

MCS Charitable Foundation

Heat pump rollout in France and the UK

A comparative analysis





Heat pump rollout in France and the UK

A comparative analysis

MCS Charitable Foundation,
www.mcscharitablefoundation.org
Author: Jennifer Russon MSc
June 2023

Acknowledgements

The initial research for this report was carried out for a Masters dissertation at the University of East Anglia and would not have been possible without the generosity of all the interviewees who gave up their time to share information and views on heat pump deployment in the UK and France.

Particular thanks are due to:

Dr Noel Longhurst: The University of East Anglia

Dr Richard Hauxwell-Baldwin: MCS Charitable Foundation
for their continued guidance and support.

About MCS Charitable Foundation

MCS Charitable Foundation is an independent UK-wide charity. Our mission is to accelerate the widespread adoption of renewable energy and low carbon technologies. With growing concern about the climate emergency and energy costs, the need to advance low carbon solutions has never been greater. We want everyone to have access to affordable and reliable renewable energy, so that we can have warm, comfortable homes as part of a resilient, zero carbon future. The Microgeneration Certification Scheme (MCS) was set up by the UK Government to maintain and promote standards in home-grown renewable energy. Since 2018 the scheme has been run by the independent MCS Service Company. MCS Charitable Foundation, set up by UK Government in 2018, is the sole shareholder of the Company, and uses the Company's business surpluses to fund its charitable work and grant-giving programme.

Designed by Jimmy Davies - jimmydavies.com

Foreword



To help decarbonise the 17% of emissions that come from heating our homes, the UK Government has set an ambitious target of 600,000 heat pump installations a year by 2028. This figure, large as it is, is still considerably less than the 900,000 a year that the Climate Change Committee suggest are needed to keep the UK on track to meet its climate targets. Despite an impressive growth in heat pump installations in recent years, we are still only installing around 55,000 a year. Meanwhile, over the channel our neighbours France are managing over 600,000 a year – ten times as many.

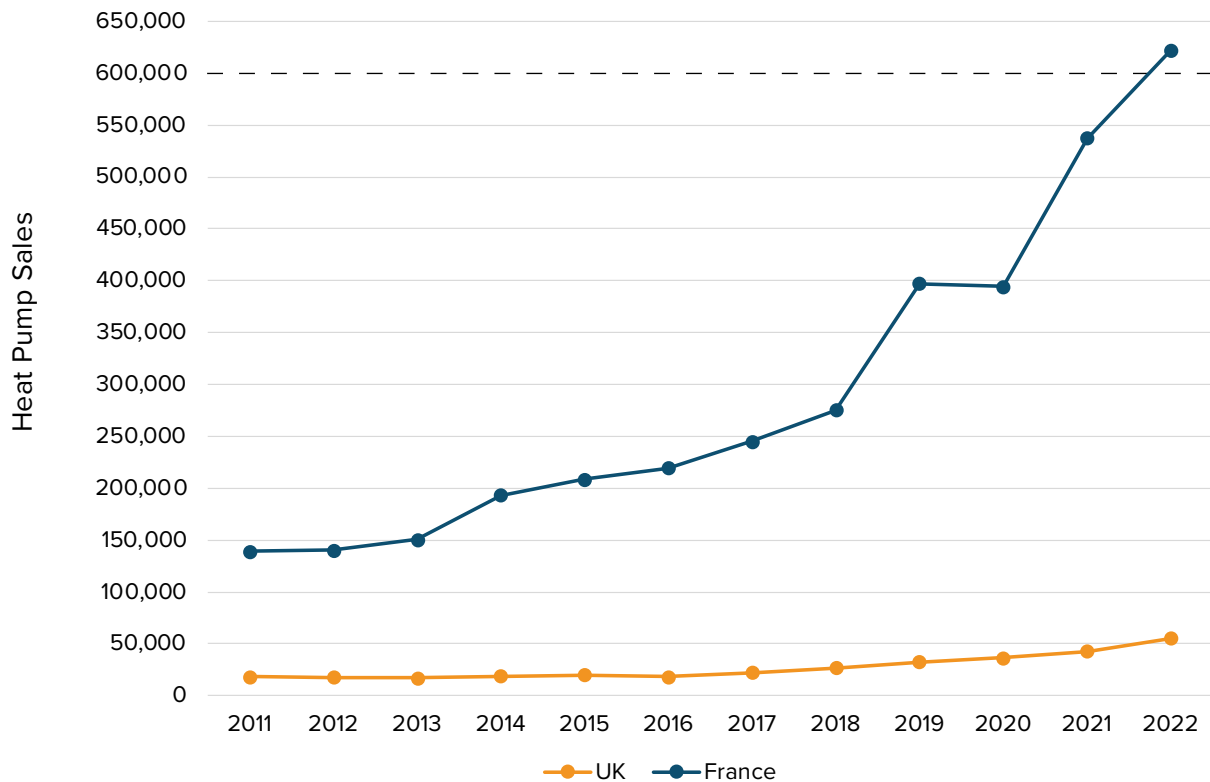
In this timely and thorough report, the author delves deep into the social, economic and policy landscapes of the UK and France to ask: what can we learn from the success of the heat pump rollout in France? The answer is simple, there is no one silver bullet, but instead a range of regulatory, policy and social changes that are needed over a long period of time to drive those numbers upwards. It took France a decade to get from 100,000 to 600,000 heat pump installations a year – we don't have that time, so another key takeaway is urgency. In the UK, we need clear regulation for new homes and certainty about the electrification of heat.

We can do it – and this report sets out a number of key policy recommendations to help us achieve the 600,000 heat pump installations a year target. The report adds weight to the growing body of evidence such as that provided by the Independent Review of Net Zero led by Chris Skidmore MP and the recent Climate Change Committee progress report on emissions reductions that have concluded we must focus on the rapid rollout of available solutions such as heat pumps if we are to have any chance of meeting our climate and net zero goals.

David Cowdrey, Director of External Affairs

Overview

Heat Pump Sales 2011-2022: France and the UK



- Domestic heating accounts for 17% of UK greenhouse gas emissions.
- Heat pumps are low-carbon heating systems that offer a solution to heat decarbonisation.
- In 2020, the UK Government set a target to install 600,000 heat pumps per year by 2028.
- France has currently installed over 10 times the amount of heat pumps than the UK.
- This study compares heat pump deployment between France and the UK from 2008 to understand why France has been more successful and determine what lessons can be learnt.

Contents

Executive Summary:

x

Policy Recommendations

Introduction

What is Carbon Lock-in and why has it been used in this study?

Methodology

Why has France been more successful in heat pump deployment?

‘Contextual’ exogenous factors

Technologies, assets, and infrastructure

Actors and agency

Formal institutions (policy, regulation, standards)

Informal institutions (norms, beliefs, discourse, attitudes)

Knowledge and competences

Microeconomics

Societal factors

Why has the UK had comparatively little success in heat pump deployment?

‘Contextual’ exogenous factors

Technologies, assets, and infrastructure

Actors and agency

Formal institutions (policy, regulation, standards)

Informal institutions (cognitive frameworks)

Knowledge and competences

Microeconomics

Societal factors

The pathway to mass-scale heat pump deployment in the UK:

What lessons can be learnt from France?

Conclusion

Executive Summary

Domestic heating accounts for almost one fifth of greenhouse gas emissions, making it a critical sector to decarbonise for the UK to achieve its legal commitment of net zero by 2050.

Heat pumps are highly efficient, low-carbon heating technologies that many experts believe will play a pivotal role in heat decarbonisation. In the Ten Point Plan for a Green Industrial Revolution in 2020, the UK Government acknowledged this, setting a target to install 600,000 per year by 2028. As the UK installed less than 10% of this in 2022, there will need to be a rapid upscaling of deployment in the next five years to meet this target. At the opposite end of the spectrum, France has had the biggest heat pump market in Europe for several years, and in 2022 they exceeded the UK Government's 2028 target, selling over 600,000 heat pumps.



UK target is to install
600,000 per year
by 2028



France is
6 years ahead
of the UK's target



Until now, there has not been an in-depth comparison of heat pump deployment in the UK and France to try and understand this difference in success.

This report aims to bridge this gap and better understand questions including:

- What has contributed to France's success in heat pump deployment?
- Why has the UK had comparatively low deployment of heat pumps?
- What lessons can be learnt from France's success to help the UK achieve its 600,000 heat pumps per year target?

The answers to these questions have been gathered through a literature review, in-depth policy analysis, and thirteen semi-structured interviews with heat decarbonisation experts from both France and the UK. Analysis was carried out using a carbon lock-in framework, to structure and facilitate the comparison.

Carbon lock-in is the theory that energy systems can become locked into fossil fuels, as elements in the system evolve in a way which favours and reinforces incumbent technologies. This framework considers an energy system as not simply influenced by technological innovations, but instead as a complex system made up of several interlinking elements.

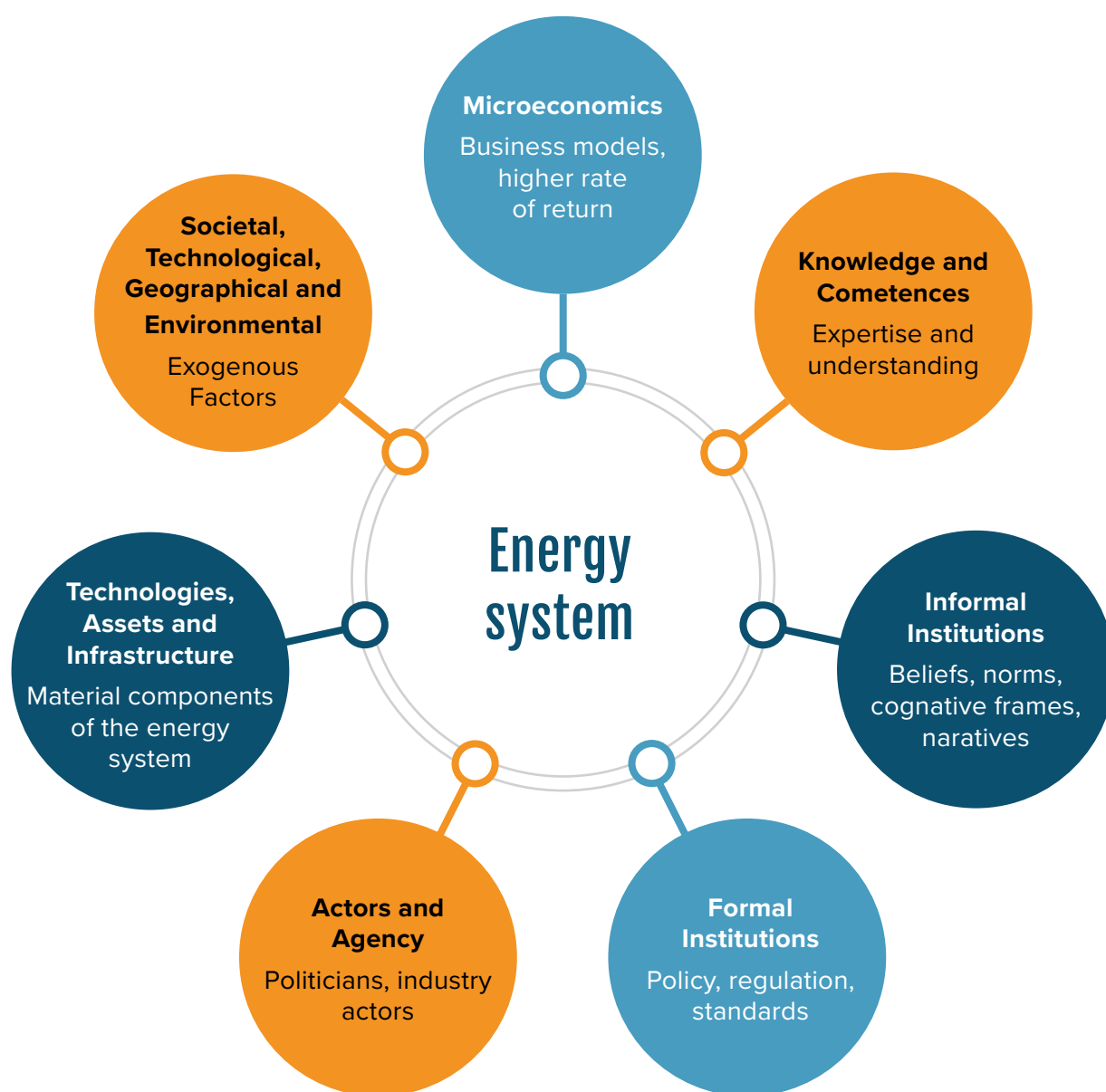


Figure 1: The seven elements of an energy systems according to Trencher et al (2020) framework.¹

Key findings

The overarching conclusion of this study is that France's comparative success in heat pump deployment cannot be attributed to one silver bullet. Equally, there is no one single factor explaining why the UK has had low deployment.

Instead, numerous elements of the energy system have developed in a mutual and self-perpetuating way that has reinforced the use of gas heating impeding the deployment of low-carbon alternatives, including heat pumps. This has not been the case in France, where the landscape for heat pump deployment has been much more favourable. This is in part due to better, longer term policy decisions, but also as a result of a combination of other factors including some geographical and climate elements.

- Since the Yom Kippur oil crises in the 1970s, there has been a drive in France to achieve energy independence. This resulted in the development of the second largest nuclear power program in the world and a well-developed electricity grid. The UK, on the other hand, has had a stable domestic supply of fossil fuels, including natural gas. This resulted in the creation of a well-established gas grid and government-led transition to central heating in the 1960s and 70s.
- Since 2008, France has installed a substantial quantity of reversible air-to-air heat pumps. This technology functions similarly to air conditioning with the added market value of providing both heating and cooling. As France already had an established air conditioning industry due to their warmer climate in the South, there was already prior knowledge, skills, and business models, as well as consumer understanding of the technology which could be transferred to hydronic heat pump technologies.
- France has had a much more diverse mix of heating technologies, with the percentage of homes using gas boilers never exceeding 42%, compared to around 85% of homes in the UK.
- The lobbying power of the gas industry has far outweighed that of the heat pump industry in the UK, whereas France has had a strong electricity lobbying network that have advocated for heat pumps since the 1980s.
- Since 2008, France has had more coherent decarbonisation policy, regulation, and strategy. Conversely, in the UK there has been stop-start financial schemes, the scrapping of efficiency regulations, and a tax regime that has disproportionately favoured gas.

- 
- France implemented its first new build efficiency regulation Régulation Thermique in 2012. This limited new homes (excluding apartment blocks) to a primary energy demand of 50kWh/m²/year. As a result of the implementation of this regulation, the number of air-to-water heat pumps installed in new homes almost tripled in just three years. In contrast, the UK scrapped the Zero Carbon Homes Plan, the equivalent efficiency regulation for new builds, before implementation in 2016.
 - In 2019, in collaboration with industry, the French Government redesigned the financial schemes introducing an upfront grant available to households of all incomes. This resulted in an 80% increase in air-to-water heat pump installations in 2019, as well as continued growth, with a record 346,313 installed in 2022.
 - Since 2008, heat pumps have been better supported in government circles in France than in the UK. Home efficiency was the focus of Emmanuel Macron's presidential campaign in 2017 in response to the riots against the carbon tax which highlighted the issues of fuel poverty. Contrastingly in the UK, the decarbonisation of heat has been politically unappealing as there is no magical policy panacea. Technology agnosticism and the possibility of hydrogen heating has resulted in policy inertia, which has ultimately favoured incumbent gas heating.
 - Since 2008, France has succeeded in building a centralised, end-to-end professionalised heat pump industry that was worth €5.3 billion in 2019 and supported 32,000 jobs. In the same year in the UK, the heat pump industry supported just 2,000 full-time jobs² and is still considered a 'cottage industry'.
 - Up until 2021, running a heat pump could noticeably increase the cost of energy bills for a household in the UK, due to the high price of electricity compared to gas. Due to their expansive nuclear power generation France has had some of the cheapest, low carbon electricity in Europe and in 2020 a heat pump was cheaper per kWh than a gas boiler.

The UK is falling
drastically behind in
heat pump deployment



What lessons can be learnt?

This study shows that there have been ‘contextual’ advantages that explain, to a certain extent, why France has installed more heat pumps. For example, their large nuclear power fleet, strong electricity network, existing air conditioning industry, and more diverse heating mix.

Nevertheless, an invaluable lesson that can be learnt from France’s success is that unlocking mass-scale heat pump deployment cannot simply be achieved by addressing one barrier in isolation. Instead, a holistic approach must be taken to drive systematic change across all elements of the energy system. For example, after the redesigning of financial schemes in France in 2019, there was an 80% rise in sales of air-to-water heat pumps. Whilst the implementation of this grant was clearly an integral policy lever, this growth in the market would never have been possible without a developed heat pump industry and supply chain, as well as consumer awareness and demand.

These elements have been developed gradually in France over the past decade and a half as a result of clearer and longer-term policy and regulation, underpinned by a drive in government circles to move away from fossil fuels and decarbonise homes. Despite the higher upfront cost, cheap electricity prices have provided an economic incentive for consumers to transition, especially households in the South that have a demand for both heating and cooling. Analysing the UK’s experience using the same framework demonstrates that common perceived barriers to the widespread rollout of heat pumps, such as cost, are in fact one factor among many complex and interlinking barriers. Thus, to match France’s success, the UK Government must put in place a comprehensive policy package that addresses all these barriers, driving a whole system transition.

Evidently, upscaling deployment in the timescale needed is an immense challenge, and yet, there has never been a more favourable context for heat pumps in the UK. The energy crisis, exacerbated by Russia’s war on Ukraine has exposed the vulnerability of the UK to volatile gas markets, increasing consumer awareness of the need for home energy efficiency. The recent government announcement in Powering Up Britain implied a commitment to decarbonise heat, with the announcement of plans to extend the Boiler Upgrade Scheme, reform electricity markets, and invest in green skills. Nevertheless, considering the UK’s gas lock-in which has developed over the past fifty years, stronger government intervention and clarity are required to upscale heat pump deployment at the pace and scale necessary to meet urgent decarbonisation targets.

This report provides some key policy recommendations.

Policy Recommendations

1. The Future Homes Standard

Strict regulations must be put in place for new build homes that bans the installation of fossil fuel heating systems. This will create instant growth in demand of low carbon heating technologies, including heat pumps. As a result of France's 2012 energy efficiency regulation *Régulation Thermique*,ⁱ the number of air-to-water heat pumps in new builds almost tripled in just three years.³ As we are over a decade behind France, the Future Homes Standard must be more stringent, ensuring that new homes are fit for the future, namely:

- Every new home must have a primary energy consumption below 46 kWh/m²/year to ensure high fabric efficiency and maximise the performance of the low-carbon heating system.
- No new homes should be connected to the gas grid.
- Every new home must be equipped with solar panels that cover at least 40% of roof space, alongside battery storage and EV chargers. This will lower the running cost of a heat pump, whilst supporting the grid.

2. All heat pump installation companies and products must be MCS or equivalent certified to ensure high standards

It is vital that heat pumps are designed and installed to high industry standards to ensure consumer confidence and satisfaction. Poor design- including oversizing- of gas boilers has been a prevalent issue in the UK heating sector.⁴ This has historically been overlooked because of cheap gas prices that have allowed consumers to run their boiler at a reasonable cost, despite the inefficiency caused by oversizing. Poor design and installation are not as easily concealed in a heat pump system, and instead have a considerable impact on both the efficacy and efficiency of the system.⁵ Currently in the UK, the MCS Service Company is the only standards organisation that offers certification for heat pump design, installation, and products. All standards are written and regularly updated by industry working groups with the purpose of maintaining high standards and providing consumer confidence across the renewable sector.

3. Reform the electricity market

It is positive that the Government has committed to rebalance the cost of electricity and gas,⁶ however it is essential that this is carried out rapidly (within the next 12 months), along with the following policies:

- **Permanently transfer environmental and social levies into general taxation:** This would not only help reduce the cost of running a heat pump, but also shield those at risk of fuel poverty, which the latest estimations predict was at 7.5 million households in April 2023.⁷

ⁱ Which limited primary energy demand in new builds (excluding apartment buildings) to 50kWh/m²/year,

- **Tariffs:** Heat pumps have the potential to provide demand flexibility, helping manage peak electricity times.⁸ This should be supported through the introduction of more time-of-use tariffs, rewarding use in off-peak times with lower electricity prices. Equally, the implementation of social tariffs for electricity would lower the running cost for lower income groups, helping support the most vulnerable to transition.

4. Launch a public awareness campaign and a free centralised home energy efficiency ‘one-stop-shop’

In 2022, the French government launched France Renov,⁹ a centralised ‘one-stop-shop’ where consumers can receive free and independent home efficiency advice online, on the phone, and in-person, with over 450 offices around mainland France. The UK Government must invest in a similar coordinated platform to help streamline the experience for consumers and key supply chain members. This must be paired with a public awareness campaign to inform consumers and installers of this resource, as well as the importance of home efficiency in reducing energy bills.¹⁰

5. Develop a clear, long-term strategy, including a ban on new oil boilers from 2026 and a ban on new gas boilers from 2033

Legislating bans on fossil fuel technologies is a necessary signal to industry, giving key actors time to invest in low carbon heating technologies, including developing skills and business models. It is also important to give consumers long-term clarity, so that they have sufficient time to research and prepare for the transition.

6. The extension and expansion of the Boiler Upgrade Scheme and the permanent zero-rating of VAT on energy saving materials

Bans on polluting heating technologies must be accompanied by government subsidies and grants to help ease the transition for consumers and make installing a heat pump reach cost parity with incumbent heating systems. To achieve this, the Government must extend the Boiler Upgrade Scheme to 2033 in line with the recommended ban on gas boilers¹¹ and increase the funding exponentially to support more households. This should include a full subsidy for the most vulnerable, fuel-poor homes, as well as an off-gas uplift to support those affected by the ban of oil heating from 2026 (see above recommendation). Equally, the Government should implement a permanent zero-rating of VAT on energy saving materials, to reduce the upfront cost of heat pumps.



**In 2022 the French
heat pump industry
supported 45,000 jobs**

7. The introduction of a government supported home efficiency low interest loan

To break the 'boom-bust' cycle and facilitate the development of self-sufficient heat pump industry, the UK Government must support the development of a range of green finance packages, where consumers can access low interest loans. For example, the launch of Property Linked Finance, a loan that is attached to the property instead of the individual. Eligibility criteria for these loans should include whole house retrofit, insulation measures, and low carbon energy technologies. With low interest rates and long payback times (10-25 years), monthly repayments should be equal to or lower than what the household is saving in reduced energy bills through increased efficiency. This type of loan limits the financial burden on the individual, whilst also generating the much-needed private finance to fund the low-carbon transition.

8. The Government must support the development of a highly skilled and diverse heat pump workforce

It was positive to see the Government's acknowledgement of the need to develop low-carbon skills in the recent Energy Security Day.¹² However, the Government must go further to ensure the long-term development of a diverse and well-skilled heat pump workforce. For example, the Heat Training Grant should be extended from 2 to 5 years and support at least 20,000 installers. Additionally, all heat engineering college courses should be reformed to include a compulsory low-carbon heating module, with the termination of gas boiler engineering training from 2028.

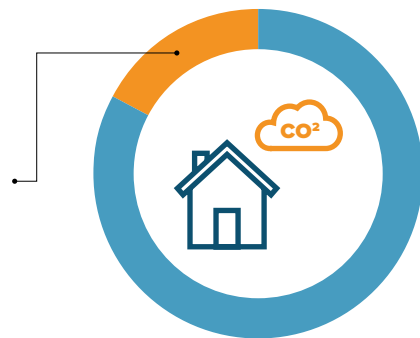
9. The creation of a cross departmental task force

Heat pump policy cannot be made in isolation. As seen from the policy recommendations above, it involves skills, building regulations, electricity markets, green finance, heat pump policy, to name but a few. Above all, it requires a coordinated approach, good communication between national and local governments, information sharing so that lessons can be learnt from successes and failures, as well as long-term planning. An independent, cross departmental task force for the decarbonisation of heat, which is voted in every 10 years, must be created to coordinate mass-scale heat pump deployment and ensure that heat pump policy goes beyond spending reviews and is not impacted by changes in government or vested interests.

Introduction

Through the 2008 Climate Change Act, the UK Government set a legally binding commitment to reach net zero by 2050.¹³ Whilst there has been some progress in heat decarbonisation - with emissions roughly 30% lower in this sector compared to 1990 levels¹⁴ - domestic heating still accounts for 17% of the UK's emissions,¹⁵ making it a critical sector to decarbonise.

domestic heating still accounts
for 17% of the UK's emissions



Heat pumps are low-carbon heating systems that use electricity to transfer heat from a 'sink' to a 'source' using a liquid refrigerant, compressor, and evaporator system.¹⁶ What makes heat pumps unique is their ability to make use of the latent heat from their surroundings. As a result, there is always a higher useful heat output for every one unit of electricity input,¹⁷ known as the Coefficient of Performance (COP). This makes heat pumps considerably more efficient than other heating systems that can only achieve a maximum theoretical efficiency of 100% in the case of electric heating systems, and around 92% in the case of gas boilers.

One in-situ study in the UK in 2017 calculated an average seasonal COP (SCOP) of 2.65 for air source heat pumps (ASHP) and 2.81 for ground source heat pumps (GSHP),¹⁸ whilst a more recent study found the median SCOP of an ASHP had improved to 2.8.¹⁹ Heat pumps are not only highly efficient, but also have the potential to be zero carbon in line with the decarbonisation of the electricity grid by 2035.²⁰

Many experts believe that heat pumps will play the leading role in heat decarbonisation,²¹ with the Climate Change Committee modelling the installation of 19 million heat pumps by 2050 to achieve net zero.²² This presents a significant challenge as the UK has only installed approximately 370,000 heat pumps to date.²³ To put it into context, installing 19 million heat pumps at the current rate of deployment would take 700 years.²⁴

Despite claiming to be a world leader in fighting climate change,²⁵ the UK is currently falling behind many European countries in heat pump deployment. In the latest market update from the European Heat Pump Association, out of the 24 countries analysed, the UK had installed the lowest number of heat pumps per thousand homes.²⁶

On the opposite end of the spectrum, France has had the biggest heat pump market in Europe for several years, installing 3.2 million units to date - almost ten times that of the UK.²⁷ Mainland France (on which this study focuses) has a similar number of homes as the UK and they are both wealthy, western European countries with developed energy systems.²⁸ What's more, both countries legally committed to net zero in the Climate Change Act (2008) and the Loi Grenelle (2009),ⁱⁱ and both signed the Paris Agreement in 2015, reaffirming their commitments to reach net zero in order to keep global warming levels below 1.5°C.

This report aims to explore the reasons why France has had more success in heat pump deployment compared to the UK, despite these similarities in context and climate change legislation history. To answer this question, it uses data gathered from a comprehensive literature review, policy analysis, and thirteen interviews with British and French heat decarbonisation experts. As the UK legally committed to net zero in 2008, followed closely by France, this comparison focuses analysis from 2008 to present.

First, it explores what carbon lock-in theory is and how it has been used to facilitate this comparison. Next, it presents the findings of this study; the reasons why France has been successful in heat pump deployment, followed by the reasons why the UK has not. Finally, it summarises the practical lessons that can be learnt from this comparison and what the UK Government must do to rapidly upscale heat deployment.



ⁱⁱ This obligated France to reduce greenhouse gas emissions by 75% by 2050.

What is Carbon Lock-in and why has it been used in this study?

Carbon lock-in is the theory that energy systems can become locked in to fossil fuels, as elements in the system evolve in a way which favours and reinforces incumbent technologies.²⁹

These elements have a self-perpetuating tendency, which means that over time transition to new, low-carbon technologies becomes more difficult.³⁰ According to this theory, energy transitions are not simply influenced by technology innovations, such as the invention of a new heating system, but instead are more complex and influenced by many elements, as shown in **Figure 2**.

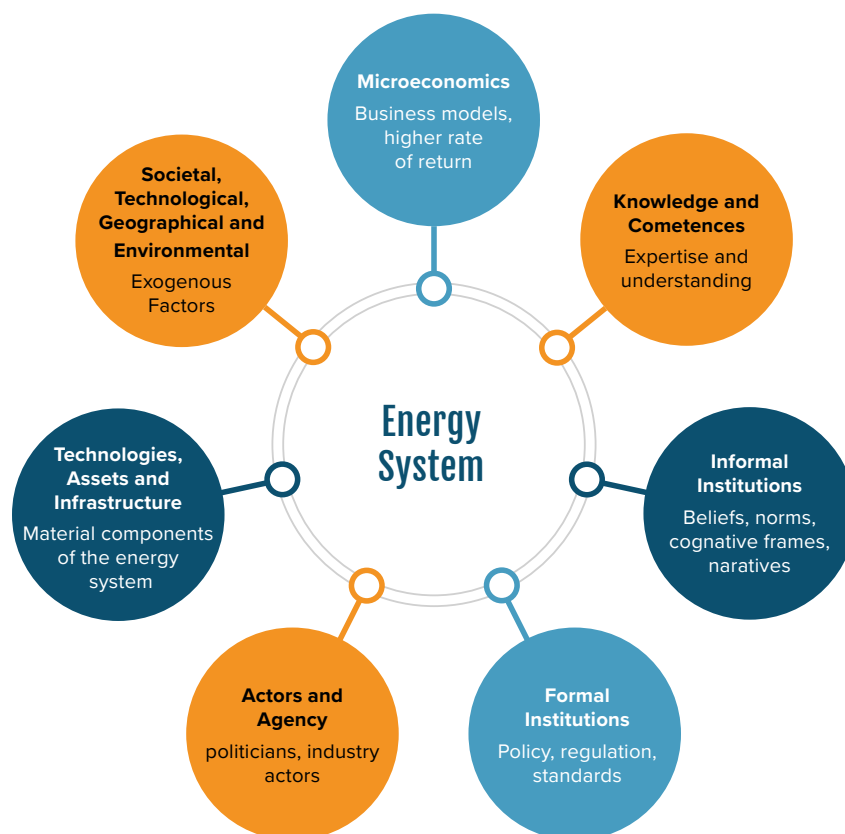


Figure 2: The seven elements of an energy system according to Trencher et al (2020) framework.

A carbon lock-in framework, as illustrated in **Figure 2**, was chosen to facilitate this comparison as it considers a broad range of factors that can impact heat pump deployment, thus allowing for a more in-depth comparison between both countries. This approach also allowed for a more holistic view to be taken, in which individual elements are considered as one part of the wider context of the energy system, resulting in no one single barrier being studied in isolation.

Methodology

To answer the main research question data was gathered through a literature review, policy analysis, and semi-structured interviews with heat decarbonisation experts in France and the UK.

Interviews were chosen as they allowed for a more in-depth and open exploration of the subject, which was critical for this research question.³¹



Thirteen interviews were carried out, six with UK experts and seven with French experts. The two main questions that the interviews were based around were

“Since 2008, what have been the main barriers to mass-scale heat pump deployment?”

and

“Why do you think France has been more successful in heat pump deployment?”

To gain personal views that were not influenced by organisational views or political commitments, the interviews were anonymous.³²

The interview data was analysed using the carbon lock-in framework by illustrated in **Figure 2**.

The original framework grouped together all societal, technological, geographical, and environmental exogenous factors.³³ These are elements outside of the energy system that nevertheless can have an influence, such as the climate or the energy endowment of a country.

It became clear in the analysis of the data that societal factors were highly significant in heat pump diffusion, and therefore the framework was modified to include this as a separate theme.

Why has France been more successful in heat pump deployment?

Despite sharing some common barriers to mass-scale heat pump deployment, such as high upfront cost, there are many factors that explain why France has had more success in heat pump deployment.

These elements are illustrated in **Figure 3** and will be discussed in more detail in this section.

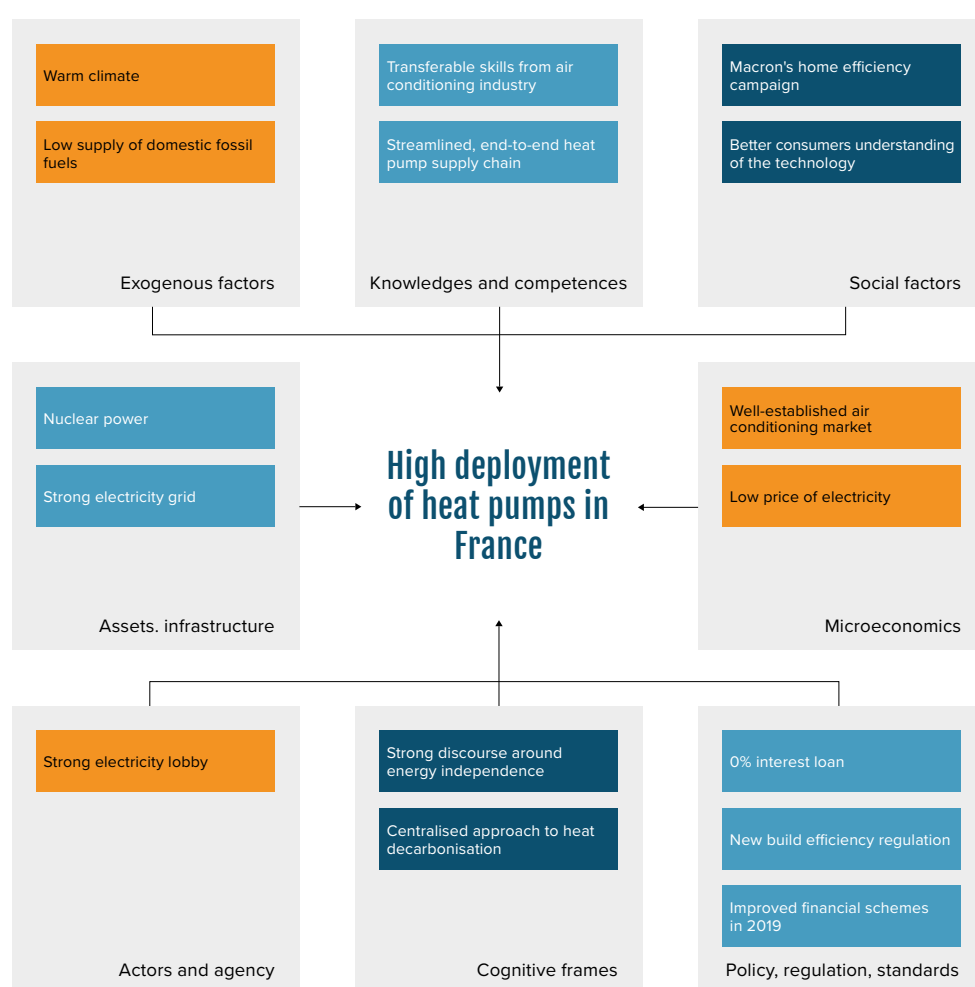


Figure 3: The factors explaining why France has had higher deployment of heat pumps.

'Contextual' exogenous factors

Exogenous factors are elements outside the energy system that can nevertheless have an impact, such as geographical factors. On the one hand, they can reinforce stability, perpetuating lock-in, however they can also create instability and help to break carbon lock-in. In France's case, the exogenous elements have provided a more favourable context for heat pump deployment.

France have had a limited domestic supply of fossil fuels which left them more vulnerable to volatile foreign markets: France is a 'low endowment' country which means that they have mostly relied on fossil fuel imports. This affected them first during WWI and WWII, but most importantly in 1973 and 1978 during the Yom Kippur war oil crises.³⁴ As a result, the electrification of heat started much earlier, in alignment with the construction of nuclear power stations in the 1970s.³⁵

France has a warmer climate in the South and therefore a well-established air conditioning market: The South of France has warm summers and mild winters thus, as one French expert observed, "there isn't really a need for a strong heating system, especially in small apartments."

Instead, there is a demand for air conditioning. France has installed a considerable amount of air-to-air reversible heat pumps. This heat pump distributes heat as air instead of using a water system. The water heating can instead be provided by sanitary hot water heat pumps.

Since 2010, the market for air-to-air and sanitary water heat pumps has seen a steady rise despite no government financial support, as seen in **Figure 4**. One of the French participants attributed this to the fact that air-to-air heat pumps are cheaper and easier to install, whilst saving the household three times the amount of electricity for both heating and cooling. In the UK, the majority of heat pumps deployed have been air-to-water heat pumps, despite 9% of UK households using electric heating, of which air-to-air heat pumps are the natural replacements, according to one French expert. This was echoed by a recent WWF report that found that air-to-air heat pumps were often the most suitable replacement for electric heaters or small apartments.³⁶

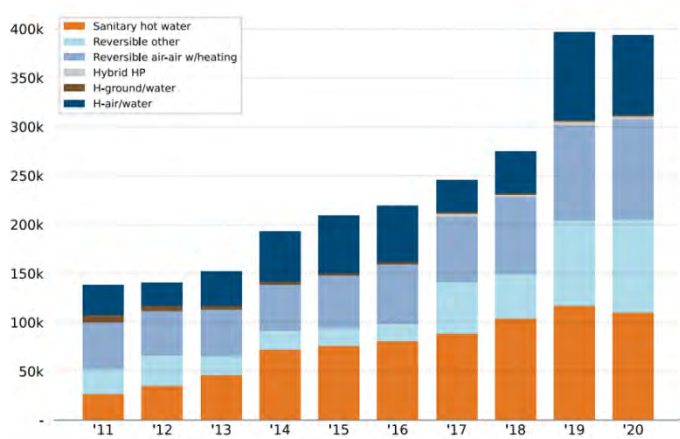


Figure 4: Heat pump deployment by technology in France from 2011-2020 (EHPA,2021).³⁷

Technologies, Assets, and Infrastructure

Technologies, assets, and infrastructure can perpetuate carbon lock-in, posing barriers to low-carbon alternatives. Existing infrastructure may be incompatible with new technologies, making change disruptive and costly. Additionally, there are sunk costs and assets associated with incumbent technologies that actors want to maintain, for example, the gas grid. Unsurprisingly, there have been infrastructural barriers to heat pump deployment in France. Most notably, a significant proportion of the building stock in French cities is made up large apartment blocks. Finding a suitable heat pump technology for these buildings has proven challenging and in 2019 heat pumps only made up 5% of the market.³⁸ However, there are also elements of France's infrastructure that help explain their relative success.

In France, the percentage of homes connected to the gas grid has never exceeded 42%:

France's energy mix for heating has historically been more varied, including oil, gas, biomass, and electric heating as seen in **Figure 5**; a quite common mix for countries with limited domestic fossil fuels.³⁹ As a result, the gas grid is not as big an asset in France as it is in the UK.

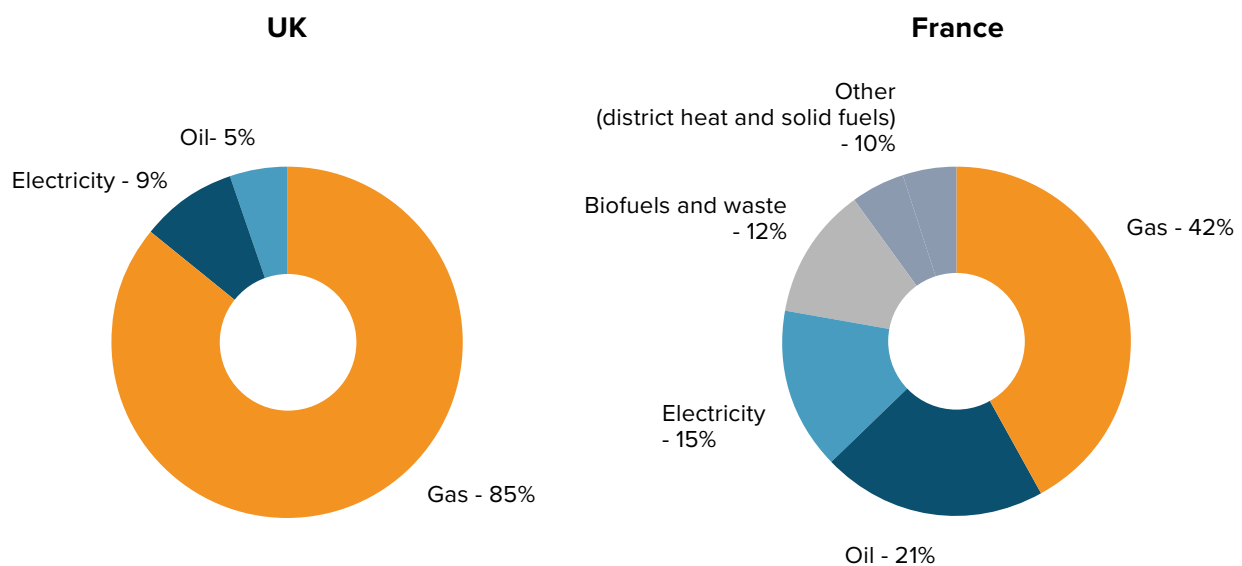


Figure 5: The heating mix in France and the UK.⁴⁰

Since the development of nuclear power in the 1970s, France has had a well-developed electricity grid:

As one French expert remarked, thanks to the development of nuclear power and the electricity grid,

“all electric systems in France are favoured”.

As the electrification of heat started much earlier, heat pumps were “the natural replacements” for the existing direct electric heaters.

Actors and Agency

Incumbent human actors, such as firms, industry organisations, and politicians, can perpetuate lock-in through continuing to support incumbent technologies, as well as resisting low-carbon alternatives. Whilst France has experienced some lobbying from the gas network, key actors in government and industry have supported heat pump deployment.

There has been a strong electricity lobbying power in France that have advocated for heat pumps: Despite some gas lobbying in France, there has been a more equal balance of power between the heat pump and gas industry. As one French expert affirmed,

“the electricity industry has a lot of lobbying power and these electricity companies have advocated for heat pumps.”

EDF especially has promoted heat pumps since the 1980's.⁴¹ Furthermore, hydrogen for heating lobbying is not as prevalent. One of the French participants recounted that in both industrial and political spheres in France hydrogen is not considered as being a viable fuel for the next 20 or even 50 years and thus, not considered by the government as a solution to low-carbon heating in the near future.



Formal Institutions (policy, regulation, standards)

Formal institutions, such as public policy, regulation, and standards can catalyse energy transitions through subsidising low-carbon alternatives, banning fossil fuel technologies and creating standards of efficiency.

Conversely, the lack of policy and regulation can instead exacerbate lock-in. France has had more coherent and longer-term policy over the past 15 years, which partly explains how they have succeeded in developing the market. As one of the French experts observed:

“Regulation, bans, and financial aids must be implemented together. You must introduce regulations to make the consumer change their behaviour, but you must also support them whilst they are doing it.”

France has had new build energy efficiency regulation since 2012: France introduced Régulation Thermique in 2012, which required all new build houses (excluding apartment blocks) to have a maximum primary energy consumption of 50kWh/m²/year.⁴² Several of the French participants attested to the significance of this in heat pump development in France, as the number of air-to-water heat pumps in new homes almost tripled in just three years.⁴³ In 2020, France introduced Régulation Thermique 2020, a more stringent regulation based around the concept of ‘positive energy’. Essentially, a new build home must generate more energy than is used by the household for utilities, heating, lighting, hot water, and auxiliaries. This requires homes to not only improve their energy efficiency and install heat pumps, but also install energy generating technologies, including Solar PV and Solar Thermal.⁴⁴

In 2019, France redesigned their financial schemes and opened them up to the ‘able-to-pay’ market: One French expert stressed the importance of stable policy to develop the supply chain and market. They argued that it was due to uncertain and unstable financial schemes that France did not see much progress from 2008 to 2018 in air-to-water heat pump deployment. For example, the tax credit scheme from 2005-2020 was inconsistent changing year on year and the only upfront grant, Habiter Mieux, was exclusively for low-income groups.

All of the French participants attribute the substantial growth in the market of air-to-water heat pumps in 2019 to improved financial schemes for the end-users, with firstly Le coup de Pouce Chauffage (2019), followed by Ma Prime Renov (2020). There was a “massification” of financial aids, as they say in French, in which the upfront grants were opened to everyone regardless of income.ⁱⁱⁱ One French expert explained that industry members collaborated with government to redesign the financial schemes to streamline the experience for consumers and supply chain members.

ⁱⁱⁱ Ma Prime Renov is means tested, however, with lower income groups receiving more money. The grant also depends on the work, as well as the type of property.

Energy companies in France have subsidised heat pumps since 2005: The financial aids to help consumers buy a heat pump in France have used a combination of public and private money. In 2005, the French government launched the Certificats d'Economies d'Energie which necessitated all French companies selling energy to financially support a certain percentage of low-carbon and energy efficient technologies, including heat pumps.⁴⁵ Many of the French participants said this had a significant effect on the heat pump market, one calling it a

“formidable accelerator.”

This was further reinforced in 2019, when energy companies volunteered to sign a government charter agreement called Le Coup de Pouce (2019); an extra financial aid for heat pumps, which between 2018-2019 contributed to an 80% increase in sales of air-to-water heat pumps.⁴⁶ In France, if you combine Ma Prime Renov, with the Certificats d'Economies d'Energie a low-income household can receive €10,000, an intermediate income €9,000, and a higher income €4,000.⁴⁷

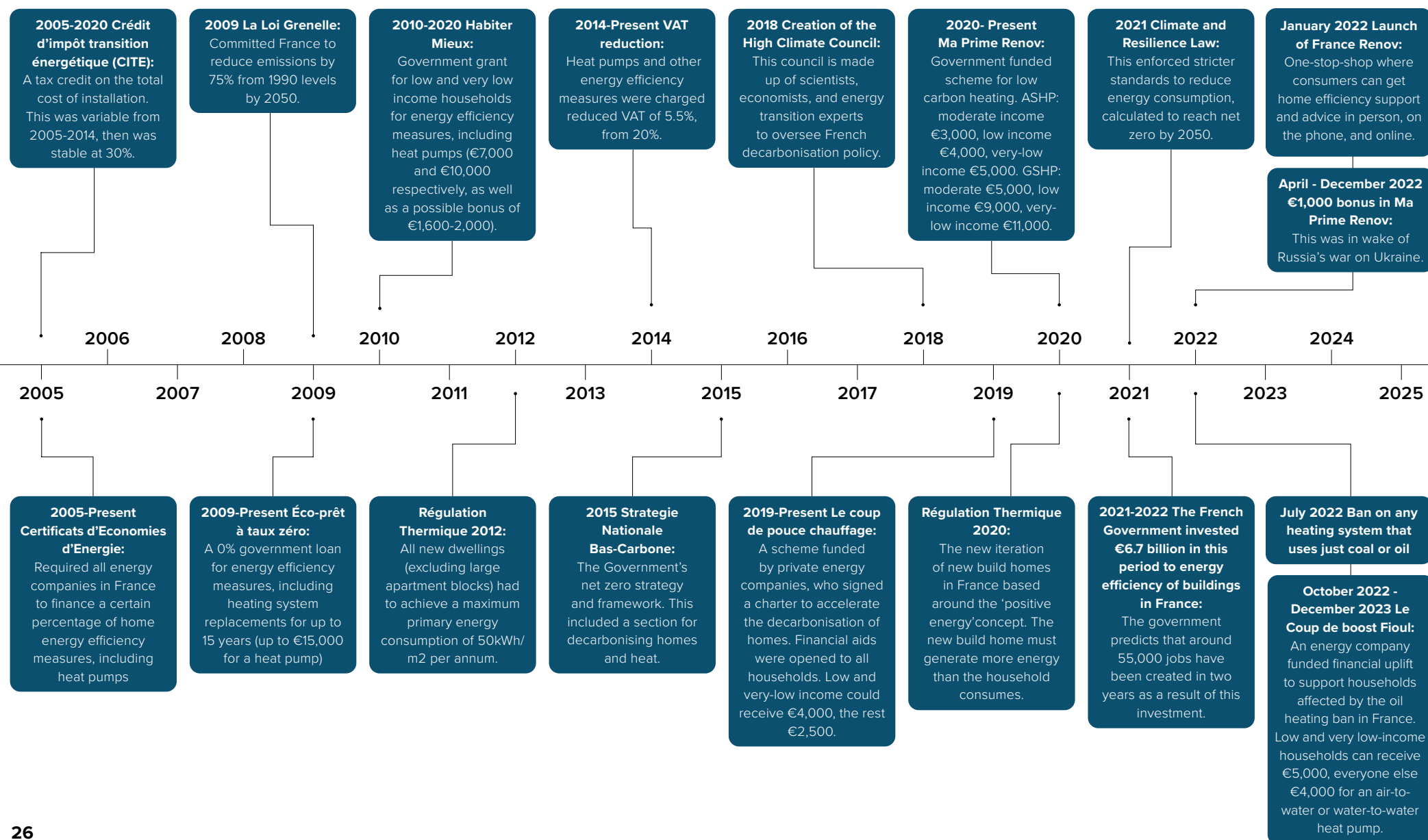
Since 2009 France has had a 0% interest loan for energy efficiency measures, including heat pumps: For the able to pay market in France who are not eligible for a complete subsidy, there has also been a 0% loan from 2009 which allows up to €15,000 to install a heat pump paid back over 15 years.⁴⁸ Though it may not be as significant an accelerator as the grants, one French expert argued that it has nevertheless been extremely important in allowing people without the upfront capital to still have access to a heat pump.

In 2019, France announced a ban on new boilers that exclusively use oil or coal from July 2022: In 2016, 21% of households used oil heating, all of whom will have to opt for a low-carbon heating system in the coming decade.

In 2022, the French Government launched a one-stop-shop to streamline and coordinate mass-scale retrofit: The poor building stock in France and the UK has been a barrier for both countries.⁴⁹ Experts from both countries stressed the importance of a coordinated, fabric first approach to energy efficiency, which has been lacking. France has tried to address this with the launch of France Renov, a centralised one-stop-shop platform where consumers can access advice in person (with over 450 offices), online, and on the phone.

Consumers can contact installers, as well as find out what grants and loans they are eligible for. All the French participants believed that this was going to be critical in streamlining the experience for both consumers and members of the supply chain.

Figure 6: France policy timeline



Informal institutions (norms, beliefs, discourse, attitudes)

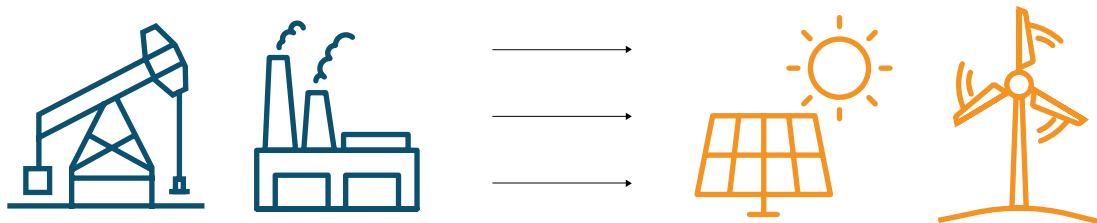
Informal institutions are cognitive frames, such as world beliefs, norms, discourse, and attitudes, that can reinforce path dependency by producing a ‘blinding effect’, as they are slow to develop and thus hard to change.

Nonetheless, some existing cognitive frames in France have acted as a positive lever to heat pump deployment.

Since the 1970s oil crises, there has been a drive in France for energy independence and to move away from foreign fossil fuels: According to one French industry expert, the drive for energy independence in France has resulted in the government promoting the use of domestic electricity to reduce reliance on fossil fuel imports. As one French interviewee recounted,

“France was heavily affected by the increase in oil prices in 2008, which spurred the government to promote heat pumps once again.”

Heat pumps provided a solution to reducing energy consumption, whilst also encouraging the use of domestic electricity.⁵⁰



The decarbonisation approach of France, especially in recent years, has been government led and centralised: This is in keeping with France’s more coordinated free-market approach which includes more government intervention.⁵¹ This is different from the UK approach, where there is tendency to rely on market mechanisms to bring about change. This could explain why there have been more consistent and stringent regulations and bans in France, such as Régulation Thermique 2012 and the ban to oil heating from July 2022- both important policy levers for heat pump deployment.

Knowledge and Competences

Knowledge and competences can contribute to lock-in as incumbent skills and knowledge are biased towards status quo technologies. Whilst France has had some difficulties in developing a workforce to install heat pumps, they have had some advantages compared to the UK.

France already had an established air conditioning industry which gave them greater knowledge and skills in heat pump manufacturing: Air conditioning is a very similar technology to heat pumps, especially air-to-air, which are also reversible. Daikin, a French heat pump manufacturer, has been producing air conditioning units since 1924. Consequently, as one expert who works for Daikin recalled

“it was easy for these manufacturers to start producing heat pumps...Air-to-air heat pumps are practically the same.”

France also had a potential workforce from two different avenues. There were the gas boiler installers on the one hand, and the electricians that installed air conditioning on the other.

France have succeeded in developing a professionalised and commercialised industry: The French heat pump industry was worth €5.3 billion and provided 32,000 jobs in 2019.⁵² This grew to €6.2 billion in 2022, providing 45,000 jobs with 30 factories around France.⁵³ As one French expert remarked, it has become a “well developed industry”, in which 85% of air-to-water heat pumps are manufactured in France.⁵⁴ One French expert revealed that:

“The French government has prioritised developing the French heat pump industry, helping to financially support the development of factories, investing in research and development to promote the French heat pump business above all.”

There has been a steady increase in installers in France which has mirrored the steady increase in demand. The industry expert maintained that this process

“simply takes time and is mostly due to the natural development of the industry over 10 years.”

There was a significant tipping point in 2021, however, in which 12,000 tradespeople received qualifications in heat pump installation or maintenance.⁵⁵ This was four times the amount compared to 2016.

Microeconomic

Microeconomic factors can have an influence on industry actors and consumers, which lead them to favour status quo technologies and business models. For businesses, there is the idea of ‘increasing returns’ in which financial and non-financial benefits, such as expertise, increase over time for incumbent technologies. France have experienced some economic barriers, including the high upfront cost of heat pumps. However, some microeconomic factors have provided a more favourable context for heat pump deployment compared to the UK.

Electricity has been historically cheap in France: Due to France’s domestic supply of nuclear electricity, domestic electricity prices have been historically cheap compared to the UK, as seen in **Figure 7**. In 2020, running a heat pump was cheaper than running a gas boiler in France, 0.06€/kWh compared to 0.08€/kWh.⁵⁶ Thus, there has been an economic incentive for consumers to transition in France.

Domestic Price of Electricity from 2010-2020 in France and the UK

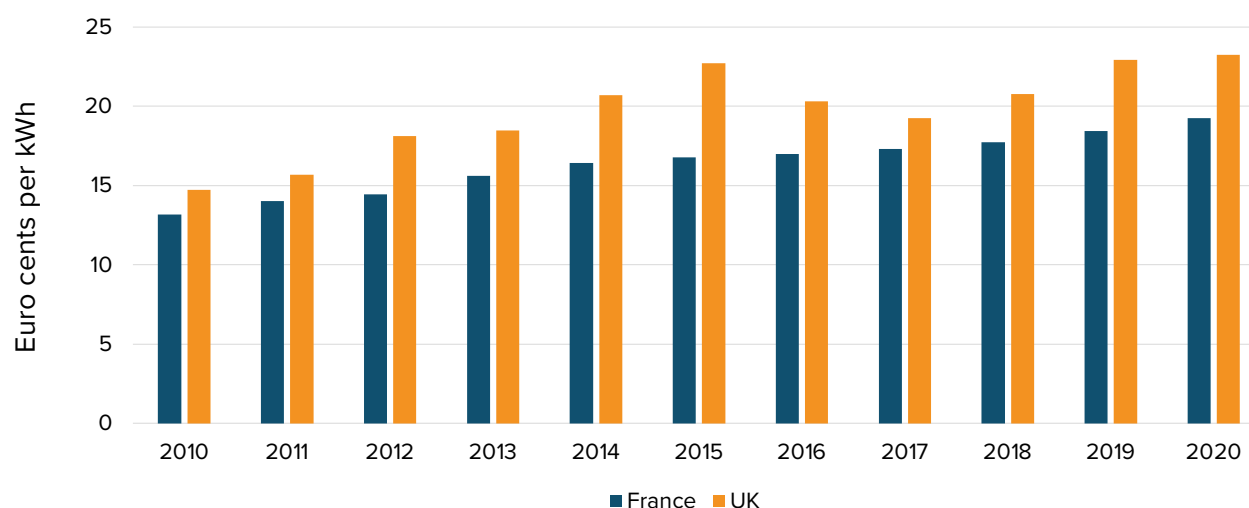


Figure 7: Domestic Price of Electricity in France and the UK from 2010-2020.⁵⁷

Many air conditioning manufacturers did not have to change their business model drastically to start producing heat pumps: This process was more complex for the gas industry, as there was a certain level of procurement of parts and a certain investment in knowledge that needed to take place. One French expert observed that there needs to be an incentive for the gas boiler manufacturers to invest in this knowledge and equipment. This can arguably only occur due to growth in demand. They observed,

“gas boiler companies want to represent all areas of the market. They don’t want to miss out on a [heat pump] market that has doubled in a year.”

Societal factors

Societal factors consider the influence of consumer elements that can reinforce status quo technologies. Societal factors could be considered ‘inside’ the energy system (satisfaction with gas boilers), or ‘outside’ the energy system (climate change apathy). All the participants affirmed the importance of consumer engagement in heat pump deployment, maintaining that climate apathy, lack of consumer awareness, and consumer distrust have all been significant challenges to heat pump deployment in France. However, France has been more successful than the UK at addressing this barrier, although many participants affirmed that more progress must be made in the future.

Home efficiency was the focus of Emmanuel Macron’s presidential campaign in 2017: Energy efficiency in homes has been a major focus in France since Emmanuel Macron’s presidential campaign.⁵⁸ It was his response to the Gilets Jaunes riots that erupted after the imposition of the carbon tax, which highlighted the issue of fuel poverty throughout France.⁵⁹ As one French decarbonisation expert recounted,

“energy efficiency of homes was THE thing of Macron’s government.”

In fact, many of the participants who worked for the French Government recounted that whilst they had not directly advertised heat pumps, the overall campaigns around home efficiency, along with the publicity around the financial aids and grants had been responsible for raising awareness.



Consumer understanding of air conditioning has led to a better consumer awareness of heat pumps: One French industry expert explained that recent digitalisation had allowed the analysis of consumer use of air conditioning and reversible heat pumps. The study found that 40% of the time the machine is switched off, 20% of the time it is used for cooling, but that 40% of the time it is used for heating. To this they added:

“Has an awareness of air conditioning helped create an understanding of air-to-air heat pumps? Yes, because they were mostly using air conditioning units for heating anyway.”



“Regulation, bans, and financial aids must be implemented together. You must introduce regulations to make the consumer change their behaviour, but you must also support them whilst they are doing it.”

French decarbonisation expert

Photo credit: Vaillant Group

Why has the UK had comparatively little success in heat pump deployment?

This section analyses the UK's experience using the same framework, to explore the factors that have contributed to the low deployment of heat pumps since 2008, as illustrated in Figure 8.

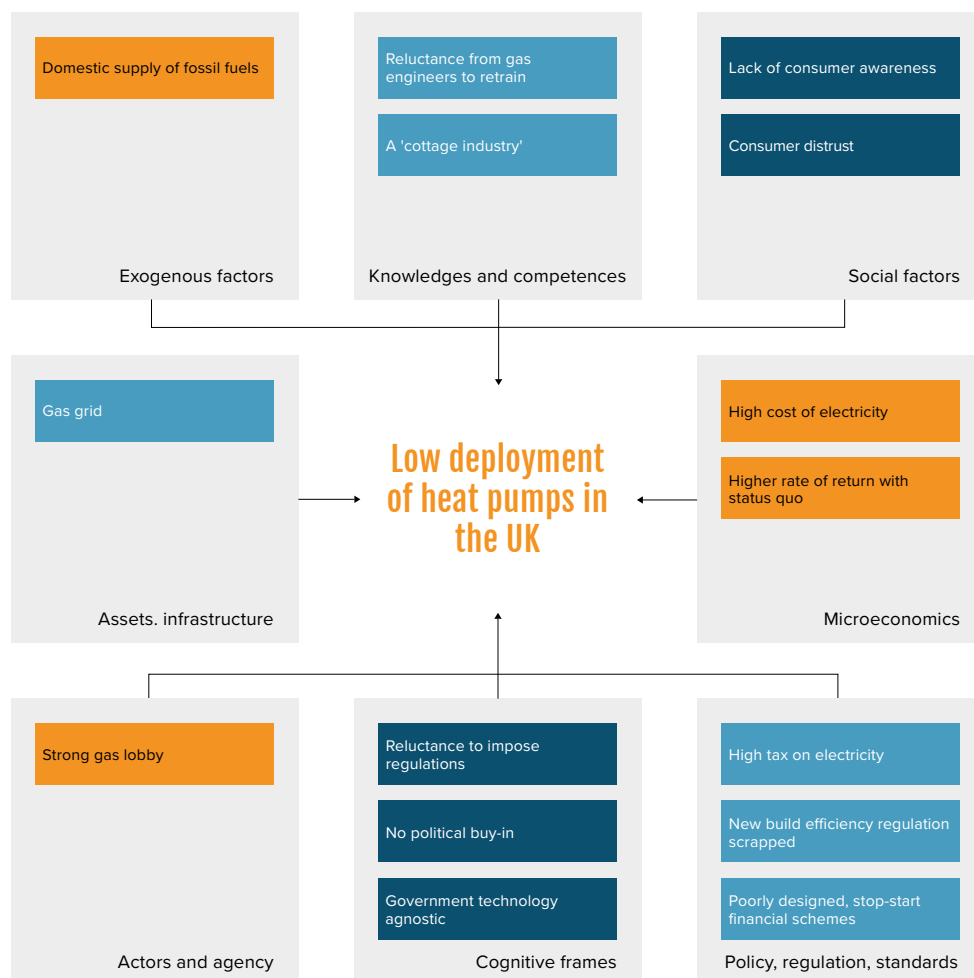


Figure 8: The factors that have contributed to the UK's low deployment of heat pumps.

‘Contextual’ exogenous factors

Unlike France, the exogenous ‘contextual’ factors have arguably been the founding cause of low heat pump deployment in the UK.

Since the industrial revolution, the UK has had a strong domestic supply of fossil fuels: The UK has historically had a stable energy system in term of fossil fuels, with domestic supplies of coal, oil, and gas.⁶⁰ As one of the UK participants remarked:

“To quote Maggie Thatcher as she always said, Britain is an island surrounded by fish and built on coal. It's always been the case that the UK has had this domestic supply of oil and gas. We've always had quite a resilient energy system.”

The nationalisation of the gas network facilitated a state-driven scheme towards gas central heating.⁶¹ This led to the development of a ubiquitous gas network, a powerful gas boiler industry, cheap gas heating, as well as skills and knowledge in gas heat engineering.



Technologies, Assets, and Infrastructure

Technologies, assets, and infrastructure in the UK have reinforced carbon lock-in, contributing to the low deployment of heat pumps in the UK.

85% of homes in the UK are connected to the gas grid: The gas grid has been a significant barrier to heat pump diffusion in the UK, with around 85% of domestic households using gas central heating.⁶² In the UK, there are high sunk costs associated with the gas grid. The UK ‘gas giants’ want to continue to exploit their asset according to one UK expert,

“as they ploughed in huge amounts”, rather than have miles of empty piping.

Actors and Agency

Incumbent actors in the UK have perpetuated carbon lock-in in the heating sector by lobbying for business as usual.

There has been a power imbalance between the heat pump and gas industry in the UK: A UK policymaker confided:

“I would love to do a Freedom of Information request to find out how many meetings ministers have had with gas boiler manufacturers compared to heat pump manufacturers...”

Another expert added that whilst the government should be neutral and make decisions based on the evidence:

“...that's a really difficult thing to do because obviously the people that the government regulates in the main are the gas industry, so obviously they have to think about what their views are.”

Hydrogen lobbyists in the UK are closely linked to the gas lobbyists, who want to maintain the gas grid by using hydrogen as a fuel for heating, which they argue leads to less consumer disruption.⁶³ According to one UK expert, hydrogen lobbying has been a significant cause of policy inertia in recent years, leading to a lack of clarity for key industry members.

Formal institutions (policy, regulation, standards)

There has been a lack of coherent and long-term heat decarbonisation policy in the UK. This has ultimately favoured incumbent technologies, to the detriment of heat pump deployment.

The UK scrapped the new build energy efficiency regulation in 2016: The Zero Carbon Homes Plan (2006) was a policy that would have required all new builds to reach a certain level of efficiency for heating by 2016 in the UK.^{iv} This would have encouraged energy efficiency measures, as well as the installation of heat pumps. However, this was scrapped in 2016 by the Conservative government and in 2023, there is still no regulation in the UK that prevents new homes being connected to the gas grid. To this, one UK expert said:

“...in my view it is scandalous that we are still building new homes that are not built to a good standard, and we then connect them to the gas grid.”

In the UK, The Future Homes Standard, a new build efficiency regulation, comes into force in 2025 in which it is expected gas boilers will no longer be allowed to be installed. This is 13 years after France’s first new build efficiency regulation.



^{iv} 39 kWh/m² /year of primary energy consumption for apartments and mid-terraced houses and 46 kWh/m² /year for end-of-terrace, semi-detached and detached houses.

The UK has had a tax system which has favoured gas heating: Ofgem predicted that in 2020, 23% of the price of electricity was made up of social and environmental levies, compared with only 2% of gas.⁶⁴ As one UK heat pump expert put it,

“we [the UK] have a tax regime which encourages people to burn gas.”

France taxes its gas and electricity comparatively highly (24% and 36% respectively), however, as electricity is so cheaply produced, electricity has still been historically cheap.

The UK has had poorly designed, stop-start financial schemes: Poorly designed and implemented financial schemes in the UK have contributed to the low uptake since 2008, according to many of the UK experts. Although the Renewable Heat Incentive was a long-term policy, the design was flawed; the paybacks were quarterly over 7 years which meant that it did not address the high upfront cost. As one UK expert recalled,

“people did not understand the RHI, so even though it was generous, it did not attract people due to the complexity.”

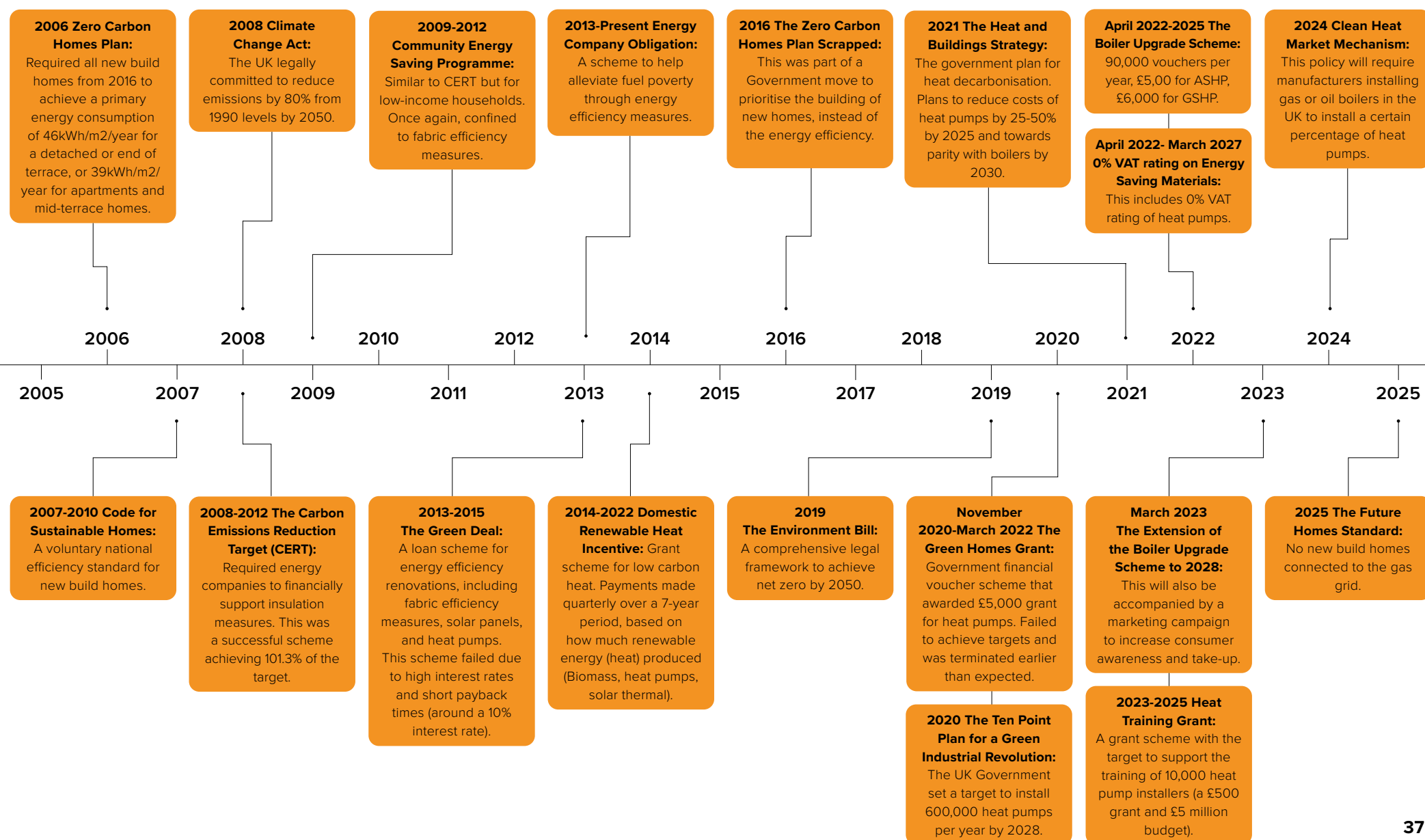
Similarly, the Green Homes Grant (2020) had a substantial budget, but it was difficult for both the consumer and the installer to comprehend, which led to it being prematurely closed.

According to one expert, this resulted in the alienation of many industry members, especially as some small installer businesses went bankrupt as a result of delayed payments.

Later research on the scheme found that half of the installers involved were dissatisfied with it.⁶⁵ According to many of the UK experts, the Green Homes Grant is indicative of many of the energy efficiency financial schemes over the past decade and half.

The Boiler Upgrade Scheme (BUS) was introduced in April 2022 and is an upfront grant of £5000 for an air-source heat pump or £6000 for a ground-source heat pump. Extended until 2028 as part of the Government’s ‘green day’ package of policy announcements, the BUS is a relatively long-term scheme with an upfront grant. With simplified administration the BUS builds on the lessons learnt from the outcomes of previous financial schemes in the UK and could be a significant lever to support heat pump deployment in the future.

Figure 9: UK policy timeline



Informal institutions (norms, beliefs, discourse, attitudes)

Cognitive frameworks in the UK have perpetuated carbon lock-in in the heating sector, contributing to low heat pump deployment.

There has not been the political buy-in to support heat pumps in the UK: One UK expert identified a climate change apathy in government circles before 2020 which had a negative impact on heat pump diffusion. This was epitomised by David Cameron's government that infamously decided to 'cut the green crap'.⁶⁶

This view of climate change as an additional extra resulted in the Zero Carbon Homes Plan being “scrapped as part of an anti-regulation drive”.

They added that one of the reasons Scotland has done slightly better in home efficiency is because:

“There's been more political buy-in for doing the difficult stuff, so that's filtered into slightly better government policy. Whereas if you look at the debate in London for the last 10 years, although renewables are almost a given now, that's not always been the case. Rewind five years ago and a lot of the lobbying in London was all about making sure that we continue to have support for solar panels, for offshore wind, and that drowned out anyone else wanting to talk about heat or transport.”



Technology agnosticism has led to policy inertia in the UK: There has been an inertia caused by government not wanting to be seen as favouring one low-carbon technology over another.⁶⁷ This is still the case in the UK, as the government is not set to make a decision on hydrogen for heating until 2026.⁶⁸ As one UK expert remarked, the government does not want to commit to something that

“...might be proven wrong later on”. But this has resulted, in their opinion, in policy inertia with “people sitting on their hands and saying ‘we don’t know enough, we need to do more research, we need to have a longer discussion.’”

Supporting heat pumps is politically fraught in the UK. As one UK expert phrased it “[successive governments have felt it their duty to give the populous ultra-cheap fuel.](#)” They argued that this has created an expectation from consumers to continue to have ultra-cheap gas, which then makes it politically fraught to put the price up whilst there still is a high upfront heat pump cost. The UK policymaker explained that often policy advice must be moderated, as ministers are influenced by what is going to be palatable to voters in the short run:

“...you could take all these environmental-social levies that are currently on electricity and put them onto gas, but that directly impacts lots of people who might be relying on gas and push people into fuel poverty...”

It is, therefore, less politically and economically risky to continue to support incumbent technologies. In France, however, home efficiency and heat pumps are seen as a solution to fuel poverty. According to one French expert who works in the housing department for the Ministry for the Ecological Transition, “[there is a political consensus that renovating houses is an important solution to reduce energy demand and reduce fuel poverty.](#)” According to the French participants, since Russia’s war on Ukraine, the French Government have been more resolved than ever to move away from gas, reflected in the €1000 increase in financial aid from April to December 2022 for Ma Prime Renov. According to one French expert,

“this crisis has made it clear to the French public that there will be even less of a future for gas and as a result there has been a vast increase in heat pump sales since the Ukraine war.”

The UK Government does not want to be seen as interfering in our daily lives: According to one UK expert,

“we are a society that doesn’t take well to Government imposing stuff on us.”

Another UK expert echoed this, stating that there is a prevalent expectation in government circles that the market will offer solutions. This provides a possible explanation as to why the Zero Carbon Homes was scrapped and why there is a reluctance to legislate a ban on fossil fuel heating.

Knowledge and Competences

Incumbent skills and knowledge in the heating sector in the UK are biased towards gas heating. As a result, there has been a difficulty in developing the heat pump supply chain.

There has been, and still is, a lack of heat pump installers in the UK: According to one UK expert, there has been resistance from gas boiler fitters to retrain, exacerbated by the age demographic of installers who are mostly in their 50s and about to retire.⁶⁹

They just “don’t see that changes in the heating sector will affect them.”

Additionally, only 2% of heating engineers and plumbers are women and 5% from ethnic minorities.⁷⁰ One UK expert stressed the importance of developing a diverse and well-trained workforce, which must not simply rely on the current gas boiler workforce.

However, since 2008 there has been a lack of apprenticeships and heat specific training courses to encourage new installers according to many of the UK experts. As a result, one UK expert recalled that there were not even enough installers to meet the demand of the Green Homes Grant.

“the Green Homes Grant... teased out huge consumer interest... the demand was enormous and what people were saying, [was] they can't find installers.”

The heat pump industry is still a ‘cottage industry’ in the UK: Both the French and UK participants in this study emphasised the importance of coherent policy to send clear signals to the supply chain and key actors. One French expert warned that the consequence of short-term, stop-start policy is a lack of confidence throughout the supply chain, as without clear regulation and policy actors will not risk economic resources and time on training. One UK expert maintained that the scrapping of the Zero Homes Plan not only impacted the uptake of heat pumps over the past six years but has also had long-lasting consequences as

“...we’ve basically lost ten years where we could have been building up a supply chain.”

As a result, the heat pump industry in the UK has a disintegrated supply chain and has remained a ‘cottage industry’, only supporting around 2,000 full time jobs in 2019.⁷¹

Microeconomic

Microeconomic factors have led both consumers and businesses to continue to favour gas boilers in the UK.

Until recently, there has not been a high incentive for gas boiler manufacturers to alter their business model to sell heat pumps: According to one UK participant, for years very few gas boiler manufacturers in the UK had any incentive to start producing heat pumps. They were able to get a higher increase of returns with ‘business-as-usual’ and as another UK participant remarked,

“they don’t see the market falling from under their feet anytime soon.”

This has started to change in the past few years with gas manufacturers, such as Vaillant, manufacturing heat pumps as well. The Clean Heat Market Mechanism is also set to launch in April 2024, where gas boiler manufacturers will be necessitated to sell a certain percentage of heat pumps based on their gas boiler sales. However, even for those gas boiler manufacturers who have started producing heat pumps, the main revenues of their business continue to be gas boilers, 1.7 million of which were sold in 2021.⁷²

Heat pumps have historically cost more to run than gas boilers: According to one UK heat pump expert, before the cost-of-living crisis

“a heat pump would increase the average energy bill by around £350 per year when replacing a gas boiler”.

Due to the recent spikes in gas prices, which went up by 83% in April 2022, it was calculated that an efficient heat pump could save the consumer over £261 per year.⁷³ However, in 2020, the price of a gas boiler (£/kW/hour) was cheaper than a heat pump.⁷⁴ Thus, from 2008-2021 there has been little incentive for a mainstream consumer who, as one UK expert remarked,

“has other pressures on their household budget”,

to pay around 3-5 times the upfront price and in the long run pay higher bills. Several of the UK participants remarked that the early majority adopters are pragmatists who are concerned above all about cost; heat pumps have historically been more expensive to install and run.

Societal factors

Societal factors have had a significant impact on reinforcing the status quo in the heating sector in the UK.

In the UK, there has been a lack of consumer awareness and trust in heat pumps: Until the recent spikes in gas prices, there was little reason for a consumer to contemplate changing their heating system.⁷⁵ Consumers have a fairly distant relationship with their heating system, in which there is a tendency to “fit and forget” according to one UK expert. This was echoed by another UK participant, who maintained that there is a greater tendency to want to match “like with like” and heat pumps function quite differently from gas boilers. To this another participant added:

“...in the UK people just don't know enough about it to feel that they can trust the technology. Can they actually keep me warm? Do I need lots of insulation measures? Do I need to invest tens of thousands in wall insulation before I can consider a heat pump?”

This lack of consumer awareness, as well as the considerable misinformation surrounding heat pumps has been a contributing factor as to why the UK has deployed so few heat pumps.⁷⁶



The pathway to mass-scale heat pump deployment in the UK: What lessons can be learnt from France?

The UK needs to upscale heat pump deployment ten-fold in the next five years to achieve the government's 600,000 per year target.

In France, on the other hand, over 600,000 heat pumps were sold in 2022, six years ahead of the UK Government's target. This study has analysed the experience of France and the UK since 2008 using a carbon lock-in framework to understand this difference in success.

It is impossible to single out one factor as being solely responsible for France's success in heat pump deployment. In 2019, when the financial schemes were redesigned and opened to the mass-market there was an 80% rise in air-to-water heat pumps, with close to 170,000 units installed.

Whilst the improved financial schemes were in part responsible for this growth, it would not have been possible without an established heat pump industry and supply chain, a sufficient number of installers, as well as consumer awareness and demand. These are elements that have developed over the past 15 years in France, as a result of more coherent policy levers and clarity from Government in their ambition to move away from fossil fuels in the heating sector.

When analysed holistically using this carbon lock-in framework, it is similarly clear that no one single barrier is responsible for the low deployment of heat pumps in the UK. Instead, the UK has experienced a gas lock-in in the heating sector over the past decade and half. The domestic supply of natural gas, that was for so long considered an advantage, has now become a major factor as to why the UK has installed so few heat pumps. Policy and regulation has not been robust enough to break this lock-in and instead policy inertia has supported business-as-usual in the heating sector.

The factors explaining low deployment include:

- Infrastructural barriers associated with the gas grid.
- An imbalance of lobbying power between the gas and heat pump industries.
- Short-term, stop-start policy.
- Policy inertia in government circles caused by technology agnosticism.
- A lack of qualified installers and failure to professionalise the industry.
- Cheap gas compared to high electricity prices.
- A lack of consumer awareness.

What has also materialised over the course of this study is that the context and history of heat pump deployment in France and the UK has differed considerably since 2008. France has had contextual advantages, namely its significant supply of cheap nuclear electricity which led to the electrification of heat at a much earlier date. Due to their warmer climate France also had a well-established air conditioning industry which gave them prior knowledge, skills, and consumer understanding of the technology, as well as reliable annual demand of air-to-air heat pumps. This has contributed to the development and professionalisation of the heat pump industry.

Nevertheless, the most valuable lesson that can be learnt from this comparison is that a holistic approach must be taken to unlock mass-scale heat pump deployment. France succeeded in installing over half a million heat pumps by having a developed electricity grid, a well organised pro-electrification lobby group who have advocated for heat pumps, coherent policy, strategy, and regulation over the past decade, a drive in government circles to reduce dependence on fossil fuels, a developed heat pump supply chain, cheap domestic electricity, and increased consumer awareness. The UK will not achieve France's success through implementing standalone policy, such as the Boiler Upgrade Scheme in isolation. Instead, the UK Government must put in place a comprehensive policy package that addresses all elements of carbon lock-in discussed in this study.

Long-term, coherent strategy and policy from here until 2050, to provide clarity to the supply chain:

Both the French and UK participants in this study emphasised the importance of coherent policy to build demand and develop the supply chain. If key industry stakeholders believe that in fifteen years' time the government will abandon the deployment of heat pumps for a high hydrogen scenario, they will not invest time and money in changing their business models to accommodate heat pumps. The Government must follow the advice from over 32 independent researchers and abandon plans for hydrogen for heating.⁷⁷ Decisions must be made that are not influenced by vested interests or political changes. For this reason, a cross-departmental independent heat decarbonisation group should be created that are responsible for implementing policies that go beyond spending reviews.

Focus on the 'low hanging fruit' to build the market: France has succeeded in developing its market by focusing on the 'low hanging fruit', the homes that are not connected to the gas grid, as well as new builds. Moving forward, the UK must build the market by ensuring that the Future Homes Standard regulation is stringent, banning the installation of fossil fuel heating systems. This, as it did in France, will ensure growth in demand, providing confidence and long-term security to the heat pump industry. The Government must also legislate a ban for 'off-gas' fossil fuel heating systems by 2026.

The UK Government must simultaneously introduce bans, as well as incentivise and support consumers, so that nobody is thrown into fuel poverty: The Government should increase the funding available in the Boiler Upgrade Scheme exponentially and extend it until at least 2033 to support consumers in the transition. The Government should subsidise whole house retrofit for fuel poor homes, as well as offer an uplift to off-grid homes.

The Government must implement key policies to reduce the cost of running a heat pump:

Electricity pricing must be reformed rapidly (within the next 12 months) to help reduce the running cost of heat pumps.⁷⁸ Social and environmental levies must be permanently transferred into general government taxation, so that electricity is not disproportionately taxed. There should also be time-of-use tariffs introduced so that heat pumps can become cheaper when used in off-peak times, as well as electricity social tariffs to reduce running costs for fuel poor homes.

Government must support the introduction of a range of low interest home efficiency

loans: Heat pumps are still more expensive to install than a gas boiler. France has addressed this through the implementation of means tested grants, as well as a 0% interest loan. It is critical that the UK Government puts in place a similar mechanism that continues to address the upfront cost barrier, even when government subsidies end. One potential option is a Property Linked Finance package, a low interest loan attached to the property which can be paid back over a long period. Monthly paybacks would likely equate to the monthly bill savings from improving the efficiency. This limits the financial burden on the consumer, whilst generating the necessary private capital for the transition.

Consumer awareness campaigns and the creation of a ‘one-stop-shop’: The UK must invest in a one-stop-shop, like France Renov, where consumers can get free and independent advice online, on the phone, and in person. The complexity of previous financial schemes in the UK has been prohibitive to consumers and installers, alienating both. Coordinating and streamlining the process would help reduce administration costs, and improve the experience for key industry members.

The UK needs to upscale heat pump deployment ten-fold in the next five years to achieve the government’s 600,000 per year target.



**Strong government
intervention is essential
to upscale heat pump
deployment**



Conclusion

Achieving the UK's 600,000 per year heat pump target by 2028 is going to be a significant challenge. And yet, there has never been a more promising time for heat pump deployment in the UK.

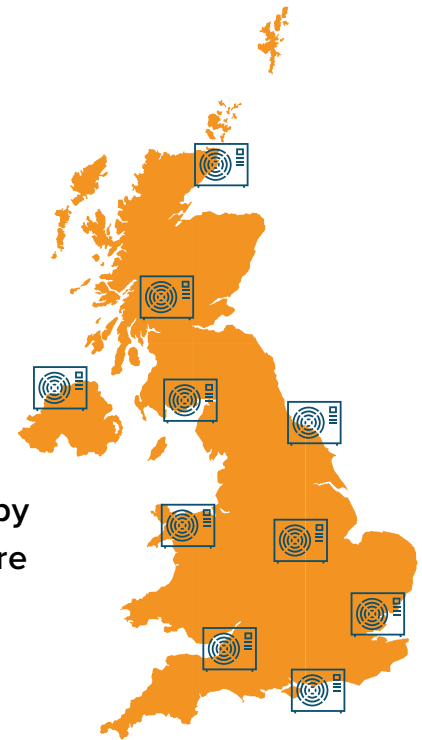
It is commonly observed that energy transitions can be “triggered by a range of factors, including security of supply concerns, changes in resource endowments, market forces and natural disasters.”⁷⁹

The energy crisis, exacerbated by Russia's war on Ukraine, could be the exogenous shock needed to break gas lock-in in the UK, leading to widespread deployment of heat pumps. It has exposed the volatility of global fossil fuel markets and has highlighted the opportunity for the UK to address social inequities by investing in a reliable, domestic renewable energy system.

The key step moving forward is for the Government to implement without delay a comprehensive heat pump policy package that addresses the issues clearly outlined in this paper. Doing so would provide stakeholders across the heat pump supply chain with the necessary long-term clarity and commitment from Government in the electrification of heat and go some way towards driving heat pump deployment towards the 600,000 a year target.

The evidence from France is clear: when these pressure points are introduced the sector can achieve significant year-on-year growth.

The evidence is equally clear that without them, it will not.



Bibliography

1. Framework created by Trencher, G., Rinscheid, A., Duygan, M., Truong, N. and Asuka, J., (2020). Revisiting carbon lock-in in energy systems: Explaining the perpetuation of coal power in Japan. *Energy Research & Social Science*, 69, p.101770.
2. Eunomia Research and Consulting (2020), Heat Pump Manufacturing Supply Chain Research Project On behalf of Department for Business, Energy and Industrial. Available at: [Strategyhttps://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/943712/heat-pump-manufacturing-supply-chain-research-project-report.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/943712/heat-pump-manufacturing-supply-chain-research-project-report.pdf)
3. Association Française pour La Pompe A Chaleur (2016), La PAC fait sa COP 21 21 mesures pour une Contribution Performante de la Pompe A Chaleur à la « transition énergétique » COP_21.indd (afpac.org) p.34
4. Bennett, G., & Elwell, C. (2020). Effect of boiler oversizing on efficiency: a dynamic simulation study. *Building Services Engineering Research and Technology*, 41(6), 709-726.
5. <https://www.heatpumps.org.uk/new-heat-pump-guide-to-support-uk-industry/>
6. HM Government, (2023). Powering Up Britain. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1147340/powering-up-britain-joint-overview.pdf
7. NEA Action for Warm Homes (2023) Energy Crisis Available at: <https://www.nea.org.uk/energy-crisis/#:~:text=That's%20based%20on%20a%20two,million%20households%20in%20fuel%20poverty.>
8. Yu, Z., McKeown, A., Hajabdollahi Ouderji, Z., & Essadik, M. (2022). A flexible heat pump cycle for heat recovery. *Communications Engineering*, 1(1), 17. <https://www.nature.com/articles/s44172-022-00018-3>
9. <https://france-renov.gouv.fr/>
10. MCS Charitable Foundation. (2020) Energising Advice Report. Available at: Energising Advice Report — MCS Charitable Foundation
11. Climate Change Committee. (2022) Independent Assessment: The UK's Heat and Buildings Strategy. Available at: <https://www.theccc.org.uk/wp-content/uploads/2022/03/CCC-Independent-Assessment-The-UKs-Heat-and-Buildings-Strategy.pdf>
12. Department for Energy Security & Net Zero. (2023) Powering Up Britain: Energy Security Plan. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1148252/powering-up-britain-energy-security-plan.pdf
13. The UK government committed to reduce greenhouse gas emissions by 80% compared to 1990 levels.
14. <https://ukerc.ac.uk/publications/net-zero-heating/> The Department for Energy Security & Net Zero (2023) 2022 UK greenhouse gas emissions, provisional figures Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1147372/2022_Provisional_emissions_statistics_report.pdf
15. The Department for Energy Security & Net Zero (2023) 2022 UK greenhouse gas emissions, provisional figures Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1147372/2022_Provisional_emissions_statistics_report.pdf
16. <https://energysavingtrust.org.uk/advice/in-depth-guide-to-heat-pumps/> ; Hepbasli, A., (2018). 4.4 Heat Pumps. *Comprehensive Energy Systems*, pp.98-124.
17. Cantor, J. (2021). *Heat Pumps for the Home*, 2nd Edition. Crowood Publishing.
18. Lowe, R., Summerfield, A., Oikonomou, E., Love, J., Biddulph, P., Gleeson, C., Chiu, L. & Wingfield, J. (2017). Final report on analysis of heat pump data from the renewable heat premium payment (RHPP) scheme. UCL Energy Institute. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/606818/DECC_RHPP_161214_Final_Report_v1-13.pdf
19. Catapult Energy Systems. (2023) Interim Heat Pump Performance Data Analysis Report. Available at: <https://es.catapult.org.uk/report/electrification-of-heat-interim-heat-pump-performance-data-analysis-report/>
20. <https://www.gov.uk/government/news/plans-unveiled-to-decarbonise-uk-power-system-by-2035>
21. Rosenow, J. (2022). Is heating homes with hydrogen all but a pipe dream? An evidence review. *Joule*.
22. The Climate Change Committee, (2020). Development of trajectories for residential heat decarbonisation to inform the Sixth Carbon Budget. Available at: <https://www.theccc.org.uk/publication/development-of-trajectories-for-residential-heat-decarbonisation-to-inform-the-sixth-carbon-budget-element-energy/>
23. European Heat Pump Association, (2023). *European Heat Pump Association Market and Statistics Report 2023*.
24. The pathway to net zero heating in the UK | UKERC | The UK Energy Research Centre

25. <https://www.opendemocracy.net/en/oureconomy/the-uk-claims-to-be-a-world-leader-in-fighting-climate-change-its-wrong/>
26. European Heat Pump Association, (2023). European Heat Pump Association Market and Statistics Report 2023.
27. European Heat Pump Association, (2023). European Heat Pump Association Market and Statistics Report 2023.
28. Kerr, N., & Winskel, M. (2021). A review of heat decarbonisation policies in Europe. Available at: <https://www.climatechange.org.uk/media/4625/cxc-a-review-of-heat-decarbonisation-policies-in-europe-feb-2021.pdf>
29. Foxon, T.J., (2011). A coevolutionary framework for analysing a transition to a sustainable low carbon economy. *Ecological economics*, 70(12), pp.2258-2267;
30. Unruh, G.C, (2000). Understanding carbon lock-in, *Energy Policy* 28 (12) (2000) 817–830; Geels, F.W., (2014). Reconceptualising the co-evolution of firms-in-industries and their environments: Developing an inter-disciplinary Triple Embeddedness Framework. *Research Policy*, 43(2), pp.261-277.; Geels, F.W., (2010). Ontologies, socio-technical transitions (to sustainability), and the multi-level perspective. *Research policy*, 39(4), pp.495-510.
31. Stroh, M. (2000) 'Qualitative Interviewing' in Burton, D. (ed) 'Research Training for Social Scientists' Sage, London, pp196-214. P.199; Esterberg, K.G. (2002). *Qualitative methods in social research*. McGraw-Hill, Boston. p.87
32. Lowes, R. and Woodman, B., 2020. Disruptive and uncertain: Policy makers' perceptions on UK heat decarbonisation. *tren Energy Policy*, 142, p.111494.
33. Trencher et al. (2020).
34. Vivid Economics & Imperial College, International Comparisons of Heating. (2017).
35. Suerkemper, F., Osso, D., Thomas, S. and Baudry, P., (2011) June. Switching from fossil fuel boilers to heat pumps: A multi-perspective benefit-cost analysis including an uncertainty assessment. In *eceee 2011 Summer Study* (pp. 1685-1695).
36. Scotland, WWF. (2023). Affordable Warmth: Next steps for clean heat in Scotland. Available at: <https://www.wwf.org.uk/sites/default/files/2023-02/WWF-Affordable-Warmth-Scotland.pdf>
37. European Heat Pump Association, (2021). European Heat Pump Association Market and Statistics Report 2021.
38. Association Française pour les Pompes, (2020). La pompe a chaleur au centre de la transition énergétique. Available at: https://www.afpac.org/La-Pompe-a-Chaleur-au-centre-de-la-transition-energetique-une-filiere-prete-a-relever-les-enjeux-de-la-reliance_a621.html (p. 20)
39. Kerr and Winskel, (2021)
40. Kerr and Winskel . (2021)
41. Suerkemper, F., Osso, D., Thomas, S. and Baudry, P., (2011) June. Switching from fossil fuel boilers to heat pumps: A multi-perspective benefit-cost analysis including an uncertainty assessment. In *eceee 2011 Summer Study* (pp. 1685-1695).
42. For more information see https://www.french-property.com/news/build_renovation_france/new_homes_rt_2012
43. Association Francaise pour La Pompe A Chaleur (2016), La PAC fait sa COP 21 21 mesures pour une Contribution Performante de la Pompe A Chaleur à la « transition énergétique » COP_21.indd (afpac.org) p.34
44. For more information see: <https://artisancentral.fr/blog/what-is-rt2020/>
45. Commissariat général au développement durable. Auteur du texte (2016) 'De l'innovation instrumentale. Les certificats d'économies d'énergie'. Available at: <https://side.developpement-durable.gouv.fr/ACCIDR/doc/SYRACUSE/353129/de-l-innovation-instrumentale-les-certificats-d-economies-d-energie>
46. Association Française pour les Pompes a chaleur, (2020).
47. https://immobilier.lefigaro.fr/article/pompes-a-chaleur-les-5-choses-a-savoir-sur-leurs-avantages-et-inconvenients_f8e8dd2a-e4d3-11ed-8f84-08cfb27d2c7b/
48. Service-public.fr. (2022). Éco-prêt à taux zéro (éco-PTZ). [online] Available at: [Accessed 6 August 2022].
49. Vivid Economics & Imperial College, International Comparisons of Heating. (2017). Cooling and Heat Decarbonisation Policies, report prepared for the Department of Business, Energy and Industrial Strategy, November 2017. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/699674/050218_International_Comparisons_Study_MainReport_CLEAN.pdf
50. Décrypter l'Energie, (2015). Nos consommations d'électricité domestique vont-elles croître inexorablement Available at: <https://decrypterlenergie.org/nos-consommations-delectricite-domestique-vont-ellescroitre-inexorablemen>
51. Carney, R., 2006. Varieties of capitalism in France: interests, institutions, and finance. *French Politics*, 4(1), pp.1-30.
52. Association Française pour les Pompes, (2020). La pompe a chaleur au centre de la transition énergétique. Available at: https://www.afpac.org/La-Pompe-a-Chaleur-au-centre-de-la-transition-energetique-une-filiere-prete-a-relever-les-enjeux-de-la-reliance_a621.html (p. 9)
53. Association Française pour les Pompes (2022) Fiche Poids de la Filiere PAC en France en 2021. Available at: https://www.afpac.org/downloads/Communiqués-de-Presse-AFPAC_t19846.html
54. P.10 Ibid 38

-
55. <https://www.emploi-environnement.com/news/formation-installateur-pompe-a-chaleur-qualite-renovation-energetique-637.html>
 56. European Heat Pump Association, (2021).
 57. Graph formed using data from Statista (2023) Electricity prices for households in France from 2010 to 2022, semi-annually. Statista Research Department. Available at: <https://www.statista.com/statistics/418087/electricity-prices-for-households-in-france/> and an average cost was calculated from the 1.5-2.5kWh cost and the 2.5-5kWh cost data in Statista (2023) Electricity prices for household consumers in the United Kingdom (UK) from 1st half 2010 to 1st half 2020, semi-annually. Statista Research Department. Available at: <https://www.statista.com/statistics/418126/electricity-prices-for-households-in-the-uk/>
 58. Paruvendu.fr. 2017. 2017 - Les promesses d'Emmanuel Macron pour l'immobilier. [online] Available at: 2017 - Les promesses d'Emmanuel Macron pour l'immobilier (paruvendu.fr)
 59. Lassere, D.G. and Lavergne, C., 2022. Soulèvements Gilets jaunes. Expériences et compréhensions plurielles de l'émeute. Socio. La nouvelle revue des sciences sociales, (16), pp.63-84.
 60. Hanna, R. and Gross, R., (2021). Heating system transformation in Europe: accelerating sources of path dependence to escape carbon lock-in. In Research Handbook on Energy and Society (pp. 69-82). Edward Elgar Publishing.
 61. Gross, R. and Hanna, R., 2019. Path dependency in provision of domestic heating. Nature Energy, 4(5), pp.358-364.
 62. Kerr and Winskel, (2021).
 63. Scott, M. and Powells, G., 2020. Sensing hydrogen transitions in homes through social practices: Cooking, heating, and the decomposition of demand. International Journal of Hydrogen Energy, 45(7), pp.3870-3882.
 64. Ofgem, (2020). Consumer Survey 2020: Update on Consumer Engagement with Energy
 65. BEIS, (2022) Evaluation of the Green Homes Voucher Scheme. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1131110/green-homes-grant-vouchers-phase-1-process-evaluation-report.pdf
 66. Savage, M., 2022. Cameron's decision to cut 'green crap' now costs each household in England £150 a year. The Guardian. Available at: Cameron's decision to cut 'green crap' now costs each household in England £150 a year | Energy bills | The Guardian
 67. Lowes, R. and Woodman, B., 2020. Disruptive and uncertain: Policy makers' perceptions on UK heat decarbonisation. Energy Policy, 142, p.11494.
 68. <https://www.gov.uk/government/publications/energy-security-bill-factsheets/energy-security-bill-factsheet-enabling-the-hydrogen-village-trial>
 69. BEIS, (2021). Social research with installers of heating systems in off gas grid areas of England and Wales. Available at: Social research with installers of heating systems in off gas grid areas of England and Wales (publishing.service.gov.uk)
 70. Careersmart.org.uk. (2022). Which Jobs do Men and Women do? Occupational Breakdown by Gender. <https://careersmart.org.uk/occupations/equality/which-jobs-do-men-and-women-do-occupational-breakdown-gender>
 71. Eunomia Research and Consulting (2020), Heat Pump Manufacturing Supply Chain Research Project On behalf of Department for Business, Energy and Industrial. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/943712/heat-pump-manufacturing-supply-chain-research-project-report.pdf
 72. Climate Change Committee, 2022b. Independent Assessment: The UK's Heat and Buildings Strategy. Available at : <https://www.theccc.org.uk/publication/independent-assessment-the-uks-heat-andbuildings-strategy>
 73. Rosenow, (2022). Analysis: Running costs of heat pumps versus gas boilers, RAP. Available at: ,Analysis: Running costs of heat pumps versus gas boilers (raponline.org)
 74. European Heat Pump Association, (2021).
 75. BEIS Committee, 2022. Decarbonising heat in homes: Seventh Report of Session 2021–22 Report, report Ordered by the House of Commons. Available at: <https://committees.parliament.uk/publications/8742/documents/88647/default/>
 76. <https://www.greenmatch.co.uk/blog/2015/11/top-10-myths-about-heat-pumps> ; <https://energysavingtrust.org.uk/five-myths-about-heat-pumps/> ; <https://www.greenbuildingrenewables.co.uk/13-heat-pumps-myths-busted/>
 77. Rosenow, J. (2022). Is heating homes with hydrogen all but a pipe dream? An evidence review. Joule.
 78. Department for Energy Security & Net Zero. (2023) Powering Up Britain. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1148252/powering-up-britain-energy-security-plan.pdf p.64
 79. Vivid Economics (2017) p.55
-

info@mcscharitablefoundation.org
www.mcscharitablefoundation.org

