challenge for the HP manufacturers is to increase their renovation market segment shares (by replacing oil- and gas-fired boilers) that account for the majority of heating system sales. We are starting to see this trend, which is already very strong in Nordic countries, enter more temperate climate markets such as France. The move can be attributed to the launch of new products that meet the demands of renovation operations, helped by the offer of measures and financial incentives for making building insulation improvements.
Hence, some manufacturers have entered the fray by supplying high-temperature heat pump ranges expressly geared to renovation works that can supply the heating circuit with water at about 65°C. This is hot enough for "high-temperature" radiators, provided the building is not too old and that its insulation level is up to early millennial standards.
Houses built to older insulation standards, requiring higher temperature water heating are less suitable for HP technologies. If the HPs were to be over-dimensioned to meet the heating needs more easily during winter cold snaps, their performance and cost effectiveness over the full heating season would be lower. In that case, it might make more economic sense to install a supplementary heating appliance (wood or pellet burner, electric convectors, etc.), couple the HP to an existing boiler, or go for the installation of a hybrid HP comprising an air-to-water HP and a condensing gas boiler. The use of hybrid systems reduces the need for major renovation works prior to installing a heat pump. They enable older housing stock to make the transition to renewable energy technologies without having to replace the original installation's "high-temperature" radiators or carry out major and costly insulation work. The top-up energy avoids having to over-dimension the HP yet improves the system's energy efficiency when outdoor temperatures are very low. With this type of set-up, smart control can be configured to automatically select the optimum and most efficient operating mode, in response to the prevailing energy market and price fluctuation parameters. By way of example, boiler manufacturer Viessmann has developed an intelligent Hybrid Pro Control energy manager. Whereas a traditional system

Block diagram of a heating installation – a split air-to-water heat pump



is exclusively controlled on the basis of the desired ambient temperature, the manager controls the system on the basis of several parameters that can be defined and changed at any time such as CO_2 emissions, energy price, coupling to an on-site consumption photovoltaic installation, the priority given to producing domestic hot water. The hybrid system can run in a particularly environmentally-responsible or economic way. The latest EHPA report published the 2019 market data available for hybrid HPs for only two EU markets, namely France (4 300 units) and Italy (7 564 units).

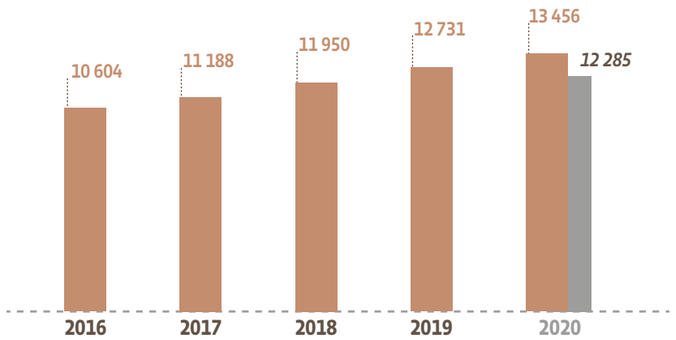
THE EUROPEAN RENOVATION WAVE STRATEGY

Our politicians clearly identify heat pump technology as being kernel to decarbonizing home heating and domestic hot water production. In actual fact, the HP sector already contributes the most to the increase in renewable energy production for heating and cooling across the European Union. According to Eurostat's SHARES tool, HPs accounted for just over half the increase in renewably-sourced heating and cooling in the EU of 27 between 2016 and 2018, or 1 357.4 ktoe of the 2 518.3-ktoe increase. SHARES puts the total contribution of HPs in the EU of 27 at 11 351.5 ktoe in 2018 (or 11.5% of all renewable heating and cooling). The initial EurObserv'ER assessment is that it should exceed the 12 Mtoe threshold for the EU of 27 in 2019 (12 106 ktoe),and in 2020 could contribute up to 12.8 Mtoe. If we include the UK, the total should be in the region of 13.5 Mtoe in 2020, which is 1.2 Mtoe more than the 28 member countries' combined national renewable energy action plan HP sector targets.

While in some countries it has become the heating technology of choice in new-build construction, the sector is now positioned on the renovation segment, thanks to the availability of new high-temperature HP models that are suitable for replacing gas- or oil-fired boilers using the existing central heating systems. Two main levers need to be set up to achieve greater rollout in the renovation segment and expand the market to those European Union countries where the technology is less well established. They are the ratification of more thoroughgoing national legislation on building energy renovation and sending a strong enough electricity-friendly price signal to the detriment of primary fossil energy sources. Therefore, carbon taxation provides leverage, both as an electricity decarbonization instrument and by reducing the competitiveness of fossil energies.

Graph n° 2

Current trend of renewable energy from heat pumps compared with the National renewable energy action plans NREAP in the EU 28 (in ktoe)



** Renewable energy production according to the criteria set by the Renewable Energy Directive*
Source: EurObserv'ER 2020.

The European legal framework has already been enshrined as a new European Directive on the Energy Performance of Buildings, published in the EU Official Journal on 19 June 2018. It directs the Member States to develop national long-term energy renovation strategies for their housing stocks and other buildings through to 2050. By 2050, CO_2 emissions from buildings must be 80-95% less compared to 1990 levels. A coordinated European Union-wide strategy must be adopted to achieve this long-term target.
The COVID-19 crisis has dealt Europe's economies a body blow and led member countries to express reservations about rolling out the Green Deal while tackling burgeoning economic and social emergencies. However, the European Commission stood its ground and reaffirmed the importance of the Green Deal on 27 May 2020 when it presented a proposal to relaunch the European economy. The plan's first component is to instigate a "renovation wave" strategy to increase the building renovation rate. Apart from its impact on GHG emissions, building renovation is seen as a strong recovery and job creation lever, that will benefit all European Union countries. The Commission published a new budget proposal in May 2020. The overall budget is worth € 1 850 Bn, split between a long-term EU budget spanning 2021-2027 to muster € 1 100 Bn of public and private capital for the Green Deal, primarily via the flagship investment plan InvestEU, the European cohesion policy fund and the Just Transition Mechanism Fund (JTM). The JTM will engage up to € 150 Bn to assist Europe's most carbon-dependent regions to achieve environmental transition. The long-term budget could be funded by new own resources raised by a carbon tax primarily on plastic products. The other proposal is the "Next Generation EU" recovery plan worth € 750 Bn financed by European Commission-issued debt.

The European Commission gave more details of its intentions in its 14 October 2020 "Renovation Wave Strategy" to improve the energy performance of buildings. The Commission intends to at least double renovation rates over the next decade and make sure that the renovations made lead to increased energy consumption efficiency and use of resources. It has set a target of 35 million buildings to be renovated by 2030, and up to 160 000 additional green jobs to be created in the construction sector. The "Renovation Wave Strategy" emphasizes three priority areas of action: decarbonizing heating and cooling systems; combating energy insecurity and addressing the problem of the worst performing buildings. It also intends to tackle the renovation of public buildings such as schools, hospitals, and administrative buildings. Furthermore, the programme plans to re-examine the Renewable Energy Directive in June 2021 to strengthen the renewably-sourced energy share target in the heating and cooling sector and introduce a minimum level of renewable energy use for buildings.
The EU must reduce the GHG emissions of buildings by 60%, their energy consumption by 14%, and the energy consumed by heating and cooling by 18% to achieve the CO_2 emission reduction target of at least 55% by the 2030 timeline proposed by the European Commission in September 2020.
European policy and funding have already had a positive effect on the energy efficiency of new buildings that only use half as much energy as buildings constructed over 20 years ago. However, 85% of the buildings in the EU were constructed more than 20 years ago, and 85-95% of them should still be in use in 2050. The renovation wave is crucial to bringing them into line with standards comparable to those of new buildings. This renovation wave is an absolute necessity if HPs are to extensively decarbonize the European Union countries' heating and cooling needs. □

Sources T1 and T2 : Ministry of Economic Development (Italy), Observ'ER (France), Ministry for the Ecological Transition and Demographic Challenge (Spain), SKVP (Sweden), Sulpu (Finland), AGEE Stat (Germany), Statistics Netherlands, DGEG (Portugal), Danish Energy Agency (Denmark), MRA (Malta), Ministry of industry and trade (Czech Republic), Statistics Lithuania, Statistics Austria, EHPA.

The next barometer will cover biogas.

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