The Monoblock CHA air-to-water heat pump manufactured by Wolf, uses the R290 fluid (propane) that doesn't alter the ozone layer and has a much lesser global warming potential than the gases that were formerly used.

+3.4%

the increase of the heat pump market (all technologies) between 2019 and 2020 in the EU

HEAT PUMPS BAROMETER

A study carried out by EurObserv'ER.

The public authorities view heat pump technology as one of the keys to achieving carbon neutrality by 2050. Europe' heat pump industry claims to be ready to rise to the challenge. The European Union-wide HP market data for 2020 confirms that this technology is consolidating its foothold in the heating segment. The reversible air-to-air HP segment is driven by cooling requirements in the southern countries and by heating requirements in the cold climate countries, making its market trends distinct. Lacklustre performances by Italy's and Spain's reversible air-to-air HP segments held back its growth across Europe in 2020.

13.2 Mtoe

the estimate renewable energy provided by heat pumps in the EU in 2020

41.9 million HPs

total number of heat pumps in operation in the EU in 2020

According to the European Commission, the built environment, in its many manifestations of housing, workplaces, schools, hospitals, libraries and other public buildings, is the EU's largest energy consumer and one of its main carbon dioxide emitters. Thus, there is considerable potential for decarbonation in this sector. The demand for space heating and cooling can be significantly reduced by improving heat insulation, installing efficient glazing solutions, and by installing efficient heating and cooling production systems that either emit no or only a little greenhouse gas.

INSULATION AND HEAT PUMPS… THE WINNING COMBINATION

The European Commission's strategy for integrating energy systems plans for 40% of all residential and 65% of all commercial buildings to be heated by electricity by 2030. Electrically-fuelled heat pumps should logically play a crucial role in decarbonating heating and cooling over the decade. As a result of more binding thermal regulations in new housing, HP systems are already the most popular form of heating in many European countries. This particularly applies to France and the northern European countries. Sweden has been the trailblazer in this trend. Its electricity mix is almost all low carbon (renewables and nuclear energy), while heating oil and gas in particular have been all but eliminated from the residential heating segment. The Commission's strategy also intends to make heat pumps the technology of choice in renovation. To achieve this, the number and quality of renovated buildings where heat pumps operate offering optimum thermal comfort with affordable energy bills will have to increase. As it stands, roughly 35% of the EU's buildings are over 50 years old and nearly 75% of all building stock is energy-inefficient. At the same time, only 0.4–1.2% of the building stock (with country variations) is renovated in any year.

The HP manufacturers' catalogues now include high-temperature heat pumps capable of raising the heating circuit feed water temperature to 65 °C (as opposed to 45 °C for so-called low-temperature HPs). These HPs are designed to work in conjunction with high-temperature radiators and are appropriate for installation when renovating dwellings with mediocre insulation, to replace a gas- or oil-fired boiler. Another alternative for the renovation market is to install a hybrid HP combining an air-to-water HP with a condensing boiler.

A range of technologies

The heat pump system differences need to be understood in order to grasp the significance of their market trends. There are three major families of HPs, distinguished by the particular thermal energy source that they harness. Air source HPs (ASHP) "capture" thermal energy in the ambient air. The second group, geothermal HPs (GSHP) group together the systems that "capture" the ground's thermal energy, and hydrothermal HPs harness the calories in the water (groundwater, lakes, etc.). EurObserv'ER processes the hydrothermal family of HPs' indicators together with those of the GSHP family in the interests of simplicity, and technological resemblance.

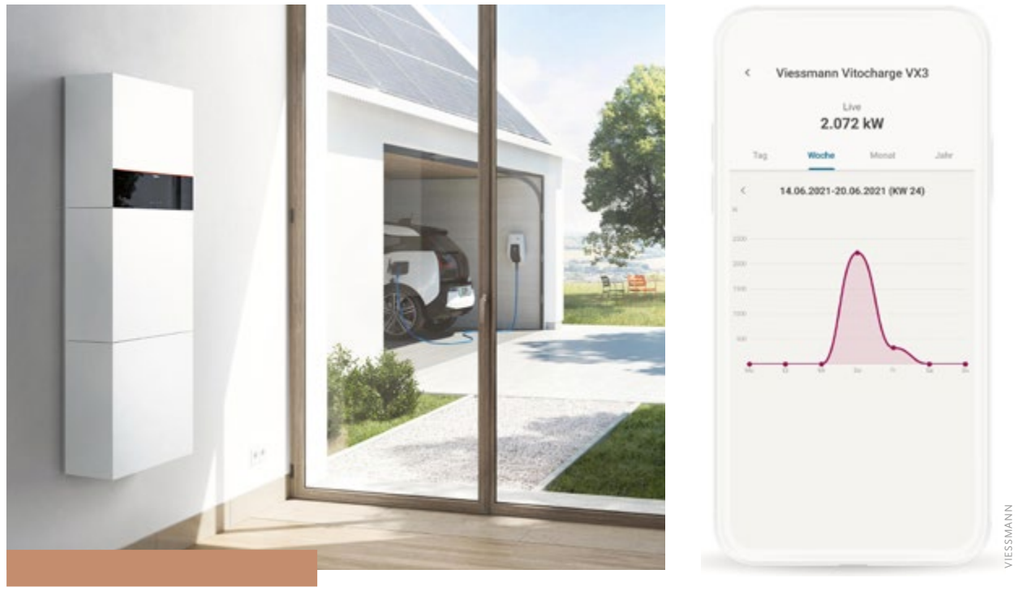
The heat produced by geothermal HPs is distributed either by underfloor heating circuits, or low-temperature radiators (provided that the building's insulation is good enough), or high-temperature radiators (when the insulation level is not so good). They are typically water-borne HPs. Air-source HP (ASHP) heat distribution methods are more diverse. Some ASHPs use water to convey the heat, like GSHPs, and are thus known as air-to -water HPs. Others use fans that blow warm air, described as air-to-air HPs and with a few exceptions, work in reversible mode. The main use of these HPs in hot climate countries and regions tends to be cooling and for this reason not all European Union markets are directly comparable. Furthermore, the HP usage, technology types and power ranges used differ across the climate zones. This phenomenon raises statistical comparison issues between the various European Union markets, not to mention the fact that in the Northern European countries, Sweden, Denmark and Finland, reversible air-to-air HPs are widely used for heating purposes.

A final ASHP category uses the exhaust air of buildings as the heat source, described as exhaust air HPs (EAHP). The main method of heat distribution is via the air but there are also water-borne EAHPs. These installations can be used as top-up heating depending on the building's needs and its insulation rating.

The special case of reversible air-to-air HPs

EHPA (the European Heat Pump Association), publishes an annual statistical and European heat pump market report, the "European Heat Pump Market and Statistics Report". The organization has exercised its discretion by including just part of the reversible air-to-air HP market statistics, on the basis of their installation climate zones, as their aim is to monitor the market for HPs primarily used for heating purposes and distinguish them from the HPs devoted to air-conditioning. In greater detail, the association reckons that in cold climate countries (Estonia, Denmark, Finland, Lithuania, Sweden, etc.), reversible air-to-air HPs are essentially used for heating. The HP associations of these countries that provide data to EHPA apply a 10% correction factor on their market data to exclude HPs used solely for air-conditioning. In temperate climate zones, EHPA does not include air-to-air HPs in its data, arguing that there is a dearth of information available on the actual use of these HPs for either heating or air-conditioning. It only includes a small fraction of air-to-air HP sales of the warm climate zone countries (southern France, Italy, Portugal and Spain) accepting an Italian study's findings that reversible air-to-air HPs were the only heat generators installed in just 9.5% of dwellings.

The EurObserv'ER approach differs in that it is based in the first place on the questionnaires returned by the ministry statistical offices that calculate how much of the HP base



For example, Viessmann has a solar HP system equipped with a Vitocharge VX3 electricity storage system that can be accessed as required. The Vicare application developed by Viessmann and accessible via its smartphone manages all the energy management processes.

should be factored in, namely the systems whose seasonal performance factor (SPF) is high enough to be included in the European Renewable Energy Directive's target calculations. Countries such as France, the Netherlands, Italy, Spain and Portugal include a sizeable proportion of reversible air-to-air HPs in their statistics providing that they meet the performance criteria set by the European Directive, excluding HPs that do not meet these criteria from their figures. Note that Germany and Austria prefer not to include reversible air-to-air HPs in their official statistics.

Reversible air-to-air HPs account for a significant share of European Union HP system sales, not only in southern, but also in northern Europe. Their unit power ratings are generally much lower than those of water-borne HPs. It should not be forgotten that the diverse types of HPs produce different amounts of renewable energy. This output depends on the supplementary energy source used to run the compressor (electricity or natural gas), the thermal energy source tapped (ground, water or air), the application (heat or cooling), the usage period and their installation climate zone.

Specific comments were made on the effective contribution made by reversible heat pumps to renewable energy production in the European Commission Decision of 1 March 2013 that laid down the guidelines for calculating the renewable energy share produced by heat pumps. Firstly, reversible heat pumps are often installed in warmer climate conditions and, what tend to be temperate conditions for cooling the interior environment, even if they are also used for winter heating. Given that the summer demand for cooling is higher than the winter heating demand, cooling rather than heating needs tend to dictate the nominal rating. As the installed power is used as an indicator of heat demand, the installed power statistics will not reflect the amount installed for heating purposes. Secondly, as reversible heat pumps are often installed in parallel with existing heating systems, it can be deduced that these heat pumps are not always used for heating. Hence, the number of equivalent operating hours at full load that can be used to calculate the amount of renewable energy produced by reversible air-to-air HPs is much lower in warm and temperate climate countries than non-reversible HPs. The resulting renewable energy output is less for equivalent power. The Commission proposed default values for the number of Equivalent Full Load Hours (EFLH) conditioned by climate conditions to help calculate the renewable energy produced by HPs. However, the real reduction is highly dependent on national heating need supply practices, and national figures should be used whenever possible, provided that the Commission is kept informed with a supporting report describing the calculation method.

By default, the EFLH for reversible electrically-driven air-to-air HPs is 480 hours in warmer climate conditions, 710 hours in temperate climate conditions and 1970 hours in the coldest climate conditions. Different climate zones can exist within a single country's borders. As for EAHPs, an adjustment is made to restrict inclusion to ambient

energy, which is the only energy that can be qualified as renewable under the Directive's terms, not the exhaust air energy (which is not renewable). The EFLH allowance for EAHPs is 760 hours for the warmest climate conditions, 660 hours for temperate climate conditions and 600 hours for the coldest climate conditions (the mean temperature observed drops in line with the climate zone). The calculation details of each Member State that determine the amount of renewable energy produced by the HP base are available in the detailed version of EUROSTAT's SHARES, a statistical tool used to harmonize renewably-sourced energy output calculations across the EU.

THE WATER-BORNE HP MARKET IS BOOMING

The heat pump market for heat or cooling production expanded in 2020. According to EurObserv'ER, over 4.3 million HPs were sold over the year in the EU of 27, all power ranges and technologies taken together, posting a 3.4% year-on-year rise (4.2 million units sold in 2019, revised figure). These statistics cover the residential and tertiary markets in particular (with power ranges starting at a few kW to several tens of kW). The medium- and high-capacity HP market is much smaller.

AIR-SOURCE HPS DOMINATE THE MARKET

The majority of HP sales in the European market are for air-to-air ASHPs. According to EurObserv'ER, almost 3.6 million units were sold in 2020, which is a similar volume to 2019 (sales increased by 1.3% between 2019 and 2020). However, this trend is chiefly representative of countries with significant summer cooling needs. Italy, Spain, Portugal and France together account for 80.8% of Europe's newly-installed air-to-air systems.
The water-borne ASHP market specifically caters for heating needs. Despite a year marked by the COVID-19 pandemic, sales in this market segment Bounced back to rise by 15.2%. A total of 578 876 units were sold (counted in 21 countries), i.e., 76 288 more unit sold than in 2019. This market segment's growth was exceptionally high in Poland where sales doubled (108%) between 2019 and 2020. Growth was also strong in Denmark (50.6%), Germany (44.0%), Belgium (35.6%) and Sweden (34.0%).
At least 10 countries recorded double-digit growth rates in this market segment.
The geothermal HP market (also water-borne) specifically caters for heating needs and also grew across the European Union. Market growth was 9.1% over its 2019 level, with 100 838 units sold. However, local market trends are highly variable. Most of the positive growth can be ascribed to the exponential rise of the Dutch market (which gained 64.6% over its 2019 level). Its installation approach is now similar to those of the German and Swedish markets. Double-digit growth between 2019 and 2020 was also registered in the main GSHP markets – Belgium (23.0%), and Germany (16.8%). The latter offers generous subsidies for powerful renewable energy heating appliances. In contrast, the GSHP market contracted in Sweden (by 6.3% compared to 2019) and Finland (by 3.8% compared to 2019) in the face of competition from air-to-water HPs.

Tabl. n° 1

Market of aerothermal heat pumps in 2019 and 2020 in the European Union (number of units sold)*

	2019				2020*			
	Aero-thermal HP	of which air-air HP	of which air-water HP	of which exhaust air HP	**Aero-thermal HP**	of which air-air HP	of which air-water HP	of which exhaust air HP
Italy	**1 614 016**	1 563 659	50 356	0	**1 574 000**	1 526 000	48 000	0
France	**904 653**	728 433	176 220	0	**987 626**	812 404	175 222	0
Spain	**446 926**	395 173	51 753	0	**400 373**	351 275	49 098	0
Netherlands	**154 255**	120 761	33 494	0	**230 309**	187 870	42 439	0
Portugal	**234 557**	234 065	492	0	**222 837**	222 389	448	0
Germany	**83 270**	0	66 770	16 500	**121 770**	0	96 170	25 600
Sweden	**97 380**	70 000	10 994	16 386	**103 667**	70 000	14 727	18 940
Belgium	**103 058**	94 380	8 678	0	**98 487**	86 723	11 764	0
Finland	**89 217**	79 033	6 345	3 839	**93 649**	82 188	7 892	3 569
Malta	**71 933**	71 933	0	0	**70 236**	70 236	0	0
Denmark	**57 998**	48 853	8 945	200	**62 571**	48 893	13 474	204
Poland	**31 314**	11 018	20 286	10	**54 125**	11 924	42 201	0
Slovakia	**48 593**	45 640	2 916	37	**42 274**	38 626	3 648	0
Greece	**29 878**	27 586	2 292	0	**40 224**	37 138	3 086	0
Czechia	**29 130**	7 500	21 563	67	**30 182**	7 500	22 615	67
Slovenia	**29 929**	23 429	6 500	0	**25 446**	18 946	6 500	0
Austria	**18 192**	228	17 964	0	**20 434**	237	20 197	0
Lithuania	**21 626**	13 091	8 535	0	**19 940**	12 450	7 490	0
Estonia	**15 010**	13 700	1 280	30	**14 980**	13 700	1 280	0
Ireland	**14 397**	6 892	7 045	460	**14 397**	6 892	7 045	460
Hungary	**2 850**	2 850	0	0	**5 820**	400	5 420	0
Luxembourg	**160**	0	160	0	**160**	0	160	0
Total EU	**4 098 342**	3 558 224	502 588	37 529	**4 233 507**	3 605 791	578 876	48 840

** Estimation. Note: Data from the Italian, French, Spanish, Portuguese and Maltese aerothermal heat pump markets are not directly comparable to others, because they include a 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 2018/2001/EC are taken into account. Market data from Romania, Bulgaria, Latvia, Cyprus and Croatia were not available at the time of data collection.* ***Source: EurObserv'ER 2021.***

A EUROPEAN HP BASE OF NEARLY 42 MILLION

Estimating the number of HPs in service is a tricky task as the exercise depends on the decommissioning assumptions factored in by each country and the availability of statistics supplied by the Member States or HP industry associations. EurObserv'ER puts the combined total of installed HPs in the European Union at about 41.9 million units (40.1 million ASHPs and 1.8 million GSHPs). This figure is not restricted to HPs used for heating, but also includes cooling and heating applications, in that the system performance coefficients meet the criteria set out in the Renewable Energy Directive. HPs that do not meet the criteria are excluded. Incidentally, EHPA, in its 2021 "European Heat Pump Market and Statistics" report, puts the total European HP base in service primarily for heating purposes at about 14.86 million in 2020 (aggregate sales from 1997 to 2020). This estimate implies that about two-thirds of the HP base primarily meets cooling needs.

NEWS FROM THE MAIN PLAYERS

The Dutch market's upswing continues

The pace of market growth did not slow down in 2020. According to Statistics Netherlands, the number of air-to-air HPs sold in 2020 increased by 55.6% year-on-year to reach 187 870 units in 2020 compared to 120 761 in 2019. This market segment had already grown by 56.7% between 2018 and 2019.
Air-to-water HP sales increased by 26.7% between 2019 and 2020, with 42 439 units sold in 2020 compared to 33 494 units in 2019 (14.2% more than between 2018 and 2019). The total number of ASHPs (air-to-air and air-to-water) sold in the Netherlands thus rose from 106 267 in 2018, to 154 255 in 2019 and to 230 309 in 2020.
The GSHP market is surging as well (by 64.6% between 2019 and 2020). In 2020, 19 349 units were sold, up from 11 755 in 2019 and 6 504 in 2018. The hydrothermal HP market has also gained ground in the Netherlands, as 2 160 units were sold in 2020 (992 in 2019).
Statistics Netherlands goes on to say that the country now has about 1 million HPs in service with combined

Tabl. n° 2

Market of geothermal (ground source) heat pumps in 2019 et 2020** in the European Union (number of units sold)*

	2 019	2 020
Sweden	**25 343**	**23 757**
Germany	**19 000**	**22 200**
Netherlands	**11 755**	**19 349**
Finland	**8 988**	**8 644**
Poland	**6 710**	**5 622**
Austria	**4 690**	**4 581**
Belgium	**2 595**	**3 193**
France	**3 475**	**3 005**
Denmark	**2 251**	**2 308**
Estonia	**1 750**	**1 750**
Czechia	**1 417**	**1 440**
Italy	**753**	**1 242**
Greece	**1 008**	**1 000**
Slovenia	**930**	**924**
Lithuania	**702**	**580**
Hungary	**335**	**347**
Ireland	**316**	**316**
Spain	**199**	**236**
Slovakia	**149**	**216**
Luxembourg	**64**	**64**
Portugal	**28**	**64**
Total EU	**92 458**	**100 838**

** Hydrothermal heat pumps included. ** Estimation. Market data for Romania, Bulgaria, Latvia, Cyprus and Croatia was not available during our study.* ***Source: EurObserv'ER 2021.***

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capacity of 7 861 MWth (977 856 units at the end of 2020) including 889 944 ASHPs with 6 135 MWth of capacity corresponding to 312.8 ktoe of renewable energy (191.1 ktoe produced by ASHPs).
This momentum is aided by the ISDE subsidy system (Sustainable energy investment subsidy scheme) that is geared to householders, small businesses, housing associations, firms, local and other public authorities. The ISDE is a one-off subsidy payment whose amount depends on the brand, type and thermal capacity of the appliance (from 500 to several thousand euros). The 2021 ISDE resource envelope for firms and householders, is 164 million euros. We should point out that the ISDE investment subsidy scheme and the SDE++ scheme, which is an operating grant, are not related. Under the terms of SDE ++, producers receive a grant per tonne of CO_2 reduction, not for purchasing a production installation. SDE++ is often allotted to large-scale investments in solar energy, biomass, geothermal energy and industrial size HPs or HPs that supply heating networks.

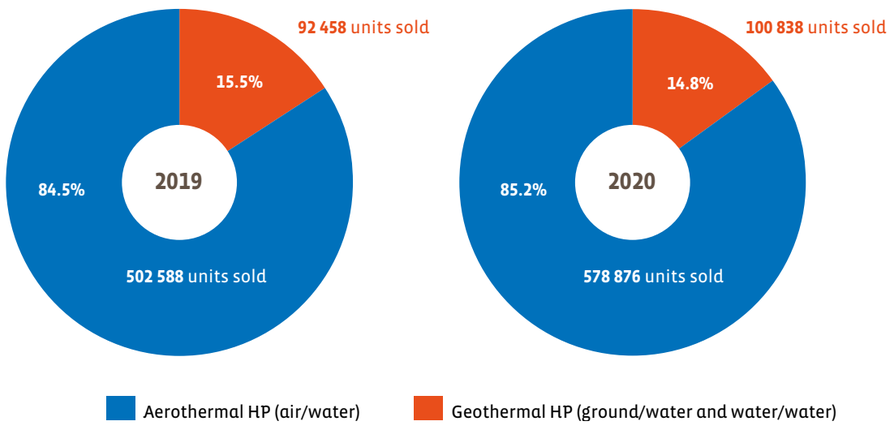
Another niche market segment could also grow over the next few years – that of hybrid HPs. Netbeheer Nederland, the Dutch association of electricity and gas grid operators, has put forward a plan to roll out up to 2 million hybrid heat pumps by 2030. The plan should be supported by a government subsidy scheme and result in the annual installation of at least 100 000 heat pumps starting in 2024. The association claims that the plan's aim is to reduce CO_2 emissions by up to 2.6 mega tonnes. The organization reports that 400 000 gas boilers are replaced every year and if they are replaced by hybrid HPs, gas consumption could be slashed by up to 70%. Hybrid HPs may be an interim solution, drastically cutting CO_2 emissions in old, poorly insulated housing stock and wherever full energy renovation (reinforced insulation +HP) cannot be envisaged in the short term.

Sweden's market is mature

The SKVP (Swedish Refrigeration & Heat Pump Association) reports that the Swedish market recovered in 2020 driven by the ASHP segment (air-to-water and exhaust air). The water-borne (air-to-water) ASHP market segment expanded by 34% between 2019 and 2020 and secured sales of 14 727 units and the EAHP segment by 15.6% with 18 940 units sold. The geothermal HP market bucked this trend, sliding by 6.3%, from 25 342 units sold in 2019 to 23 757 in 2020. The SKVP's provisional data for the first three quarters of 2021 show a rise in sales right across the board. Like-for-like sales for air-to-water HP were up by 27%, by 13% for EAHPs and by 15% for GSHPs for the same period in 2020. The GSHP segment's clear recovery comes after its poor showing in 2020.
Sales turnover for first three quarters 2021 was 7.3 billion SEK, which is 16% higher than the same period in 2020. According to Anders Mårtensson, SKVP's CEO, 2021 has the potential to record heat pump's best performances in many years, boosted by a highly active property market. As proof of the technology's maturity, the HP replacement market – replacing HPs by new HPs – rose to 30.2% in 2020. It is now just as common for an HP to replace an old one, as for it to replace electric convectors or an electric boiler.

Graph n° 1

*Geothermal and air source 2019 and 2020 market shares of the water-borne heat pump segment in the EU**



*1.hydrothermal HP included. 2. A 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). * Estimation. Market data for Romania, Bulgaria, Latvia, Cyprus and Croatia was not available during our study* ***Source: EurObserv'ER 2021.***

Another stellar year for HPs in Finland

Notwithstanding the previous year's high sales figures and the coronavirus pandemic, heat pumps sales continued to increase in Finland. According to Sulpu (the Finnish Heat Pump Association), 102 293 HPs were sold in 2020 compared to 98 205 in 2019 (a 4.2% rise). The air-to-air HP market segment expanded by 4% (with 82 188 units sold) over the previous year while the air-to-water HP segment (with 7 892 units sold) expanded by 24.4%. The latter double-digit increase can be ascribed to State aid awarded for replacing oil-fired heating systems.
This contrasts with EAHP and GSHP sales which contracted (3 569 units and 8 644 units sold), by 7% and 3.8% on their 2019 levels, respectively. Yet, Sulpu indicates that as the average capacity of GSHPs sold in 2020 increased significantly, this market segment's sales value actually increased.
Sulpu's Executive Director Jussi Hirvonen, talks of another emerging trend – that installing HPs in apartment buildings. He reckons that about 500 multi-occupied dwellings have already had heat pumps installed to recover heat from exhaust air, which reduces their needs for heat from district heating networks. Other solutions that combine geothermal HPs and EAHPs enable buildings to dispense with district heating altogether. Jussi Hirvonen feels that the development potential is still high, as 120 000–150 000 houses are currently heated by oil-fired boilers and 30 000 apartment blocks expel exhaust air at 23°C to the outside that could be recovered all year round.

Tabl. n° 3

*Total number of heat pumps in operation in 2019 and 2020 in the European Union **

	2019			2020		
	Aerothermal heat pumps	Geothermal heat pumps	Total heat pumps	Aerothermal heat pumps	Geothermal heat pumps	Total heat pumps
Italy	18 222 141	14 903	18 237 044	17 949 738	16 145	17 965 883
France	7 457 091	205 195	7 662 286	8 444 717	208 200	8 652 917
Spain	4 157 961	3 256	4 161 217	4 558 334	3 492	4 561 826
Sweden	1 349 857	551 776	1 901 633	1 441 828	561 033	2 002 861
Portugal	1 870 935	909	1 871 844	1 937 887	909	1 938 796
Germany	762 336	392 784	1 155 120	878 829	411 198	1 290 027
Finland	836 620	127 964	964 584	930 269	136 608	1 066 877
Netherlands	661 480	70 708	732 188	889 944	87 912	977 856
Denmark	380 995	68 997	449 992	445 455	72 453	517 908
Malta	425 237	0	425 237	485 289	0	485 289
Belgium	321 593	15 804	337 397	420 080	18 997	439 077
Greece	314 434	6 536	320 970	354 658	7 536	362 194
Slovenia	237 826	12 730	250 556	251 044	13 654	264 698
Austria	126 246	109 669	235 915	146 394	112 379	258 773
Poland	112 950	60 196	173 146	167 075	65 818	232 893
Bulgaria	214 971	4 272	219 243	214 971	4 272	219 243
Czechia	150 440	26 316	176 756	180 622	27 756	208 378
Estonia	161 747	17 625	179 372	176 727	19 375	196 102
Slovakia	94 586	3 964	98 550	136 860	4 180	141 040
Lithuania	43 551	4 160	47 711	63 491	4 749	68 240
Ireland	36 436	4 722	41 158	50 833	5 038	55 871
Hungary	12 800	2 745	15 545	18 620	3 092	21 712
Luxembourg	1 759	806	2 565	1 919	870	2 789
Total EU	37 953 992	1 706 037	39 660 029	40 145 584	1 785 666	41 931 250

** Estimation. Note: Data from the aerothermal heat pumps in operation for Italy, France, Spain, Portugal and Malta are not directly comparable to others, because they include a 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 2018/2001/EC are taken into account. Data for Romania, Latvia, Cyprus and Croatia was not available during our study.*
Source: EurObserv'ER 2021.

Coming up to 1 million HPs sold in France

According to the SDES, in its Key figures for Renewable Energy – 2021 edition, based on the PAC & Clim'Info data published at the very start of the year, combined sales of HPs of all technologies approached the one million mark in 2020 (990 092 units compared to 907 235 in 2019), which is a 9.1% year-on-year increase. In detail, 812 404 air-to-air HPs were sold (11.5% more than in 2019), 175 222 air-to-water HPs (0.6% fewer than in 2019) and 2 466 GSHPs (4.5% fewer than in 2019).

Observ'ER, the Observatory of Renewable Energies, monitors the individual householders' market segment only. While the trends found are similar to those of PAC & Clim'Info on the ASHP segment, the Observ'ER study points to a slightly higher figure for GSHP sales (3 005 units in 2020), but a sharper year-on-year fall (13.5%). The Observ'ER assessment is that this segment's general context has not changed. Most householders are dissuaded from considering GSHPs seriously as they are relatively expensive to purchase compared to the alternatives (primarily ASHPs). Furthermore, the general public is largely unaware of this technology. The Coup de pouce Chauffage scheme set up in 2019 that offered 2 500–4 000 euros of aid to low-income families for water-water HPs, did not improve the sector's activity level. The 2020 financial and health crises compounded matters and could have slowed down sales even more than was the case. The ASHP market segment resisted better as it was one of the only renewable technologies for householders to expand in 2020. These results are all the more surprising because they were achieved against the backdrop of a severe health crisis when new build in the residential sector suffered a 7% setback. The air-to-air heat pump segment's vigorous growth continues and increased by more than 12%. The effect of the new build market decline in 2020 was partly offset by the renovation sector. Lockdown enabled householders to refocus on their living conditions and change their old electric heating systems or replace old heat pumps. In addition, the summer of 2020 was yet again extremely hot… which also encouraged sales of these HPs for air-conditioning.

In the air-to-water heat pump segment, sales took time out in 2020 after the previous year's dramatic growth (80%). The sector consolidated its sales following the 2019 trend that was mainly driven by the replacement of old gas- and oil-fired boilers. The upcoming energy regulations (RE2020), due to come into force from Summer 2021, will favour renewable energy-based production systems to the detriment of gas solutions for new housing over the next few years. Hence, the market share of ASHPs, that already dominate the individual home market, is set to rise.

The SDES puts renewable heat production by heat pumps (equal to the heat output minus the electricity consumption used to produce the heat), at 37.5 TWh corrected by climate variations (equating to 3.2 Mtoe) and 32.6 TWh in actual output (equating to 2.8 Mtoe).

The German market flourishes as never before

Germany's heat pump market enjoyed an unprecedented level of expansion– 40.8% – between 2019 and 2020. It should be remembered that Germany only includes water-borne HPs and EAHPs in its renewable energy accounting, leaving air-to-air reversible HPs unmonitored.

According to AGEE-stat, the number of air-to-water HPs rose to 96 170 in 2020 (66 770 in 2019), equating to 44% growth, while the EAHP sales figure was 25 600 units (16 500 in 2019), equating to 55.2% growth. It thus put the total number of ASHPs sold in 2020 at 121 770 up from 83 270 in 2019 (a 46.2% rise), excluding a small number of gas heat pumps. Double-digit growth in GSHP sales was recorded (16.8% year-on-year growth), namely 22 200 units sold in 2020 up from 19 000 in 2019.

The BWP, the German Heat Pump Association, ascribes this success to the good reception given to the State's financing measures for environmentally-friendly heating systems.

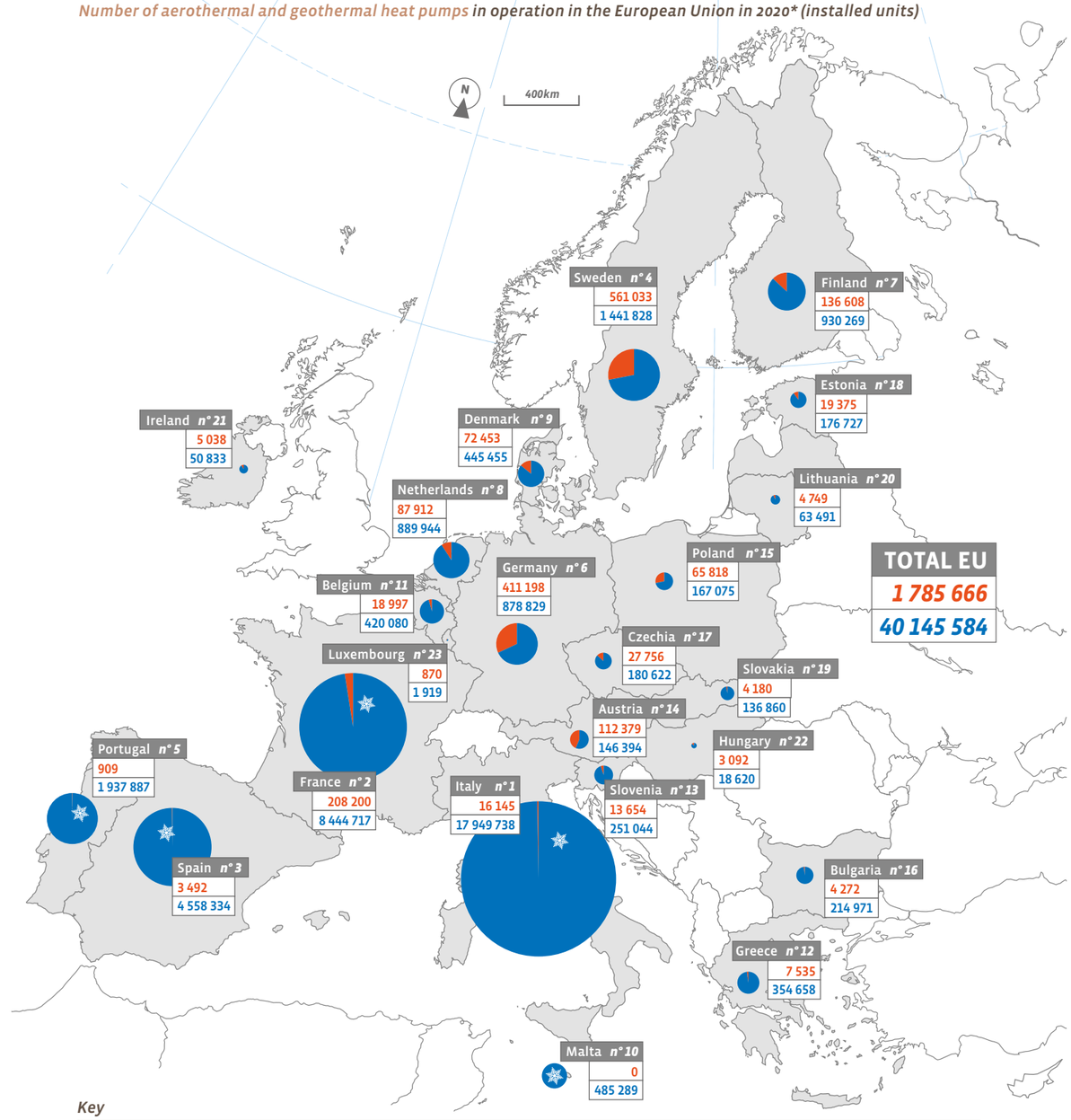
Germany's MAP is a funding programme operated by the Federal Ministry for Economic Affairs and Energy to encourage use of renewable energies in heat production by private consumers, professionals, businesses, local authorities and other eligible parties such as not-for-profit organizations. Beneficiaries receive a State grant if they install an efficient environmentally-friendly heating system. Under this framework, the installation of heating systems that run entirely on renewable energies, such as heat pumps and biomass systems, is supported by an investment grant of up to 35%. If an old oil-fired heating system is replaced, the funding rate can be as much as 45%.

The BWP believes that almost a quarter of the heat pumps installed in 2020 replaced old oil-fired heating systems, amounting to some 30 000 systems. According to Paul Waning, BWP chair, heat pumps are a key technology in the heating sector, with unbeatable efficacy in reaching climate protection goals. Yet, he feels that the price of renewable electricity is still far too high for consumers. "The new Federal Government should pursue radical restructuring of the taxes and levies on energy sources. An alternative funding model is urgently needed for the EEG surcharge, which is currently borne by the ultimate client alone. Electricity, in particular, that is used to produce climate-friendly heat through heat pumps, should be exempt from taxes and supplements for consumers in a timely manner," Waning stated. He also reckons that the price of CO_2, which came into force in 2021, goes nowhere near far enough for fair tax distribution on energy sources. The BWP points out that there is still a long way to go for the decarbonation of heating systems, because while the country has just over 1 million HPs in service (1.3 million according to AGEE-stat), this figure pales in comparison with the total of 21 million heating systems operating on German soil.

EUROPE SPEARHEADING THE HEAT PUMP INDUSTRY

EHPA is lucky in being able to remind the European heat pump and component manufacturers that they are the world leaders in this technology. Primarily because the manufacturers now offer integrated solutions equipped with

Number of aerothermal and geothermal heat pumps ***in operation in the European Union in 2020* (installed units)***



Key

Geothermal heat pumps — 14 100 *Total number of geothermal heat pumps in operation in the country*

Aerothermal heat pumps — 19 600 000 *Total number of aerothermal heat pumps in operation in the country*

Data from the aerothermal heat pumps in operation for Italy, France, Spain, Portugal and Malta are not directly comparable to others, because they include a high part of reversible heat pumps whose principal function is cooling.

** Estimate. Note: Only heat pumps that meet the efficiency criteria (seasonal performance factor) defined by Directive 2018/2001/EC are taken into account. Data for Romania, Latvia, Cyprus and Croatia was not available during our study.* ***Source: EurObserv'ER 2021.***

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interfaces and can thus offer growing efficiency for practically all areas of application.
Basing its calculations on the average sales price of HP systems for heating applications (leaving aside HPs used for air-conditioning), EHPA puts the total 2020 market volume value at about 10.98 billion euros, including VAT. Air-to-water heat pumps for heating only account for 36% of this sales figure, reversible air-to-air HPs with heating function account for 27% and ground-to-water heating-only systems account for 16% of the total figure. The remainder comprises reversible air-to-water HPs (15%), heat pumps for domestic hot water production (5%) and EAHPs (1%).
The heat pump sector's labour force is well trained in R&D, component (e.g.: compressors) and heat pump manufacturing, installation (including drilling) and service and maintenance. Based on the number of hours' work required to install the diverse types of heat pumps and experts' estimates of sales per employee, the total number of employees in the European heat pump industry is put at 89 784, about 37% of whom are employed in heat pump manufacturing, 29.5% in installation work, 18.5% in component manufacturing and 15% in maintenance services.
Europe is a heat pump manufacturing stronghold. The industry is diversified with many players of all sizes, even though a few bigger firms and groups have developed, through internal growth and acquisition strategies **(see table 4)**. Naturally, we find the major market leaders specializing in domestic heating products, such as Sweden's Nibe Energy Systems of the Nibe Industrier Group with a strong foothold in the Nordic countries, Poland and the Czech Republic. There are also electric heating, hot water production and ventilation renewable energy solution specialists, such as Germany's Stiebel Eltron and the French group, Atlantic. Then there are the major mainstream heating manufacturers who diversified into the HP segment years ago, such as the Viessmann, BDR Thermea, Vaillant and Bosch Thermotechnology groups that each has a portfolio of brands. Lastly, there are the European subsidiaries of the major Asian global groups specializing in air-conditioning and heating such as Daikin Europe N.V., LG, Mitsubishi and others that have set up bases in Europe and some of which have developed production lines in the European continent.

Tabl. n° 4

Representative Heat Pump Companies in the European Union.*

Group	Affiliated companies and brands	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
	Daikin Manufacturing Germany GmbH (former 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 2021.***

Several industry players have announced that they will be investing in new production lines to meet the strong European demand for HPs. A point in case is Saunier Duval, a French subsidiary of the German Vaillant group since 2001, that revealed it was investing 10 million euros in a new heat pump manufacturing plant on its Nantes site (to increase its production capacity by 40%). Annual sales growth in the heat pump segment in excess of 30% for the last four years supports this decision. Its primarily export-driven prospects are just as promising, (60% of the heat pumps from Nantes are delivered to Germany). The firm intends to raise current output by about 35 000 HPs from 2020 to 130 000 units by 2023. Furthermore, the German Vaillant group announced that its HP sales had risen by 50% in 2020 and that it had doubled its production capacities in 18 months in its German stronghold of Remscheid and its Nantes factory.
Another piece of news is that in March 2021, the Daikin Group announced its decision to invest in a new production line in its German water-borne heat pump factory, Daikin Manufacturing Germany GmbH (DMGG), to meet growing European demand. The new production line is designed to produce 20 000 units by the end of 2021 and should expand further in coming years. The DMGG factory has also increased its workforce by 37% since October 2020 to achieve its aims. At the start of 2020, the group decided to integrate the Daikin Airconditioning Germany GmbH and Rotex Heating Systems GmbH sales, market and services activities and use the Daikin brand on all products manufactured by Rotex, a German heating manufacturer that it has acquired.

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MODERN, CONNECTED AND CLIMATE-FRIENDLY TECHNOLOGIES

HP and PV, a winning match

Heat pump manufacturers have developed their product ranges by devising connected solutions that enable users to heat their homes intelligently. The electricity price hike has also increased the popularity of packages that couple a photovoltaic system with a heat pump. They aim to take advantage of own solar energy production to cover a household's heating, hot water and cooling needs, while reducing carbon emissions and energy bills all year round. The principle of this combination is simple. When solar electricity is not used by the heat pump it can either be stored as heat in a hot-water tank, or in a battery for use as required.
These solutions are not new. Back in 2014, Bosch presented its e-control system at the Intersolar Europe Fair. The system optimizes coupling a heat pump, a solar system and battery storage together, and controlling them by smartphone. Nowadays most major brands are positioned on this market segment and offer full solar-heat pump systems.
For example, Viessmann has a solar HP system equipped with a Vitocharge VX3 electricity storage system that can be accessed as required. The Vicare application developed by Viessmann and accessible via its smartphone

manages all the energy management processes. Viessmann goes even further, having set up " ViShare" energy communities of environmentally-conscious consumers who can produce and use their own electricity and share it with others cheaply. The contracting party of ViShare Energy Community is Energy Market Solutions GmbH (EMS). NIBE offers a range of solar energy heat pumps equipped with a NIBE PV pack comprising 10 no. 3.6-kW PERC monocrystalline modules, an installation system, an inverter and a communication system linked to the heat pump. Individual room temperatures, moisture content and CO2 level can be regulated for optimum comfort by adding small, smart "myUplink" accessories.

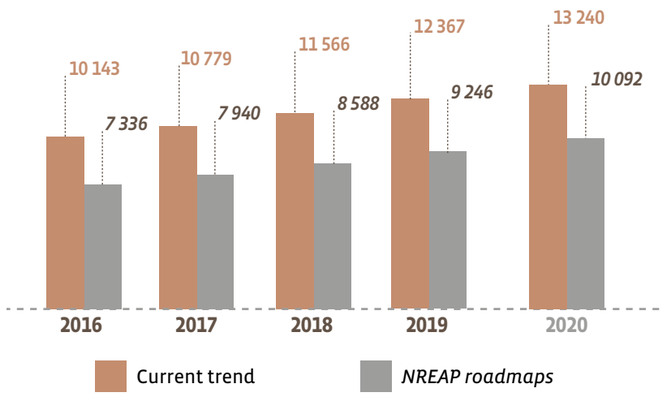
The multinational South Korean group LG recently launched its "Home Energy Package" early in 2021 in the first instance on the German market. It is a hybrid system that combines a heat pump, a photovoltaic system and battery storage, with an integrated control system to optimize self-consumption. The company states that the system can easily be integrated into other LG products, primarily EV charging stations.

New generation of refrigerants

We can report on another important aspect of the progress made by industry on the use of more environmentally-friendly refrigerants, prompted by the European F-Gas Regulation. After banning HCFCs (hydrochlorofluorocarbons) on 1 January 2015, the F-Gas regulation aims to gradually ban another family of fluorinated gases, HFCs (Hydrofluorocarbons), including R410A which is still commonly used in air-conditioning and heating installations. The regulatory framework encourages manufacturers to focus on using low global warming potential (GWP) solutions such as R290 (propane) or lower GWP such as R32 (difluoromethane), that has zero impact on the ozone layer and whose GWP is three times lower than that of R410A (675 compared to 2088) and instructs manufacturers to overcome the challenges posed by high working pressures, the toxicity and/or flammability of these refrigerants. The industry's research and development efforts into these fluids have been successful and many of the new models already use the R32 gas as the working fluid for reversible HPs. Some water-borne HPs now use the R290 gas which can achieve working temperatures of 70 °C, the temperature level required for HPs geared to the renovation market.

Graph n° 2

Curent trend of renewable energy from heat pumps ***compared with the National renewable energy action plans NREAP in the EU 27 (in ktoe)***



** Renewable energy production according to the criteria set by the Renewable Energy Directive*
Source: EurObserv'ER 2021.

THE TIME HAS COME TO DECIDE

Heat pumps are not only identified as a key technology for decarbonating the building sector, but their technologies contribute a great deal to increasing renewable energy production. According to the Eurostat SHARES tool, the total contribution made by heat pumps in the EU of 27 is 12 387 ktoe in 2019 (i.e., 12.2% of the renewable heat and cooling total). EurObserv'ER feels as a first approximation, that it should transcend the 13.2 Mtoe threshold for the EU of 27 in 2020. As for the current decade, everything is in place to accelerate the contribution made by HPs to achieve our climate goals. A much more aggressive building energy renovation policy is required to fuel this acceleration.

The European Commission's "Fit for 55" package, published on 14 July 2021, is clearly a step in this direction. It comprises a string of legal texts that should reduce CO2 emissions by 55% from their 1990 level, which is crucial to achieving carbon neutrality. The building sector which uses 40% of the energy consumed in the EU, and which generates about 36% of its energy-related CO2 emissions is kernel to the Commission's legislative proposals.

The proposed revision to the Renewable Energy Directive provides measures for accelerating heating and cooling systems' transition to renewable energies in the context of renovations. Thus, the Commission plans to set a reference value of 49% of renewable energies in buildings by 2030, which could be provided by the electrification of heating and cooling needs with heat pumps alongside direct use of renewable heat (biomass heating, geothermal and solar thermal energy partially via heating networks). The Commission also proposes to oblige its Member States to increase renewable energy use in heating and cooling by 1.1 of a percentage point by 2030. Apart from housing, public buildings must also be renovated, to use more renewable energies and be more energy-efficient. Accordingly, the Commission plans to set the Member States an annual binding renovation target of at least 3% of the total floor area of all public buildings.

Furthermore, and certainly the most controversial point, is that the Commission proposes to expose the building sector to the European carbon market (in the same way as the road transport sector). In detail, fuel suppliers to buildings will be obliged to acquire equivalent quotas to the emissions generated by the energy quantities sold from 2026 onwards. The upshot of such a system would be to drive energy renovation in housing and radically and swiftly eradicate the most polluting heating modes. The downside of this system is that it exposes European consumers to energy surcharge, especially fuel poor households. To mitigate the social impact, the Commission plans to set up a clean-energy social transition fund. The new Climate Social Fund will support those EU citizens who are the most exposed to or affected by energy or mobility poverty. A 72.2 billion euro envelope will be provided over 7 years to fund building refurbishments and access to zero-emission and low-emission mobility, and even income support.

In an interview conducted in 2018 published in the Journal de l'environnement, the French climate scientist Hervé Le Treut aptly appraised the situation we have arrived at: "*We need to consider the response to climate changes as a whole with the concomitant implications for climate, energy, environmental and societal issues. Social tensions will be triggered by implementing most of the scenarios. It is essential that we do not lose sight of the fact that prioritizing social matters over climate issues will expose us to higher temperature levels. On the other hand, prioritizing climate issues without assessing all the consequences, will expose us tensions that will get out of hand. Prudence will have to be exercised over the policy mix. Because we have come to the fateful moment when we can no longer do everything. A choice will have to be made. And the range of choices is restricted.*" □

Sources: GSE (Italy), SDES (France), Observ'ER France), Ministry for the Ecological Transition and Demographic Challenge (Spain), AGEE Stat (Germany), Statistics Netherlands, SKVP (Sweden), Sulpu (Finland), DGEG (Portugal), Danish Energy Agency (Denmark), IJS (Slovenia), Geological Survey of Slovenia, ENFOS (Austria), Statistics Austria, CRES (Greece), STATEC (Luxembourg), NSO (Malta), EHPA.

The next barometer will cover solid biomass..

Funded by the European Commission

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