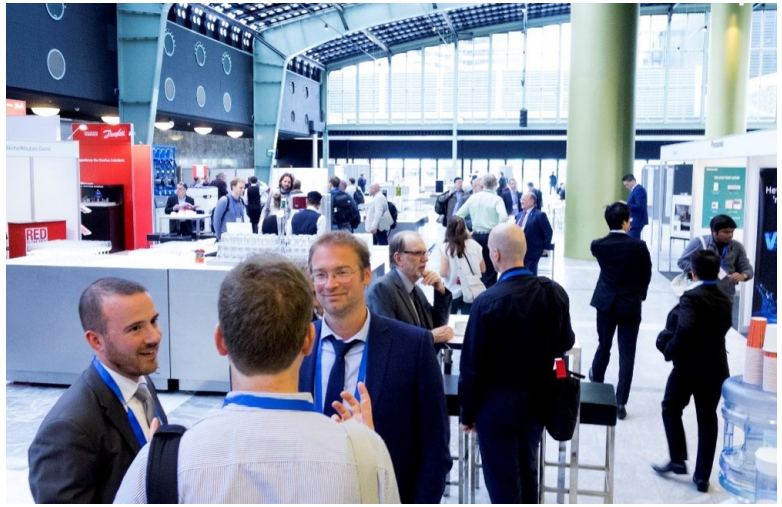
IEA Technology Collaboration Programme on Heat Pumping Technologies (HPT TCP)

Member Country Report Germany 2024

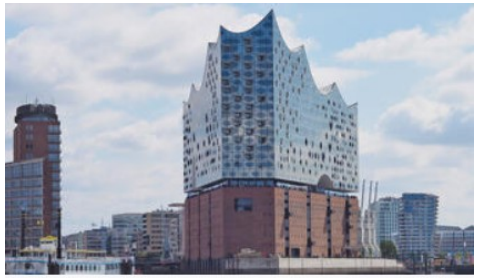



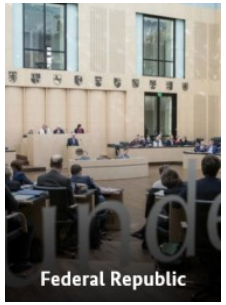
Research, Development, Demonstration, and Deployment of Heat Pumping Technologies

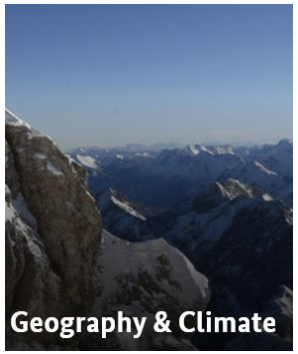
The HPT TCP is part of a network of autonomous collaborative partnerships focused on a wide range of energy technologies known as Technology Collaboration Programmes or TCPs. The TCPs are organized under the auspices of the International Energy Agency (IEA), but the TCPs are functionally and legally autonomous. Views, findings, and publications of the HPT TCP do not necessarily represent the views or policies of the IEA Secretariat or its individual member countries.

Agenda

- **General**
- Market
- Policy – Guidelines
- R & D
- Summary
- Sources

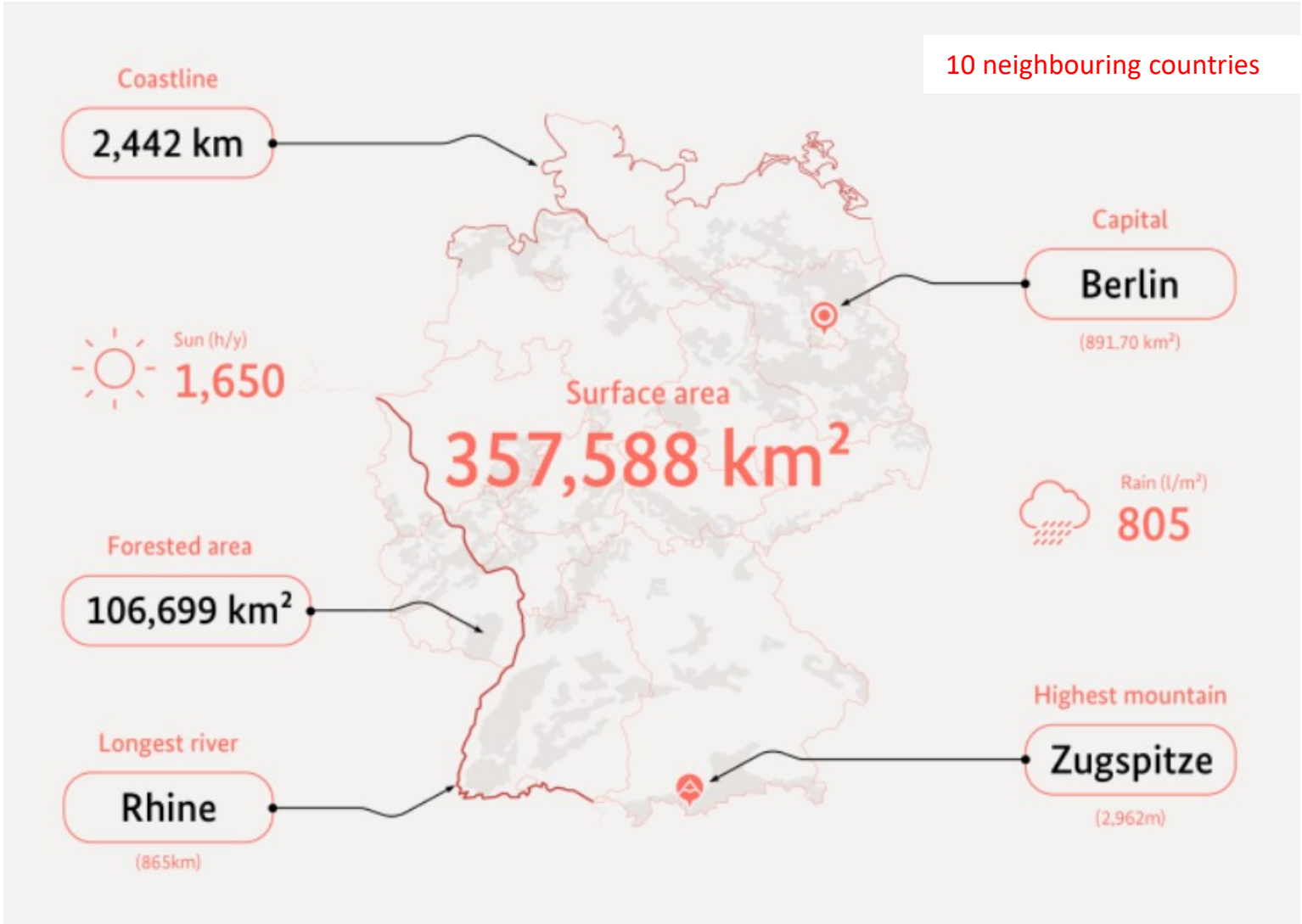




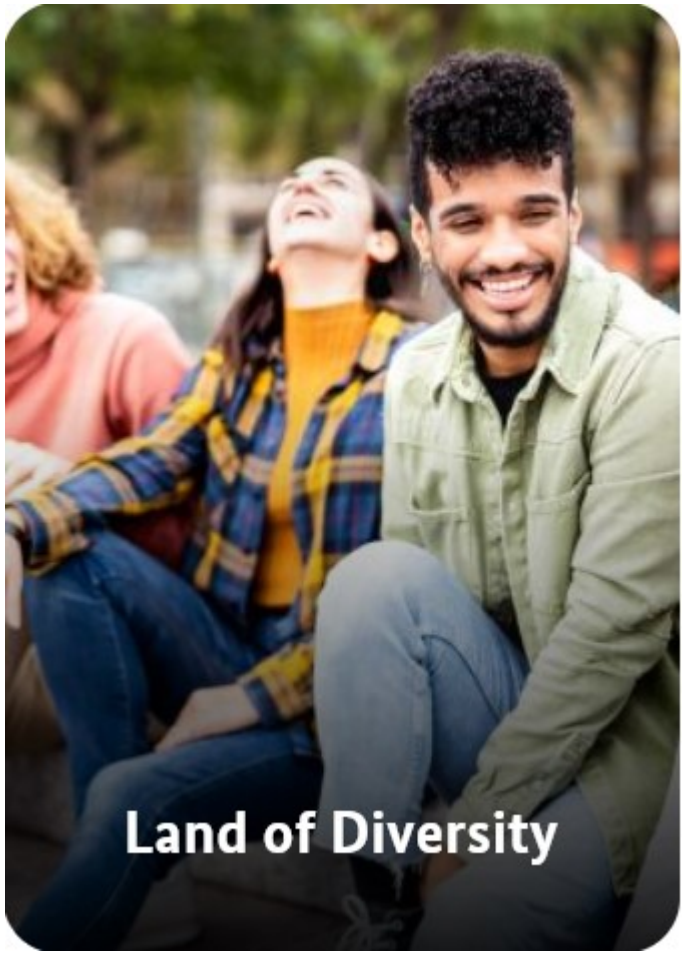


Source: Facts

General



Germany



Source: Facts

General

- **Germany** is a federation.

- 357,588 km²
- 82.7 mio. inhabitants (Zensus 2022)
- 40.236 mio. households (Zensus 2022)
- 43.1 mio. dwellings (Zensus 2022)
- 75 % of the dwellings heated with oil or gas (Zensus 2022)

Source: Facts D ESTATIS Zensus 2022

- **41.1 %** 1-person **33.5 %** 2-persons 11.9 % 3-persons 9.5 % 4-persons 3.9 % 5+ persons
  More than 50 % of people live in rented accommodation, this is the highest level on an EU comparison (DESTATIS)

General

First and foremost, federalism offers protection against one person or party having too much power.
This is because power is shared. It also gives politics the chance to react more to regional problems and opportunities.
It also gives citizens a better chance to have a voice.

Source: Facts

General

- Germany enjoys a moderate climate. In July, the mean temperature was 18.9 °C, and in January 1.5 °C (2024). The most recent winters in Germany were particularly mild, and the summers particularly hot. With a mean temperature of 10.6 °C, 2023 was the warmest year since records began in 1881.
- Germany is the most populous country in the EU and one of the most densely populated; around 77 % of its inhabitants live in densely and highly populated areas. Around 30 % of the population resides in major cities with more than 100,000 inhabitants, of which there are 80 in Germany, four with more than one million inhabitants, Berlin, Hamburg, Munich and Cologne.

Source: Facts statista

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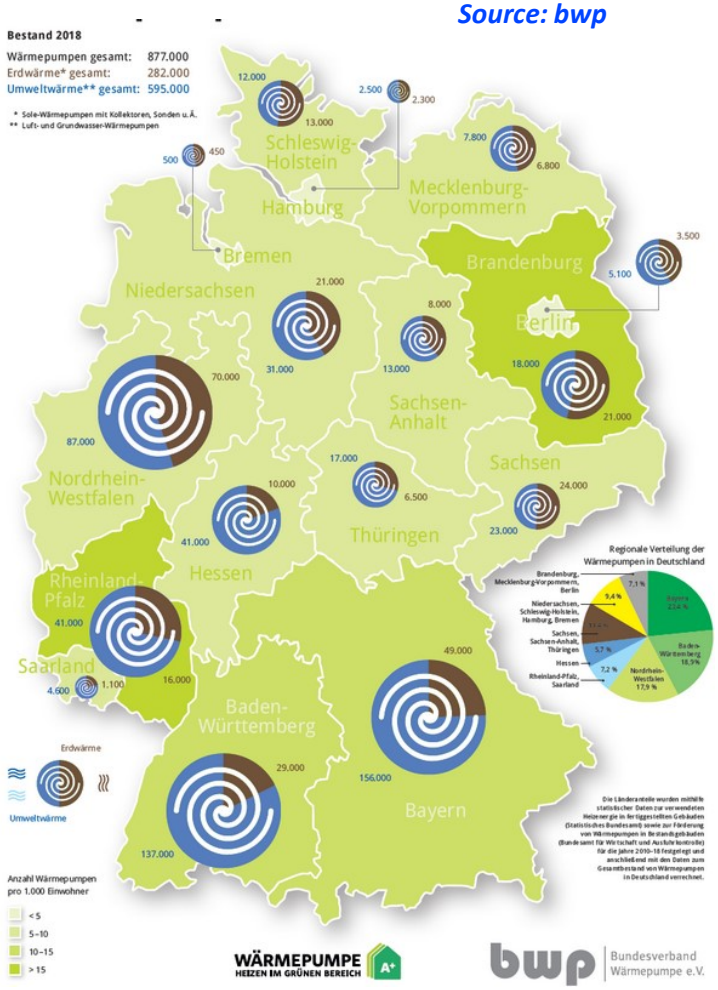
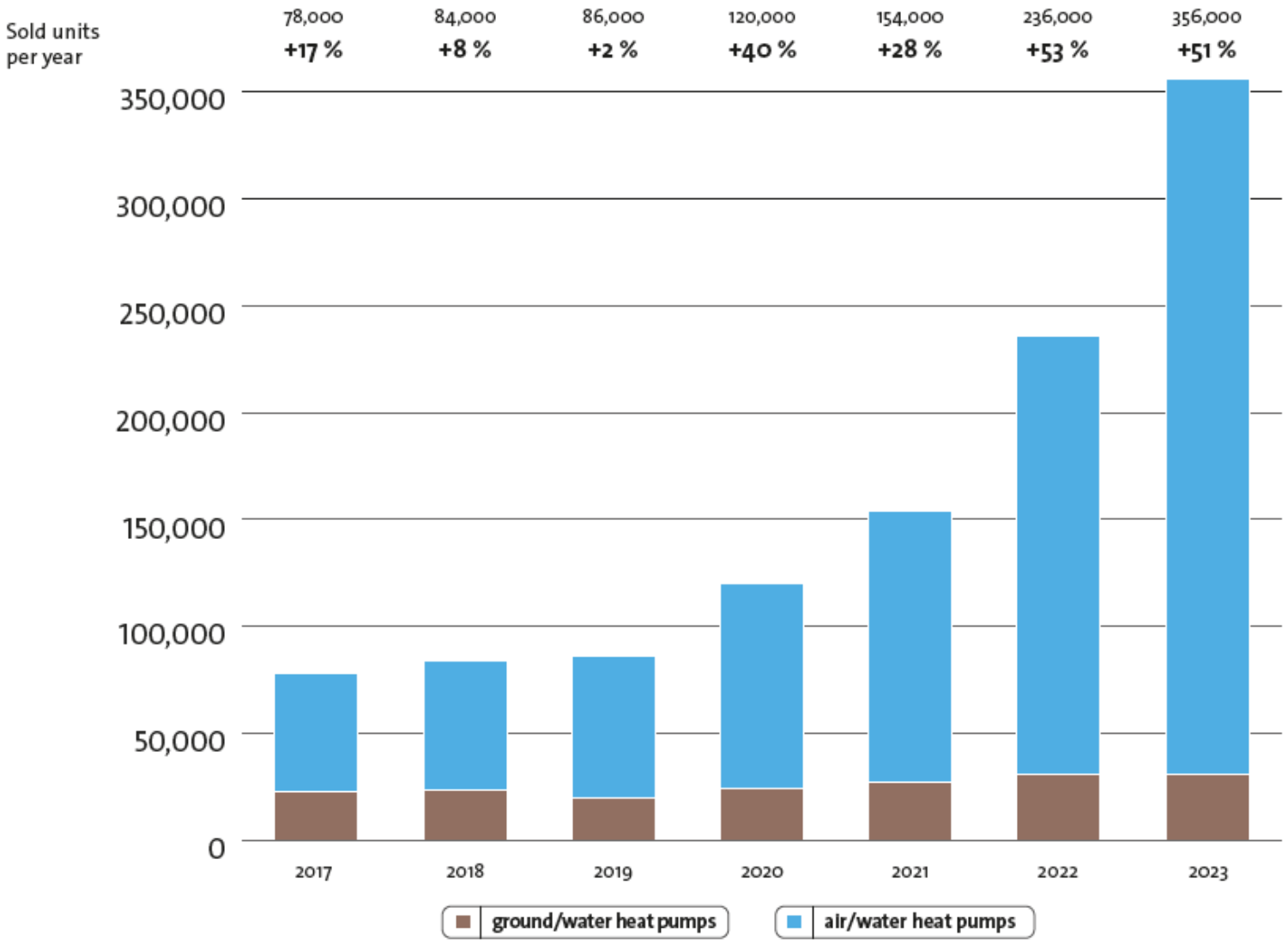
Source: bwp



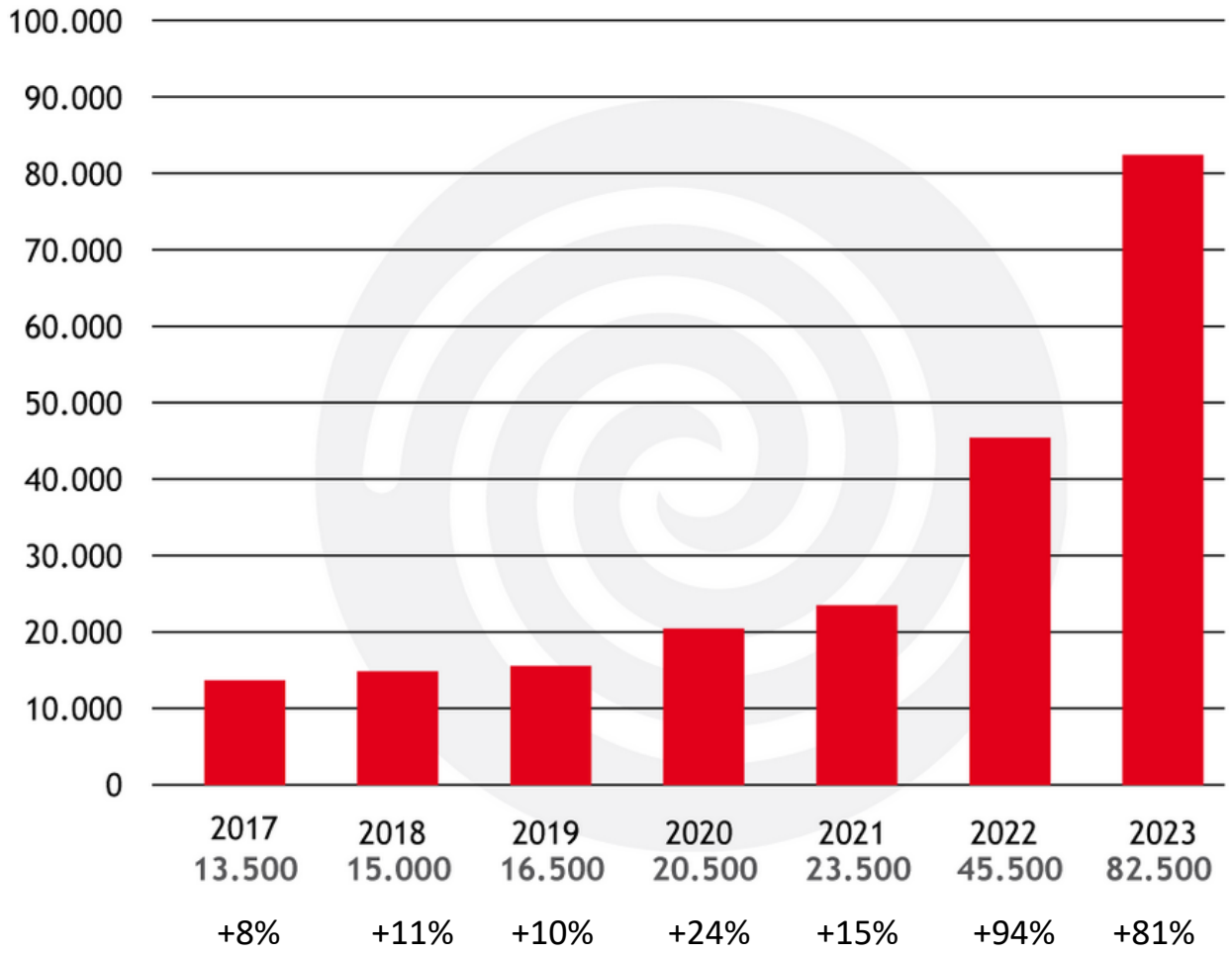
Market Heat pump sales in Germany 2017-2023



Source: Federation of German Heating Industry (BDH) / German Heat Pump Association (BWP)

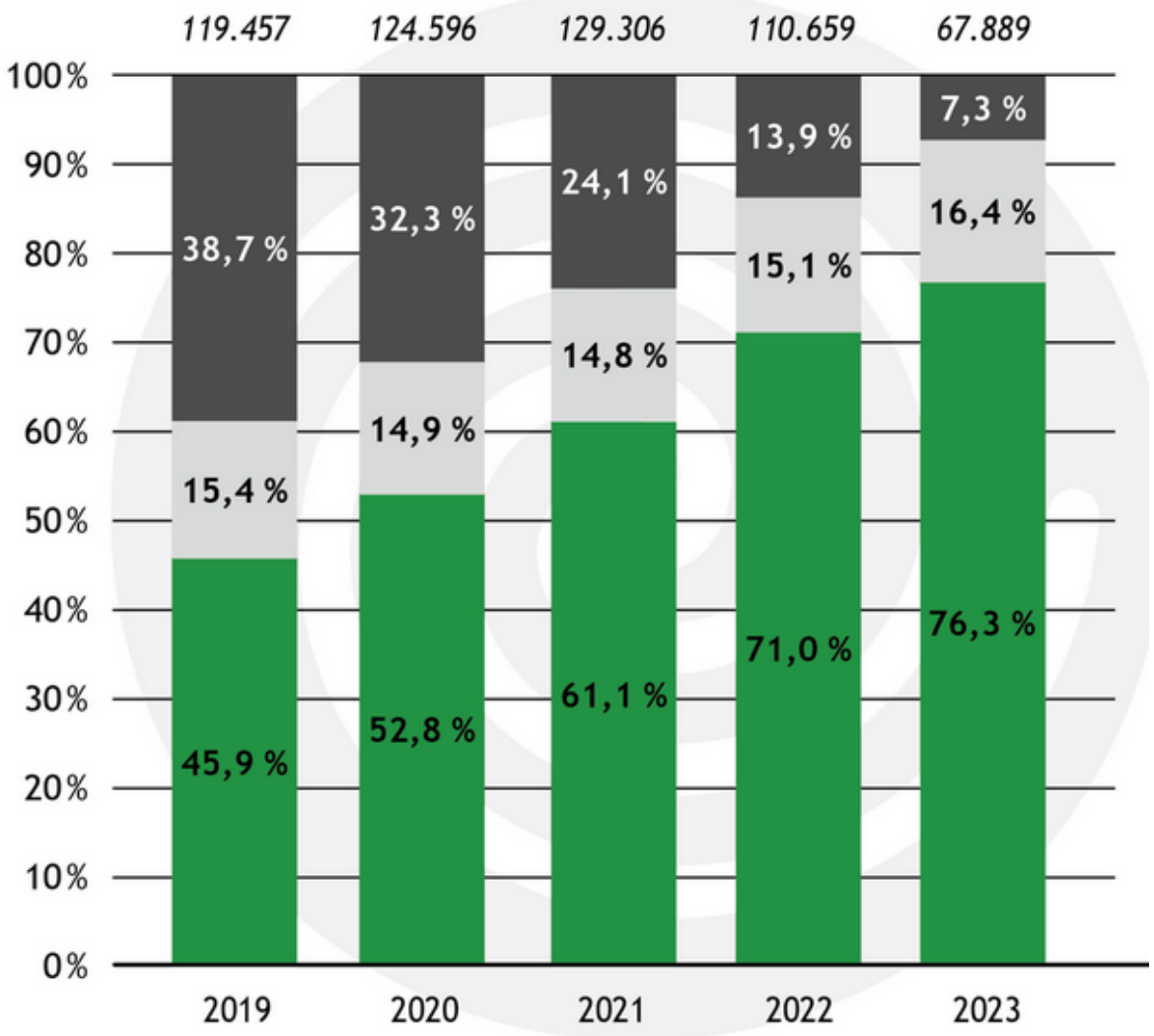
Source: bwp

Market Sales of domestic hot water heat pumps



Source: bwp

Market House-building permission



→ # authorized new buildings

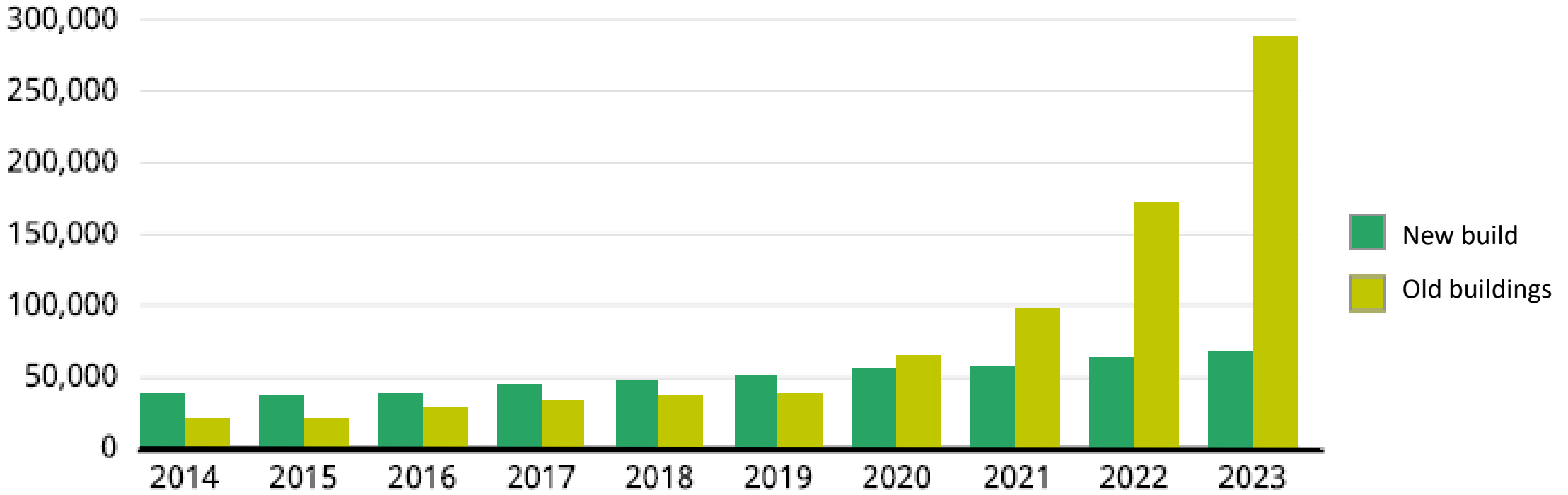
gas

misc.

heat pumps

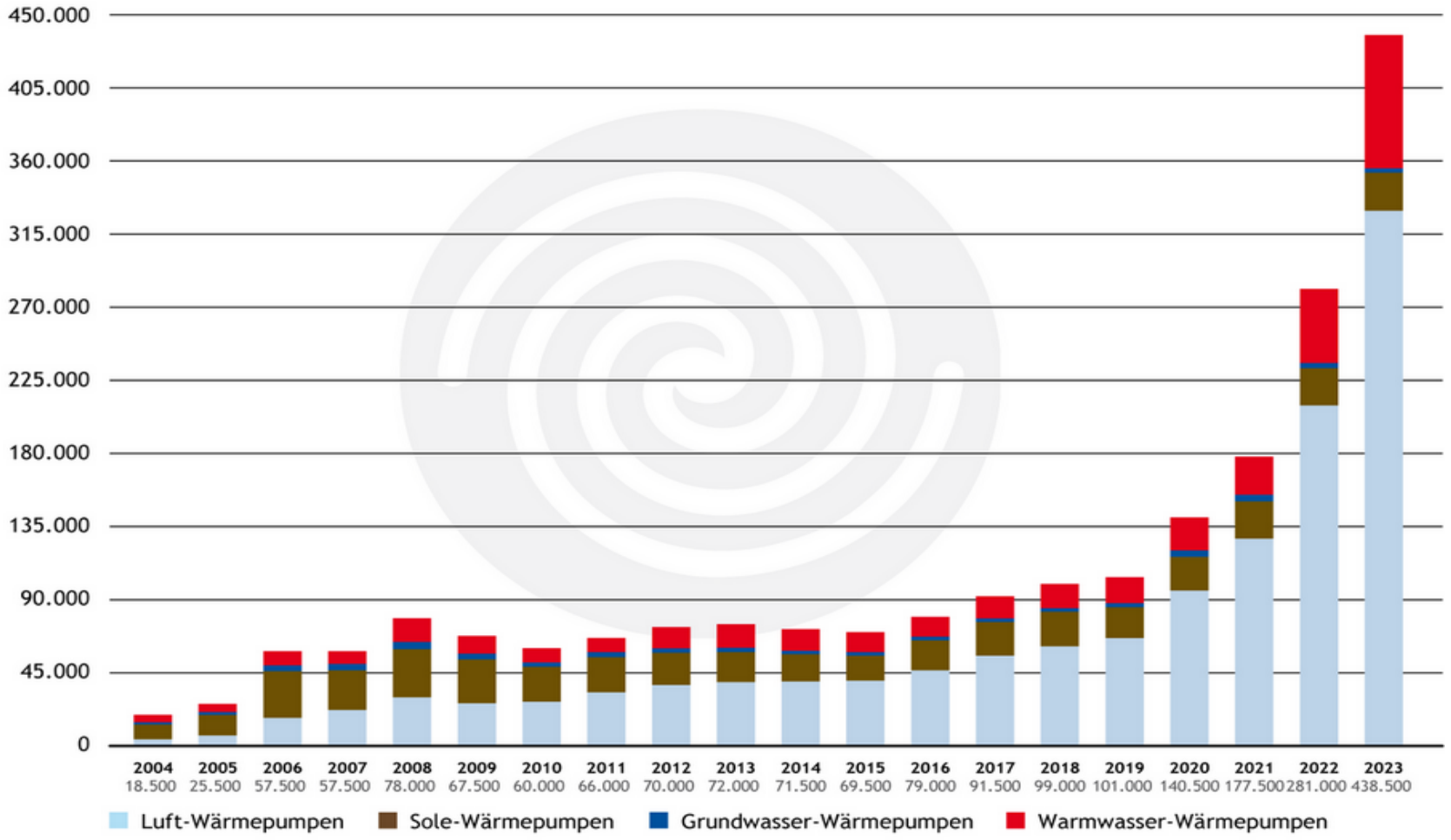
Source: bwp

Market New build & Old buildings



Source: bwp

Market Total sales of heat pumps



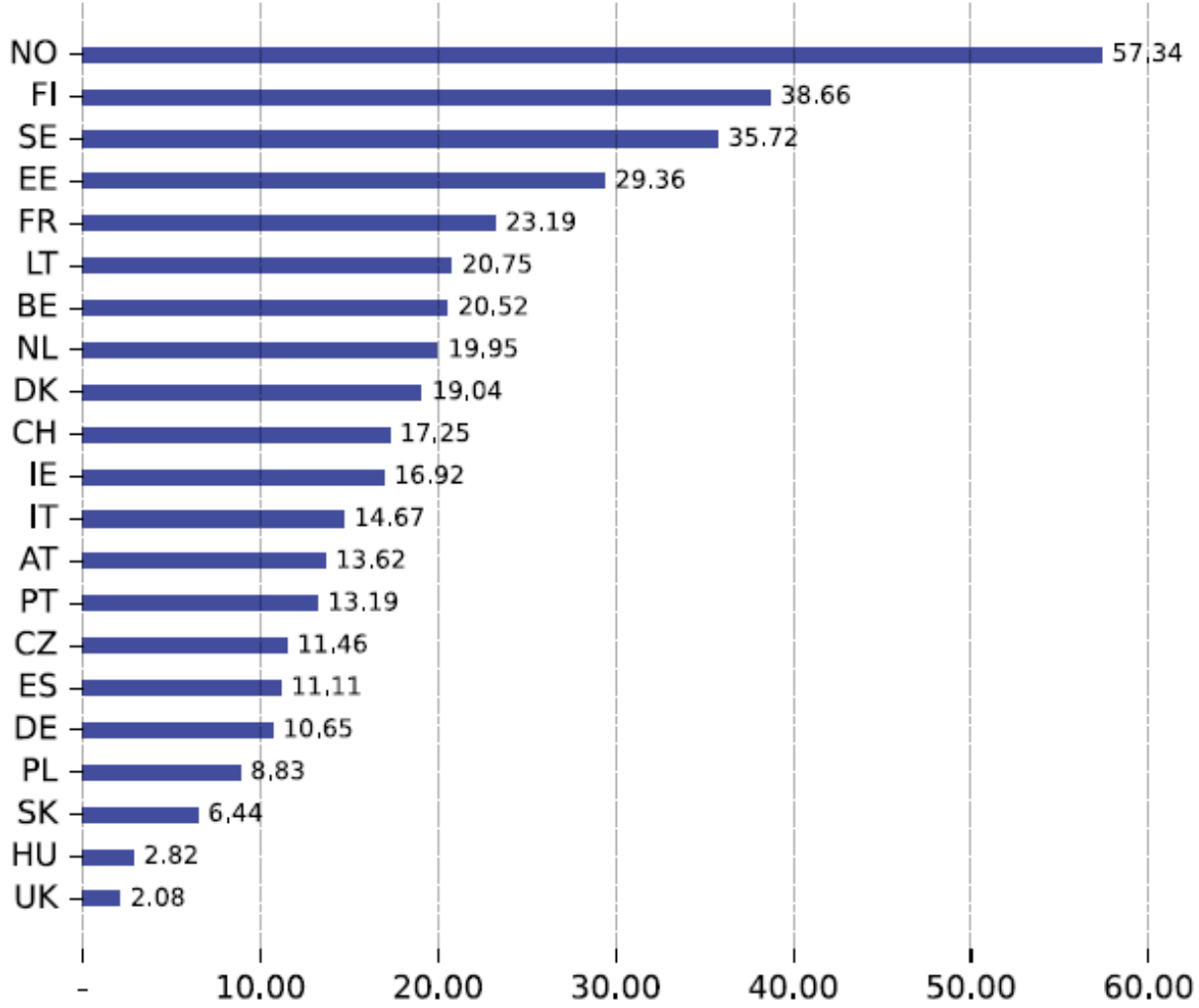
Domestic hot water

Ground water
Ground coupled

Air

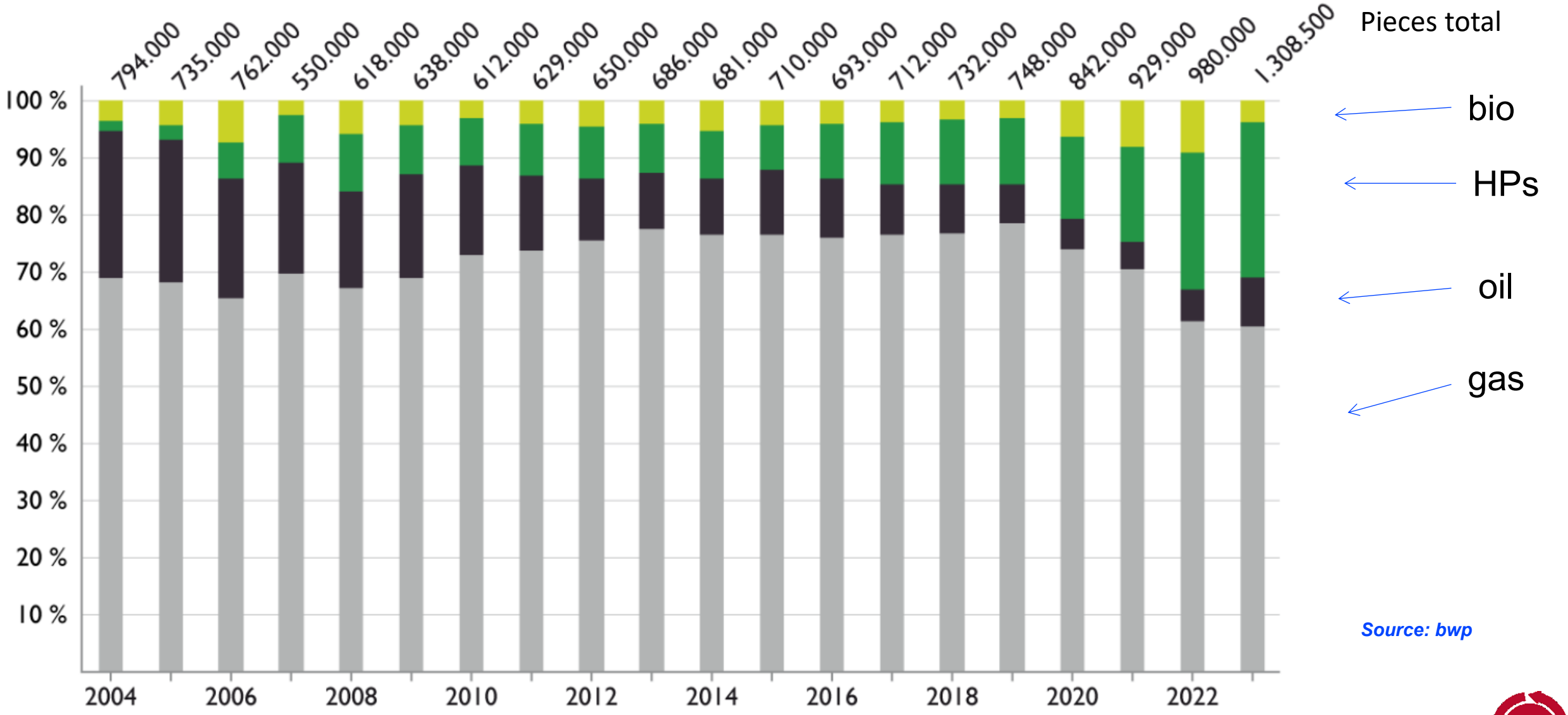
Source: bwp

Heat Pump Sales per 1 000 Households 2023



Source: EHPA

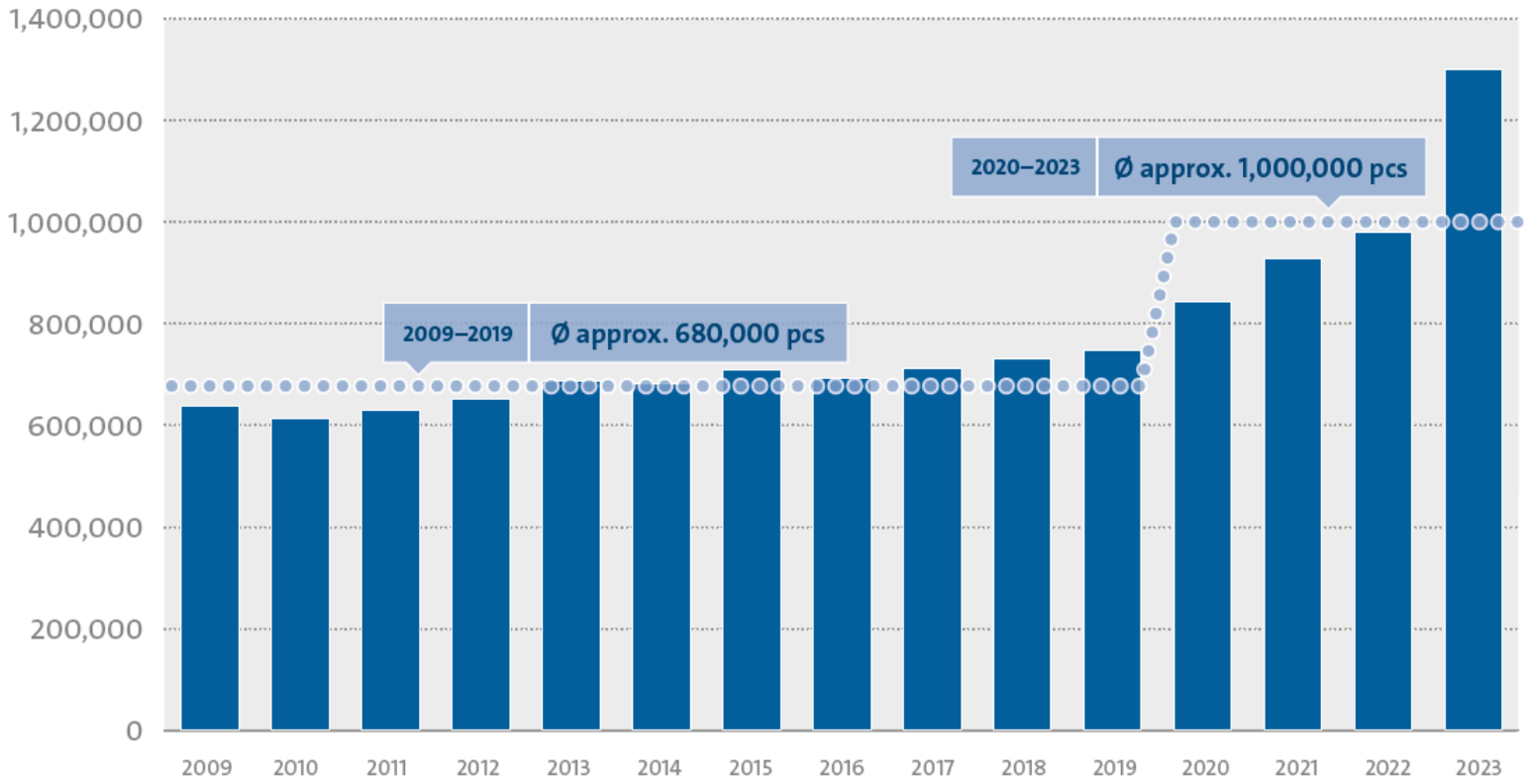
Market Heating systems sold



Source: bwp

Average sales in the heating industry in Germany 2009–2023

■ Record year 2023 distorts average for 2020-2023



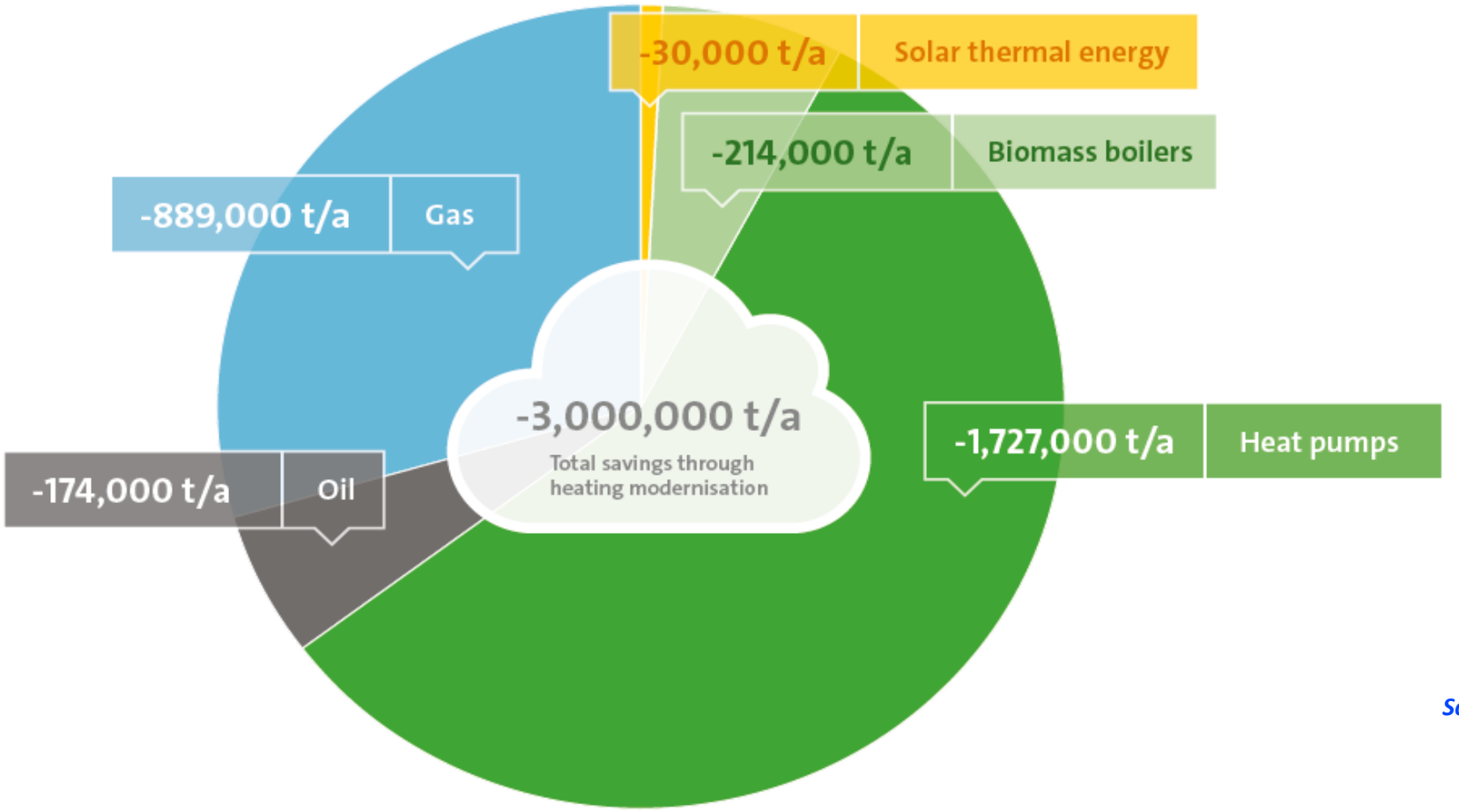
Source: BDH

Market Comparison: Sold heating systems 2021-2024

Heating System	2021	2022	2023	2024 1-2 Q Δ % in comparison to 2023 1-2 Q
Gas boiler	653,000	598,500	790,500	223,000 **-42 %**
Oil boiler	45,500	56,500	112,500	55,500 **+14 %**
Heat pumps	154,000	236,000	356,000	90,000 **-54 %**
Domestic hot water heat pumps	23,500	45,500	82,500	20,000 **-53 %**

Market CO_2 savings in Germany through heating system modernisation in 2023

- Of the 1.3 million appliances sold, around 1.2 million were used for modernisation



Source BDH

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Roadmap Dekarbonisierung

Strategies

Leitpapier

Climate change act

Bundesförderung

Green Deal

Impulse paper

Gebäudeenergiegesetz

Wärmeplanungsgesetz

Förderprogramm

Climate protection act

Energiepreisreform

Policy Germany to achieve climate neutrality earlier

Source: Federal Government 2021

Climate Change Act 2021

With the amendment to the Climate Change Act, the German Federal Government intends to tighten climate regulations and enshrine in law the goal of achieving greenhouse gas neutrality by 2045. The aim is to reduce emissions by **65 % of 1990** levels by **2030**. The Bundestag approved the amended Climate Change Act on Thursday. It was finalised by the Bundesrat. 25.6.2021

- **Greenhouse gas emissions**

  By **2030**: 65 % less CO_2 (current target 55 %)
  By **2040**: 88 % less CO_2
  By **2045**: Climate neutrality (current target 2050)

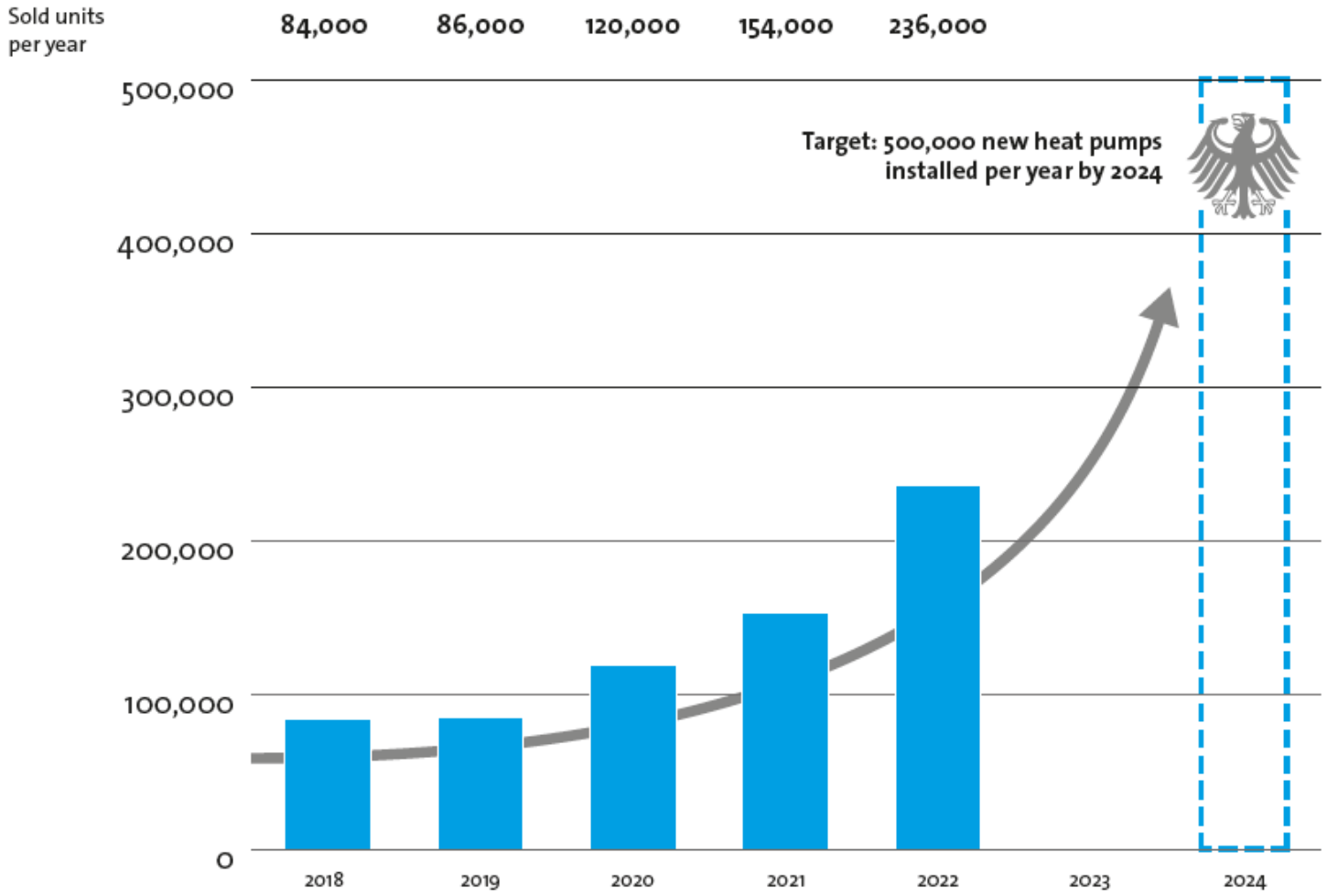
- Permissible annual CO_2 emissions for individual sectors such as energy, industry, transport and buildings to be reduced.

Policy

- Climate Change Act 2020 2021 (amendment) Link
- The German government's Climate Action Programme 2030 Link
- Germany is to cut its greenhouse gas emissions by 65 % of the 1990 levels by 2030
- Since the start of 2020, a government scheme has rewarded property owners replacing older oil-fired central heating
- "From 2024, solar systems should be installed on every new roof, if possible, at least on every commercial, every new heating system should be powered by **at least 65 % renewable energy**, ..."

Summit with industry representatives: R. Habeck wants 500,000 new heat pumps a year.

Policy Market: Development heat pumps in Germany



Source:
Federation of German Heating Industry (BDH) / German Heat Pump Association (BWP)

Policy Heat pump roll-out

- **Broad stakeholder alliance*** agrees on key principles to speed up the roll-out of heat pumps Link
- Two virtual heat pump summits in June and November 2022 hosted by Vice-Chancellor and Federal Minister for Economic Affairs and Climate Action Robert Habeck and Federal Building Minister Klara Geywitz.

* Involvement of the whole industry

Policy Implementation by the industry

Vaillant 30 May 2022

Vaillant Group: heat pumps are causing a growth spurt

- Sales revenue increased to €3.3 billion in 2021
- Further growth of more than 50 per cent in heat pumps
- €300 million expenditure on heat pumps, research & development and digitalisation in 2021

Daikin Europe begins construction of €140m R&D centre

19 MAY 2022

BELGIUM: Daikin Europe has begun construction of its new €140m EMEA Development Centre (EDC) in Ghent and announced further increases in heat pump production at Ostend.

VIESMANN

Viessmann Group to invest EUR 1 billion in heat pumps & green solutions

Shift towards Integrated Solutions pays off | EUR 3.4 billion in sales in 2021 | Overall +21% versus 2020 | Heat pumps with strong growth of +41%

Bosch to open heat pump factory in Poland

BOSCH

Bosch has announced plans to build its first heat pump factory in Dobromierz, Poland. The German heating manufacturer will invest €225 million ($247.3 million) in the new facility, which is expected to start operations in early 2026.

DAIKIN

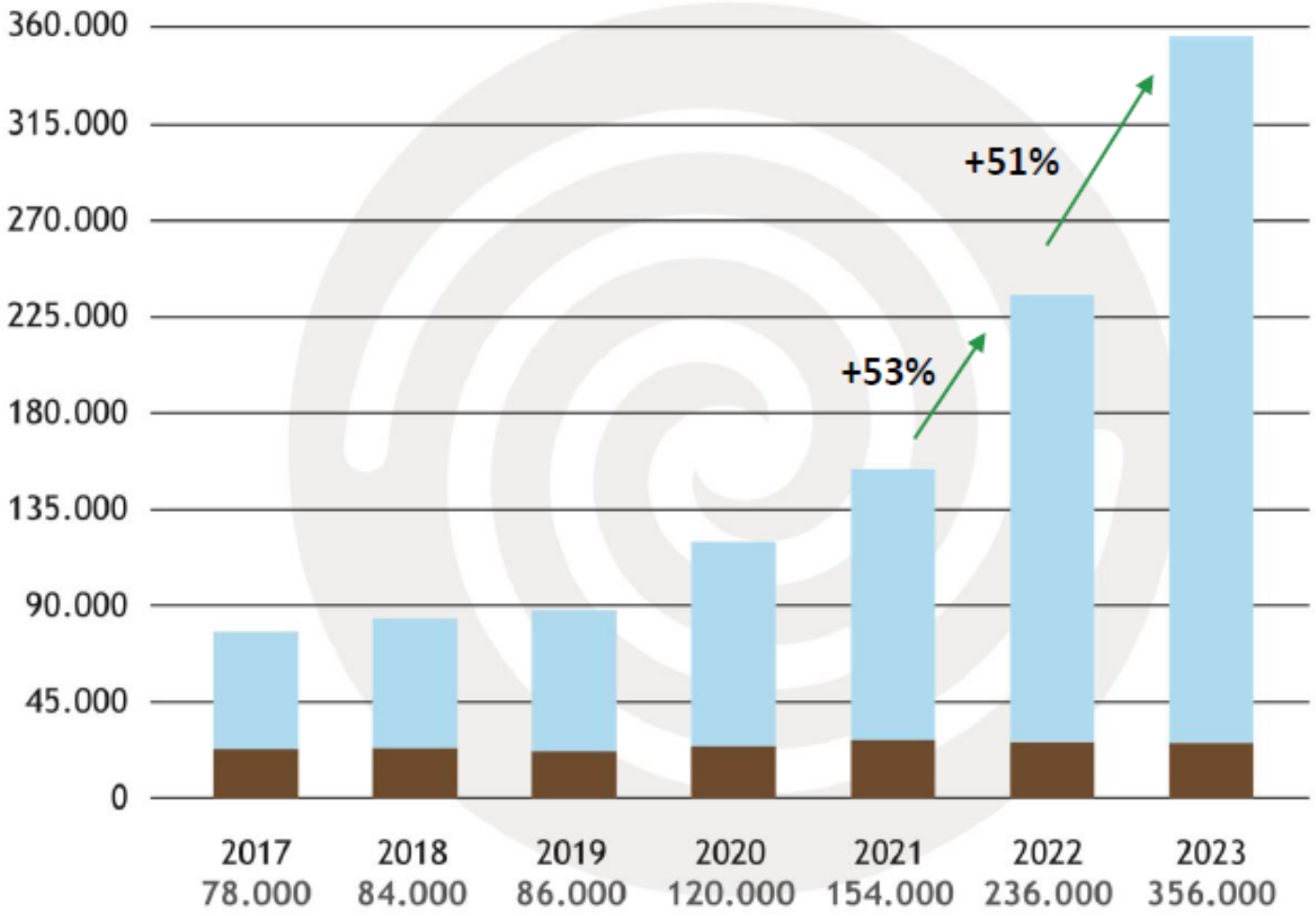
CORPORATE NEWS

July 8, 2022

Daikin Establishes New Heat Pump Heating Factory in Poland

Daikin Industries, Ltd. has recently decided to invest 300 million euros (equivalent to 37.5 billion yen at the exchange rate of 1 euro = 125 yen) to establish a new factory for heat pump units at the Ksawerów Industrial Park in Lodz Province, Poland. The new production base will start operations in July 2024 to meet the rapidly increasing demand for heat pumps in Europe.

Policy Result of the heat pump roll-out activities: Sales of heat pumps



Source: bwp

Grants for Heat Pumps

Heat Pumps	Building Stock	
	Subsidy rate (max. 70 %)*	
Basic funding	30 %	
Climate speed bonus	20 %**	For replacing old oil, coal, night storage or gas heating systems that are at least 20 years old
Income-related bonus	30 %	For households with an annual taxable income of less than € 40,000
Efficiency bonus	5 %	For the use of heat pumps with natural refrigerants or geothermal energy as a heat source

* The subsidy is granted for a maximum investment cost of € 30,000 for the first residential unit

** The climate speed bonus will decrease by 3 % points every two years from 2029. The bonus will no longer apply from 1.1.2037.

Policy **Barriers**

Challenging Heat & Electricity Prices

→ Focus on Countries with favorable Price Ratios:

- Sweden
- Finland
- Bulgaria
- Netherlands
- France
- etc.

→ Focus on Rural Areas without Gas Networks

Country	Electricity/Gas Price Ratio			
	Households	Small Enterprises	Large Enterprises	Indicator
Sweden	1,2	1,3	1,0	↑
Finland		1,8	1,2	↑
Bulgaria	1,9	2,6	2,0	↑
Netherlands	1,5	2,6	2,6	↑
France	1,4	2,7	2,5	↑
Slovenia	2,5	2,1		↑
Portugal	2,1	2,5	2,4	↑
Estonia	2,5	2,6	2,2	↑
Austria	2,8	2,7	2,0	↑
Poland	2,4	2,8	2,4	→
Lithuania	1,7	3,4		→
Croatia	2,6	2,6		→
Hungary	3,1	2,4	2,8	→
Latvia	2,2	3,5	2,7	→
Luxembourg	3,2	2,3		→
Slovakia	1,7	3,5	3,2	→
Denmark	4,2	1,9	2,7	→
Czech Republic	2,2	3,7	2,9	→
Spain	2,9	3,5	2,5	→
Greece	2,3	4,0		→
Italy	2,2	3,9	3,7	→
Romania	4,2	3,0	2,8	→
Belgium	2,8	4,0	3,2	→
Germany	3,0	4,0	3,5	→
Ireland	4,1	3,9		↓
United Kingdom	2,8	4,2	5,1	↓
EU-28	2,4	3,3	3,0	→

Prices
4. Quarter 2023

Gas	2024 01	10,68 ct/kWh
Electricity	2024 07	41,35 ct/kWh
Price Ratio		**3,9**

Households				
Gas	2023	11,53 ct/kWh	Pricecover 12,0 ct/kWh	2020: 5,97 ct/kWh
Electricity	2023	44,17 ct/kWh	Pricecover 40,0 ct/kWh	2020: 31,81 ct/kWh
Price Ratio		**3,8**	**3,3**	**5,3**

Sources: BDEW-Gaspreisanalyse_Dezember_2023_06.12.2023
BDEW-Strompreisanalyse_Dezember_2023_12.12.2023

Policy

Business Association:

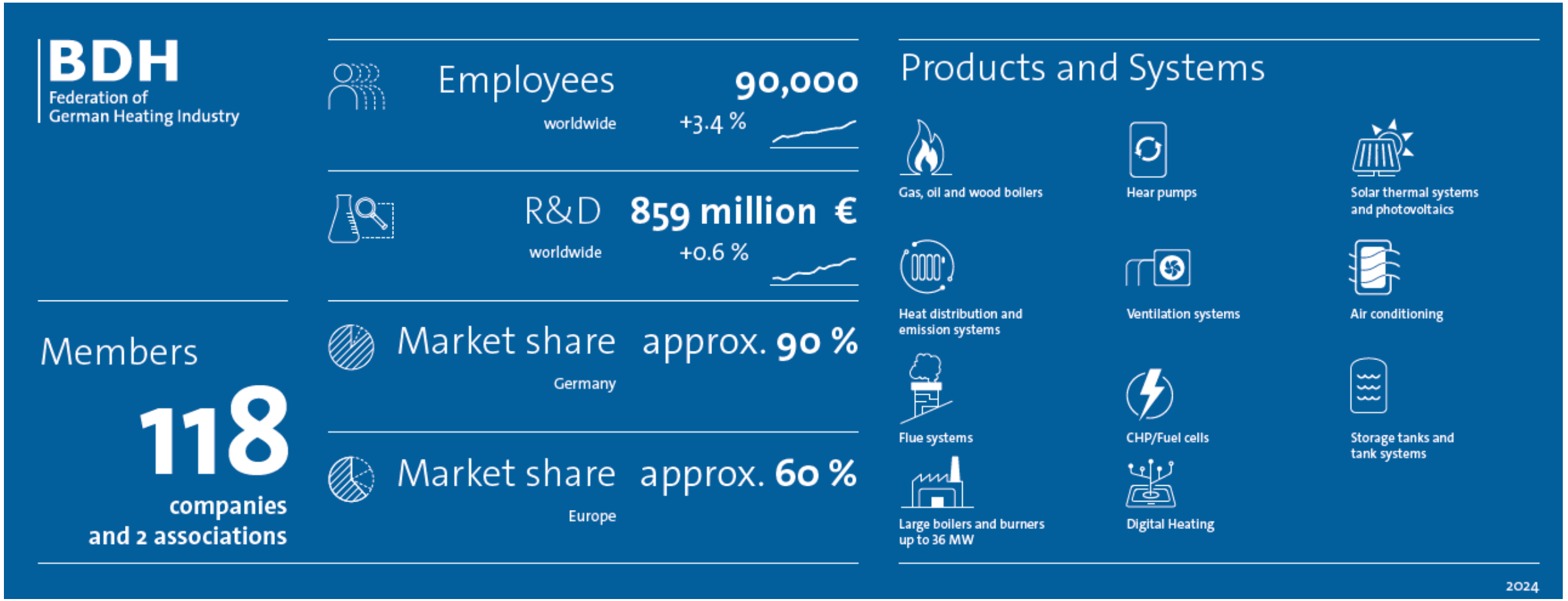
BDH, BDEW, BWP, BVF, B.KWK, Geothermie, FGK, BTGA, VDMA, ZVEI, ZVSHK ...

Technical Society:

DKV, FKT, IZW, VDI, VDE ...

This paper is not intended to be complete or definitive.

Portrait of the Federation of German Heating Industry BDH



The German heating industry occupies a world-leading technological position

Source: BDH

BDH: Heat Generators

Gas condensing technology: Modern gas condensing boilers are highly efficient and can make a decisive contribution to reducing your private energy consumption. Read more

Oil condensing technology: Modern oil fired condensing boilers make heating more environmentally friendly and efficient. Read more

Heat pumps: With a heat pump you can use the environmental heat that is present in the soil, in the ground-water and in the air for heating or cooling. Read more

Hybrid Heat Pumps: Hybrid HPs are suitable for use in new buildings as well as in existing buildings. Read more

Solar thermal energy: With a solar thermal system, sunlight is converted into heat. This can be used for heating and DHW heating. Read more

Heat from wood: Wood is a renewable resource that absorbs about as much CO_2 as it releases when burning. Read more

Cogeneration of heat and power (CHP): Heating which generates electricity, also known as decentralised CHP (cogeneration of heat and power), on the other hand, generates both electricity and heat at the same time. Read more

Source: BDH

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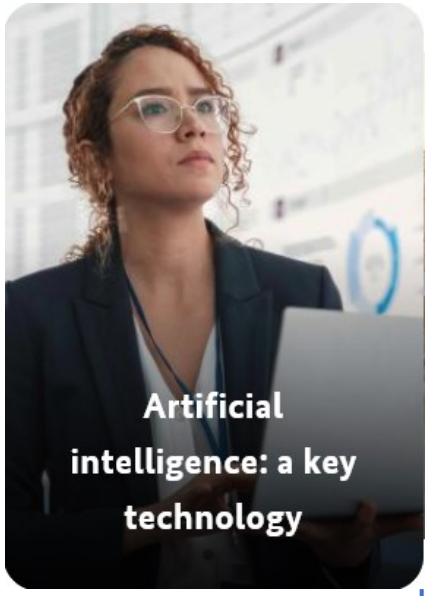

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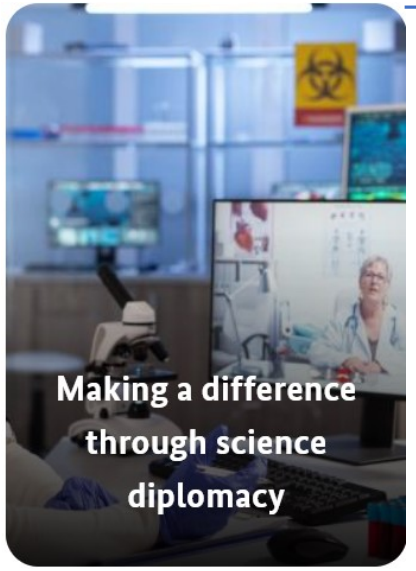
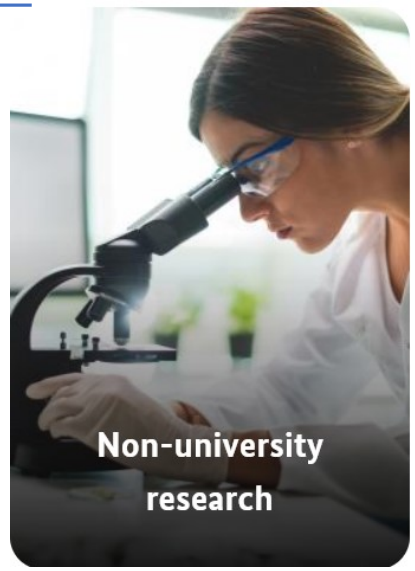




Source: Facts

Research

- Between 2017 and 2023, research projects related to heat pumps and refrigeration technology were funded by the BMWK with more than 400 million €. (Development- integration in grids, in buildings, in processes…)
- In the past few years, development has focused mainly on HPs for buildings and the main areas of development are refrigerants, components, integration and demonstration. In recent years, the number of projects addressing heat pumps for industrial applications or district heating has also been increasing.
- Currently, important topics are the use of low-GWP refrigerants, the reduction of refrigerant charge, the acoustics of heat pumps, and high-temperature heat pumps

Source: BMWK

Current figures on energy research funding

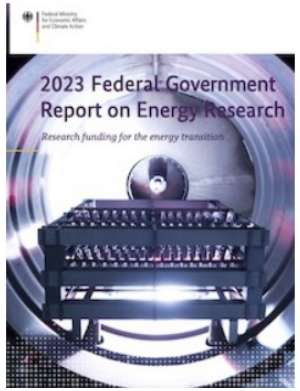
In 2023, the BMWK invested around 599 million € in funding in 5,482 ongoing non-nuclear energy research projects as part of the energy research program (Link).

The **EnArgus** information system:

The public internet portal EnArgus.de (Link) provides ongoing updates into running and completed energy research projects since 1977 - research topics and project durations, partners involved and funding utilised.

Report 2024* Report 2023 Report 2022 Report 2021 Report 2020 Report 2019

*** Available in German**



Source: BMWK

R &D

The German government is aiming for a climate-neutral building stock by 2045 (Climate Action Plan). In order to achieve this goal, it is necessary to reduce the heat demand on the one hand and to achieve a climate-neutral heat supply on the other hand.

In order to accelerate this process, the Federal Ministry for Economic Affairs and Climate Action (BMWK) has defined the guidelines for funding applied energy research with its new* 8th research programme as part of a mission-oriented innovation policy.

*only German

The priorities of the new energy research programme are

- Research for a resilient and efficient energy system Mission Energy System
- Research for a climate-neutral heating and cooling supply Mission Heat Transition
- Research for the conversion of the electricity supply Mission Electricity Transition
- Research for a sustainable hydrogen economy Mission Hydrogen
- The rapid transfer of research results into practice Mission Transfer

Source: BMWK

Research

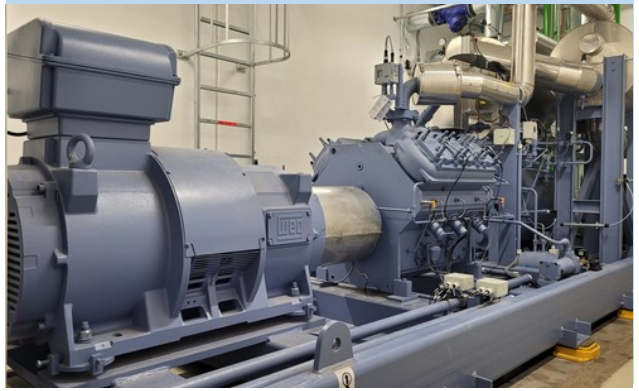
- A major project on the topic of heat pumps in district heating networks "Reallabor GWP" has been started as of 01.04.2021.
  The Federal Ministry of Economic Affairs and Climate Action is funding this project with 21 million €. Link Energiewende Bauen Link Fraunhofer ISE

Source: BMWK

Demonstration of Heat Pumps in District Heating

District Heating / Neukölln Berlin

1.3 MW_{th} | 80 °C | Piston



Premounted R-717

Public Utility / Rosenheim

1.5 MW_{th} | 88 °C | Screw Piston

Premounted R-717

Vattenfall / Berlin

1.3 MW_{th} | 80 °C | Piston

EnBW / Stuttgart

22 MW_{th} | 90 °C | Turbo

Build on site R-1234ze(E)

MVV / Mannheim

20 MW_{th} | 99 °C | Turbo

Sources: Johnson Controls, Vattenfall, Fraunhofer ISE

Research Germany is participating in the ongoing projects

HPT TCP Annex 65 **Heat Pumps in a Circular Economy**

HPT TCP Annex 64 **Safety Measures for Flammable Refrigerants**

HPT TCP Annex 63 **Placement Impact on Heat Pump Acoustics**

HPT TCP Annex 62 **Heat Pumps for Multi-Family Residential Buildings in Cities**

HPT TCP Annex 61 **Heat Pumps in Positive Energy Districts**

HPT TCP Annex 59 **Heat Pumps for Drying**

R & D

- A large number of universities, research institutes and industrial companies are working on heat pump technologies in Germany.
- In particular, the Fraunhofer Institute for Solar Energy Systems ISE, the Technical University of Dresden, ILK Dresden, and the E.ON Energy Research Center at RWTH Aachen University on the research side and Vaillant, Viessmann, Stiebel Eltron, and Bosch Home Comfort on the industry side are to be mentioned.
- New Institutes for large energy systems:
  German Aerospace Center's (DLR) Institute of Low-Carbon Industrial Processes
  Fraunhofer Research Institution for Energy Infrastructures and Geothermal Systems (IEG)

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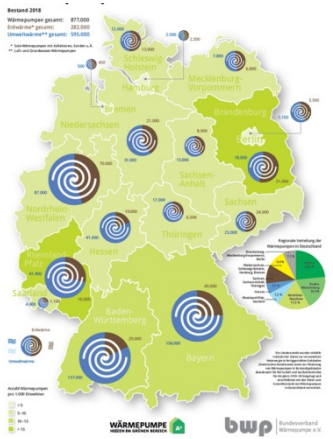

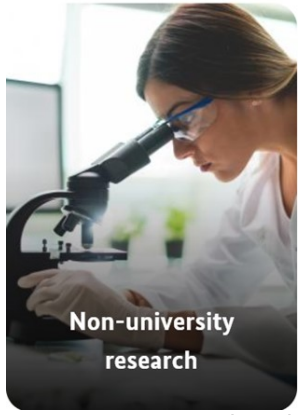

Summary

- The heat pump has 2022-2023 arrived in politics after many lost decades, but 2024 is a severe setback
- Heat pumps as heating systems are dominant in new build
- There is further a great potential in the building stock
- A government scheme rewards property owners replacing older heating systems
- Air to water heat pumps have > 90 % market share
- Great potential also in commercial and industrial applications
- High electricity prices in comparison to gas and oil are a strong barrier for HPs

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Sources

- Facts about Germany https://www.tatsachen-ueber-deutschland.de/en
- DESTATIS https://www.destatis.de/EN/Themes/Society-Environment/Population/Households-Families/_node.html Status 2023
- Zensus https://www.zensus2022.de/EN/Home/_node.html
- BDH https://www.bdh-industrie.de/en/
- bwp https://www.waermepumpe.de/
- BDEW https://www.bdew.de/service/daten-und-grafiken/bdew-strompreisanalyse/
- Bafa https://www.bafa.de/EN/Energy/energy.html
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This paper is not intended to be complete or definitive.

Many thanks for your attention

Any questions? Comments? Suggestions?

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https://www.chillventa.de/en/events-programme/chillventa-congress/heat-pumping-technologies

On Monday – 7 October 2024

Chillventa CONGRESS – Heat Pumping Technologies for Residential, Commercial and Industrial Applications

The lecture series on new developments and trends in heat pump technology on Monday – 7 October 2024 – is organized by the Informationszentrum Wärmepumpen und Kältetechnik (Information Centre on Heat Pumps and Refrigeration | IZW).

- Energy Efficiency in Industrial Drying (IEA HPT project)
- Heat pumps in a circular economy (IEA HPT project)
- Pure Refrigerants vs. Zeotropic Mixtures in Heat Pumps
- Safety with flammable refrigerants (IEA HPT project)
- Steam Compressors for Heat Pumps
- How semi-hermetic compressors can simplify the switch to R717.
- Thermal energy storage with a heat pump
- Smart Heat Pumps