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Are the Ambitious Heat Pump Targets Achievable?

Marek Miara*

Heat Pumps Watch, Paul-Ehrlich-Strasse 7, 79106 Freiburg, Germany

Abstract

Heat pumps are central to achieving climate goals and decarbonizing heating. The EU aims for 60 million additional units by 2030; Germany targets six million. However, these targets face criticism based on outdated information rather than scientific evidence.

This paper examines five key areas: production capacities, workforce availability, applicability in existing buildings, deployment in multi-family buildings, and economic viability. Recent €7 billion investments in European production created capacity exceeding targets. Intensive training addresses workforce shortages. Field studies across six European countries show heat pumps achieving seasonal performance factors of 3.2 in unrenovated buildings, maintaining efficiency above 2.0 during cold waves.

Modern heat pumps deliver up to 75°C flow temperatures. In France, heat pump share in new multi-family buildings rose from 4% to 45% in five years. Economic viability, supported by innovative business models integrating photovoltaics and intelligent control, depends on energy prices and subsidies.

Achieving ambitious targets is technically and organizationally feasible with sustained political will, targeted funding, and coordinated implementation. The debate represents a political choice about energy transition, not a technical limitation.

Keywords: heat pumps, energy transition; building decarbonization, existing buildings retrofit, field performance

1. Introduction

Heat pumps are considered a central technology for the heating transition. Ambitious political plans call for a significant increase in the number of installed heat pumps. For example, the European Union, as part of the REPowerEU plan [1], has set the goal of installing a total of 60 million additional heat pumps by 2030. This project is a central component of the strategy to reduce dependence on fossil fuels and achieve climate goals. Internationally, the IEA forecasts in its 'Net Zero Emissions by 2050' scenario [2] a tripling of global heat pump capacity from 1,000 GW in 2021 to nearly 2,600 GW by 2030. In Germany, the federal government aims to have a total of six million heat pumps in operation by 2030 to achieve climate targets. [3]

This paper examines the main arguments questioning the achievability of heat pump targets in Europe and evaluates them against recent technical developments and field study results. Five key areas are analyzed: production capacities, workforce availability, applicability in existing buildings, deployment in multi-family

* Corresponding author. *E-mail address: marek.miara@heatpumpswatch.org*

buildings, and economic viability. The focus is primarily on the European market, with particular emphasis on Germany, though international comparisons are included where relevant.

In public debates, the cited targets are repeatedly questioned and criticized. The arguments often include theses that are not based on scientific results and rarely reflect the current state of technology.

2. Initial Situation and Political Discussion

The German government planned to introduce a new Building Energy Act in year 2024. The media debate this law was highly emotional and frequently characterized by disinformation. The term "heating ban" connected to the new law was used misleadingly to delegitimize climate protection-oriented measures. Yet the electrification of the heating sector is an essential building block for achieving climate goals. Heat pumps are key to decarbonization, especially in conjunction with an electricity system increasingly based on renewable energies.

The expression "heating ban" (Heizungsverbot) was even ranked second by the language-critical action 'Word of the Year' for 2024. The jury criticized the term as misleading and factually incorrect. In reality, the law neither prohibits heating nor heaters in general, but rather regulates the construction of new heating systems, which should use at least 65% renewable energy.

2.1. Background: The German Building Energy Act (Gebäudeenergiegesetz - GEG)

The proposed legislation aimed to require that newly installed heating systems use at least 65% renewable energy starting in 2024. This applied to new installations only—not existing, functioning heating systems. The law did not mandate immediate replacement of fossil fuel heaters but rather set requirements for future installations when systems reach end-of-life or are voluntarily replaced.

The term "heating ban" (Heizungsverbot) emerged in political discourse as a pejorative label, despite the law neither prohibiting heating nor banning existing equipment. This misnomer dominated public debate and created significant misconceptions about the actual regulatory intent, which was to gradually phase in renewable heating technologies through natural replacement cycles rather than forced, immediate conversion.

The controversy highlighted broader challenges in communicating technical energy policy to the public and illustrated how terminology can shape public perception independently of actual policy content. For international readers, this context is essential to understanding why heat pump deployment faces not only technical but also significant political obstacles in Germany, despite the technology's proven capabilities.

3. Why Should the Heat Pump Targets Not Be Achievable?

3.1. Production Capacities

Just a few years ago, there was a concern that the available heat pump production capacities in Europe would not be sufficient to achieve the ambitious targets. However, production capacities have been significantly increased in recent years. It is estimated that heat pump manufacturers have invested 7 billion euros in new factories and/or production lines in a very short time. The cumulative potential production capacity thus clearly exceeds the planned installation targets. The new investments have in many cases caused a conversion to fully automated production methods, which indicates declining production costs in the future.

Meanwhile, more than 60 CEOs from the heat pump industry see investments in Europe at risk. In a letter to EU Commission President Ursula von der Leyen, they are calling for the immediate publication of the European Heat Pump Action Plan—also because governments in North America, Asia, and other regions outside Europe are expanding their support for heat pumps, creating competitive pressure for European manufacturers. [4]

3.2. Staff Shortage

An assessment by the German Heat Pump Association from 2020 showed that only 15% of all SHK (sanitary, heating, and air conditioning) companies install heat pumps. However, demand for installations has increased very sharply in recent years. Particularly through legal requirements to reduce CO_2 emissions and through funding programs, the use of heat pumps is becoming increasingly attractive. This leads to high demand for skilled workers who are able to professionally install and maintain these systems. Installing a heat pump requires specific knowledge. Installers must be familiar not only with heating and air conditioning technology, but also with refrigeration and electrical engineering.

However, there are also trends indicating a relaxation of the situation. A representative survey by the Central Association of Sanitary, Heating and Air Conditioning (ZVSHK) from spring 2023 found that more than 80 percent of heating installation companies are capable of installing a heat pump. Strongly increasing interest in heat pump training courses, such as 'Expert for Heat Pump Systems according to VDI 4645' (2020 – 176 attendees; 2023 – 3945, Source: German Heat Pumps Association), confirms a growing willingness of SHK companies to position themselves for the future.

Large, nationwide providers such as Thermondo, aira, Woltair, and Octopus offer streamlined installation processes, promising heat pump installation within approximately one month from order to commissioning.

3.3. Heat Pumps in Existing Buildings

In discussions about the potential applications of heat pumps in existing buildings, the main counterargument is the assumed very high heating circuit flow temperature. This would lead to poor efficiency of heat pumps and thus be an exclusion criterion for the use of heat pumps.

How high the maximum flow temperature can be that a heat pump is capable of delivering depends on many aspects—such as the type of refrigerant or compressor. Standard heat pumps achieve a flow temperature of 55° to 60°C. This is a rather conservative guideline value. So-called 'high-temperature heat pumps' for use in residential buildings can achieve approximately 65° to 70°C (in industry and commerce, this term is reserved for heat pumps that exceed 100°C). Devices that can reach 75°C are also available on the market—for example, heat pumps with the natural refrigerant propane.

Figure 1 shows an overview of efficiency results from air-source heat pumps from six European field studies conducted over the past 20 years that provided comparable values [5-9]. The studies cover installations in Germany, France, Switzerland, and Austria, representing diverse climate zones and building stocks across Central Europe. Except for the "St. Gallen / ETH Zurich" study, the efficiency values were determined by measuring the heat actually provided and the electrical energy required for it and then relating them to each other. In the "St. Gallen / ETH Zurich" investigation, the real internal parameters of heat pumps were measured, and the efficiency of the systems was determined using validated models.

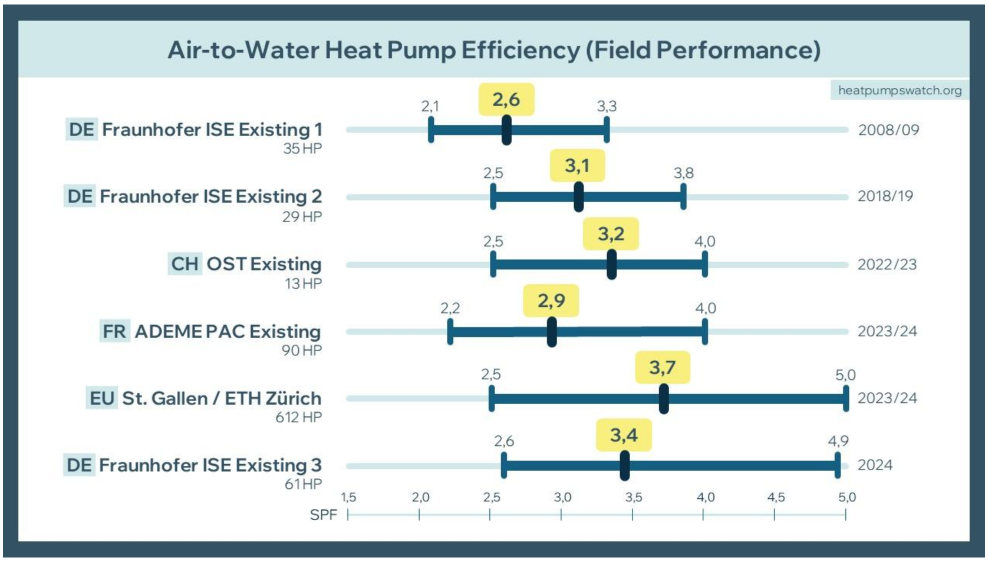

Figure 1. Field Performance of air-to-water heat pumps from six monitoring projects. *Source: heatpumpswatch.org*

The results show that air-source heat pumps in existing buildings achieve an average seasonal performance factor (SPF) of 3.2, demonstrating that existing building stock can be efficiently heated with this technology without extensive renovation measures. These performance figures were confirmed even during extreme weather events. During the cold wave in early 2024, when outdoor temperatures dropped below -15°C in many locations, monitored systems maintained SPF values above 2.0, validating the reliability of heat pump technology under challenging conditions [10].

The progression of these studies over 20 years also demonstrates continuous technical improvement. Modern heat pumps equipped with inverter-controlled compressors, improved refrigerants, and enhanced control algorithms achieve significantly better performance than systems from the early 2000s, particularly in part-load operation which represents the majority of annual operating hours.

3.4. Multi-Family Buildings

The use of heat pumps in multi-family buildings (MFB) is gaining increasing importance, particularly during the energy transition and the rising requirements for energy efficiency in the building sector. While heat pumps were predominantly used in new single-family homes for a long time, technical developments and improved system concepts now also enable economical and efficient use in multi-family buildings—both in new construction and in existing buildings.

The use of heat pumps in MFBs is well documented through many examples from different countries. Nevertheless, the technology is not deployed on a large scale. The reasons for this are both administrative and technical in nature. This applies to both new construction and existing buildings.

The most important technical obstacles to overcome are the required heating capacity and flow temperature as well as access to heat sources for the heat pump.

The diversity of multi-family buildings and their characteristics enables the application of various technical solutions based on heat pumps. At the same time, this diversity leads to individual solutions that can only be applied to a limited extent for large-scale deployment. Therefore, greater standardization of solutions in multi-family buildings is required.

In individual countries, many heat pumps are already being installed in MFBs. For example, in France, the legal situation shows a clear commitment to the technology. There, in just five years, the share of heat pumps in newly built multi-family buildings increased from 4% to 45% [11]. This clearly demonstrates that technological feasibility exists.

3.5. Economic Viability

Heat pump technology has clear ecological and energy efficiency advantages over fossil heating technologies. However, end users predominantly make decisions based on economic considerations. Economic viability strongly depends on energy prices, which affect both operating and investment costs. These costs can be influenced through subsidies, but structural energy pricing plays a more fundamental role.

A critical factor in heat pump economics is the ratio between gas and electricity prices. In Germany, this ratio currently stands at approximately 3:1, meaning electricity costs three times as much per kWh as natural gas. With typical seasonal performance factors of 3.0 to 3.2 observed in field studies, heat pumps achieve comparable or slightly lower operating costs than gas boilers. However, this operational parity alone is insufficient to overcome the significantly higher upfront investment costs, which can be two to three times higher than conventional gas heating systems.

In contrast, Nordic countries maintain gas-to-electricity price ratios near 2:1 through different energy taxation structures. These ratios correlate strongly with heat pump market penetration: Norway (2.0 ratio, 60% market share in heating), Sweden (2.1 ratio, 45% market share), versus Germany (3.0 ratio, 15% market share in new buildings). At a 2:1 ratio, heat pumps achieve substantially lower operating costs that can amortize the higher investment within reasonable timeframes, even without subsidies. This suggests that structural energy price policy—rather than temporary subsidies alone—provides the foundation for sustainable heat pump market growth.

Since the beginning of the war in Ukraine, it has become clear that energy carrier costs can change dramatically in a very short time. For example, between February and July 2022, the gas price in Germany more than doubled, temporarily creating a 5:1 ratio. As a consequence, a heat pump—in a typical existing building—could save up to €3,600 annually in energy costs compared to a gas boiler, making the business case compelling even with high investment costs. However, as gas prices declined in 2023-2024 and the ratio returned to approximately 3:1, the economic advantage narrowed again. This volatility underscores the need for stable, predictable energy price structures rather than reliance on crisis-driven conditions.

The investment cost barrier remains the primary economic obstacle. Even when operating costs favor heat pumps (at the current 3:1 ratio), the payback period of 12-15 years exceeds what many homeowners consider acceptable. This explains why market growth remains heavily dependent on subsidies despite favorable operational economics.

New business models bring realistic opportunities to address this challenge. In most cases, these innovative approaches integrate several components such as PV, energy storage, electromobility, and energy management systems. The integration of artificial intelligence and flexible electricity tariffs offer new opportunities for intelligent and economical use of heat pumps. These integrated systems create "energy autonomy" value propositions that extend beyond simple heating economics, potentially attracting customers motivated by energy security rather than purely financial optimization. More importantly, system integration improves the business case by adding value beyond heating alone, helping to justify the higher upfront investment..

4. Ensuring Sustainable Market Growth: Beyond Targets

Achieving installation targets represents only part of the challenge. Equally critical is establishing steady, sustainable market growth that avoids boom-and-bust cycles. The question is not only whether targets are achievable, but how to reach them through lasting market transformation.

4.1. Three-Pillar Strategy for Market Stability

- *Economic Foundation: Improving the Business Case*

The current gas-to-electricity price ratio in Germany (~3:1) creates a fundamental challenge: while heat pumps achieve comparable operating costs with typical seasonal performance factors of 3.0-3.2, this operational parity alone cannot overcome significantly higher upfront investment costs. Nordic countries maintain ratios near 2:1 through different energy taxation structures, correlating with market penetration rates of 40-60% versus Germany's 15%.

Reducing the ratio to approximately 2:1 through energy taxation reform would establish heat pumps as economically competitive without extensive subsidies. This structural policy intervention creates stable, long-term market conditions rather than temporary incentives, aligning economic incentives with climate policy objectives.

- *Financial Accessibility: Beyond Upfront Costs*

High initial investment costs remain the primary barrier even when operating economics favor heat pumps. Two complementary approaches are essential. First, targeted subsidies or low-interest financing programs focused on lower-income households can prevent a two-tier heating system divided by economic means. Second, "heating-as-a-service" models bundle installation and maintenance into monthly payments, eliminating upfront barriers while demonstrating commercial viability across several European providers.

- *Regulatory Framework: Sequence Matters*

The German experience demonstrates that introducing stringent requirements before establishing favorable economic conditions generates political backlash. A properly sequenced approach—first establish economic competitiveness through price ratio adjustment, then improve accessibility through financing, finally implement regulatory requirements—creates stable, predictable market growth. This timing determines whether regulations accelerate adoption or provoke resistance.

4.2. Market Stability Through System Integration

Integration with photovoltaics, battery storage, and intelligent energy management reduces operational cost volatility while creating multi-benefit value propositions beyond heating alone. This bundling attracts customers motivated by energy independence rather than purely financial optimization, while offering installers higher-margin system sales that support workforce development.

5. Conclusion

Heat pumps are a central technology for achieving climate goals and decarbonizing the heating sector. They are strongly promoted both politically and technologically—both at the European and national levels. Previous obstacles such as insufficient production capacities and lack of skilled personnel have been largely addressed in recent years. Manufacturers have invested massively and many HVAC companies are specifically training to professionally install heat pumps.

The technical applicability—particularly in existing buildings and multi-family buildings—is demonstrably given. Numerous field studies prove the efficiency and reliability of modern heat pump systems, even under difficult conditions. Field data from six European countries show average seasonal performance factors of 3.2 in existing buildings, with systems maintaining efficiency above 2.0 even during severe cold waves. Nevertheless, there continue to be structural and administrative challenges, especially in the area of standardization for complex applications such as in multi-family buildings.

Economic viability strongly depends on energy prices and funding conditions. The gas-to-electricity price ratio emerges as a critical structural factor: Nordic countries with ratios near 2:1 achieve heat pump market penetration rates of 40-60%, while countries with ratios near 4:1 struggle to reach 15% despite technical maturity. This suggests that energy taxation reform may be more important than temporary subsidies for establishing sustainable markets.

Innovative business models that combine heat pumps with PV, energy storage, e-mobility, and intelligent control systems open up additional potential for a sustainable and economically attractive energy transition in the building sector. These integrated approaches reduce vulnerability to energy price volatility and create multi-benefit value propositions that appeal to diverse customer motivations.

From today's perspective, achieving the ambitious heat pump targets is both technically and organizationally feasible—provided that political will, targeted funding, and coordinated implementation remain in place. However, achieving these targets sustainably requires attention to policy sequencing: establishing economic competitiveness through price ratio adjustment before imposing regulatory requirements, and ensuring financial accessibility through innovative financing mechanisms.

Beyond all the myths about alleged technical weaknesses, the heat pump debate is fundamentally a political confrontation. It is not really about the technology itself, but about a political vision for the energy transition. Put sharply, opposition often represents an attempt to enable the continued use of fossil fuels regardless of the associated consequences.

We should not use heat pumps because some politicians are pushing their use or others are calling them "green folly." We should use this technology because it is the best, fastest, and most cost-effective solution for a successful energy transition. Undoubtedly, this solution also presents certain challenges—workforce development, standardization in complex buildings, economic framework conditions—but the alternatives are simply not better. The technical feasibility is proven; the remaining challenge is creating the economic and regulatory environment for sustainable market transformation.

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