THE
HIGH EFFICIENCY **HEAT PUMPS**

Using system for both heating and cooling

Group 6:

Varun, Somya, Xiao, Charles

A **Design Futures** Methodology for Adaptive Low Carbon Heating in London

ASSUMED STATEMENT

Problem Statement

Achieving the **UK's 2050 Net Zero** target necessitates a rapid transition from **fossil-fuel-based heating to low-carbon** alternatives such as **heat pumps**. However, the **retrofit of existing residential buildings** remains a complex, context-dependent challenge that resists standardised, top-down implementation. Current approaches often overlook the importance of **adaptability** as the capacity of systems, policies, and users to evolve in response to changing technical, infrastructural, and social conditions. Without embedding adaptability as a guiding design principle, efforts to decarbonise residential heating risk becoming rigid, inequitable, and unsustainable over time. There is, therefore, a critical need to understand how adaptability can be operationalised across technical, infrastructural, policy, and behavioural dimensions to support a more resilient and inclusive heating transition. We attempt to outline a **framework for sustainable design futures in residential heating transitions,** for accelerated implementation at a societal level, and thus, **stabilising the issues of Climate Change.**

Breaking Down the Topic

What is a Heat Pump? | Why do we want High Efficiency? | Who "Needs" It?

"Heat Pumps could bring down global CO2 emissions by half a gigaton by the end of this decade."

Yannick Monschauer, "6 things to know about heat pumps"

Timeline:

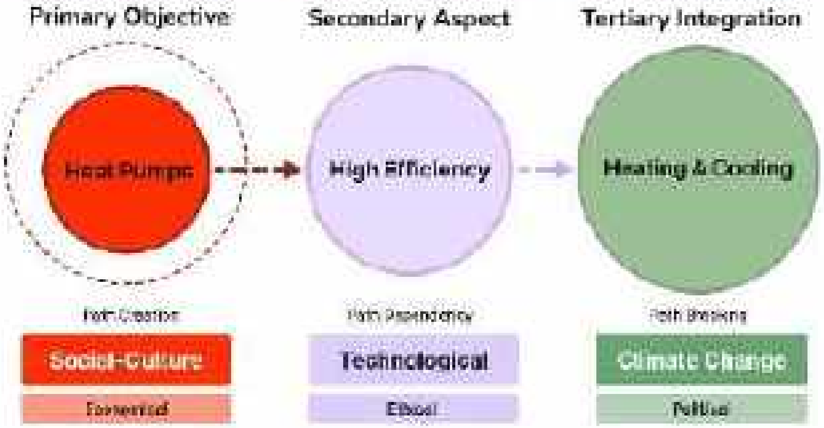
TOPIC INTRODUCION

What it is

Gas-Fired Heat Pumps

↓

A **heat pump in 2025** is a reversible HVAC device that uses electricity to transfer thermal energy from ambient air, ground, or water into a home for heating, and reverses the flow to cool indoors during warmer months, **offering high efficiency and lower emissions.**



What we WANT

By 2050 "heat pump" may be defined as a smart, **adaptive thermal-exchange system** that not only transfers heat for space heating and cooling, but dynamically **integrates with renewable energy infrastructure, urban energy sharing networks, and climate-responsive materials to optimise comfort, efficiency, and sustainability.**

Concept Video Reference: https://www.youtube.com/...

PROBLEM FRAMING

Implementation-Focused

What
Who

Contextualizing

Social Challenge

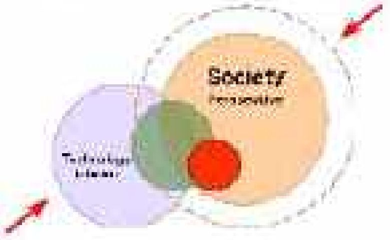
In present times, **Heat Pumps** are central to UK's low- carbon strategy to achieve the **Net-Zero** transition, given that the fossil fuel heating dominates within the **"existing" homes**, producing about 17% of **national emissions**. Thus, making **Social challeng (Key Barrier)** as the **Homeowners Adoption and Awareness.**

Policy-Design-User Integration for the Environemnt

Where
When
Why

System-Level Prespective

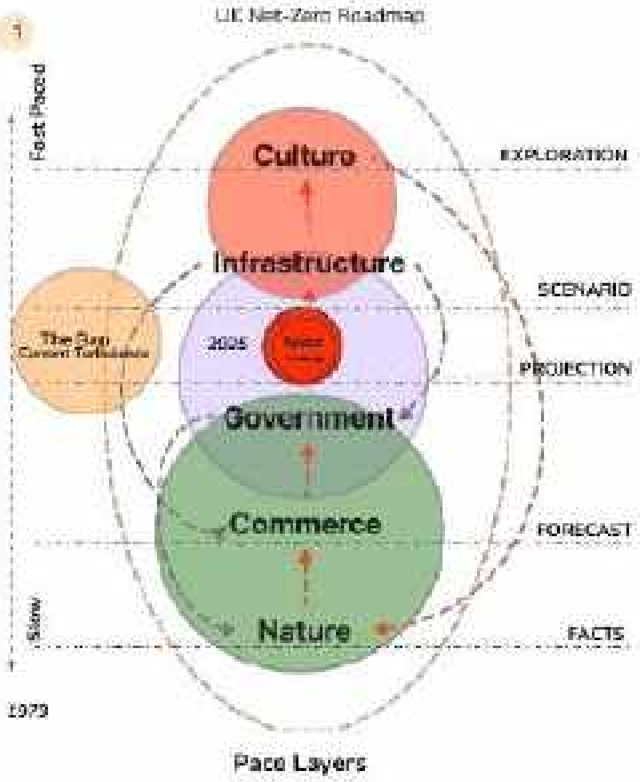
A clear link between its affected stakeholders where we treat **efficiency** not completely as a technical problem, but as a **design response to user behiviour and contextual condition.** ultimately the bigger aim is to **stabalize the environmental crises** (Oil crisis) pushes us to pursue this study in the first place.



How

With such a varied **Domestic scene of London Dwellings** it is essential to understand the **diverse typography** and **retrofit constraints.** With **User/Homeowners** at the center, we look at heating retrofit for its upfront costs, inconsistent existing policy support, and **limited consumer trust as the starting point** to achieve a **probable future solution.**

SCALES



2025-2050

Temporal Scales

As the starting point, **Nature** provides the clearest **factual evidence** and a slow-built foundation for **climate and ecological changes**. **Commerce and Policies** have been under development for over a decade regarding these topics. **Infrastructure** moves at a reasonable pace, where the **housing and energy networks** come to play, which must adapt to **new demands**. **Social value and norms** are **collective attitudes** towards **sustainability** and often slowest to move/change because they demand efforts at a personal level.

Something has already been started. How do we stabilise and facilitate the exponential growth of this social dimension? What is the integration of short-term actions and long-term systemic transformations?

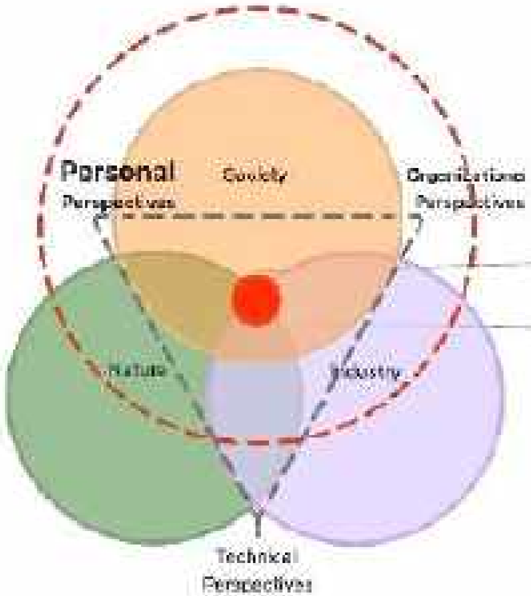
Why is it important?

We are at a critical juncture in time where **stabilizing social systemic issues** is essential for achieving accelerated and sustainable results.

To move forward effectively, it is crucial to identify **where and how barriers (Social Structures) may become bottlenecks**, restricting the successful implementation of existing or newly developed **policies and technologies**.

Inspiration Source: Brand, S. (2018) 'Pace Layering: How Complex Systems Learn', The Long Now Foundation. https://longnow.org

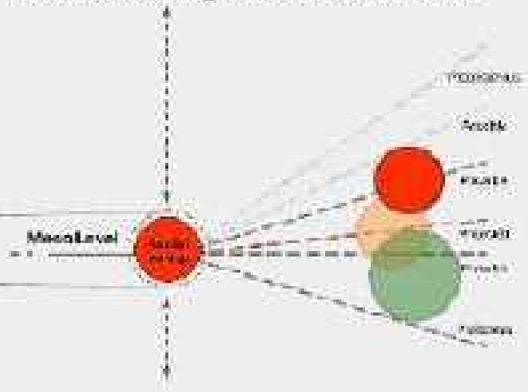
IDENTIFICATION



Represents Retrofit Complexity

Our Critical **(Meso) Context** Positioning

Understanding **Contextural Scales** & Potential Guiding **Futures Narratives**



Context

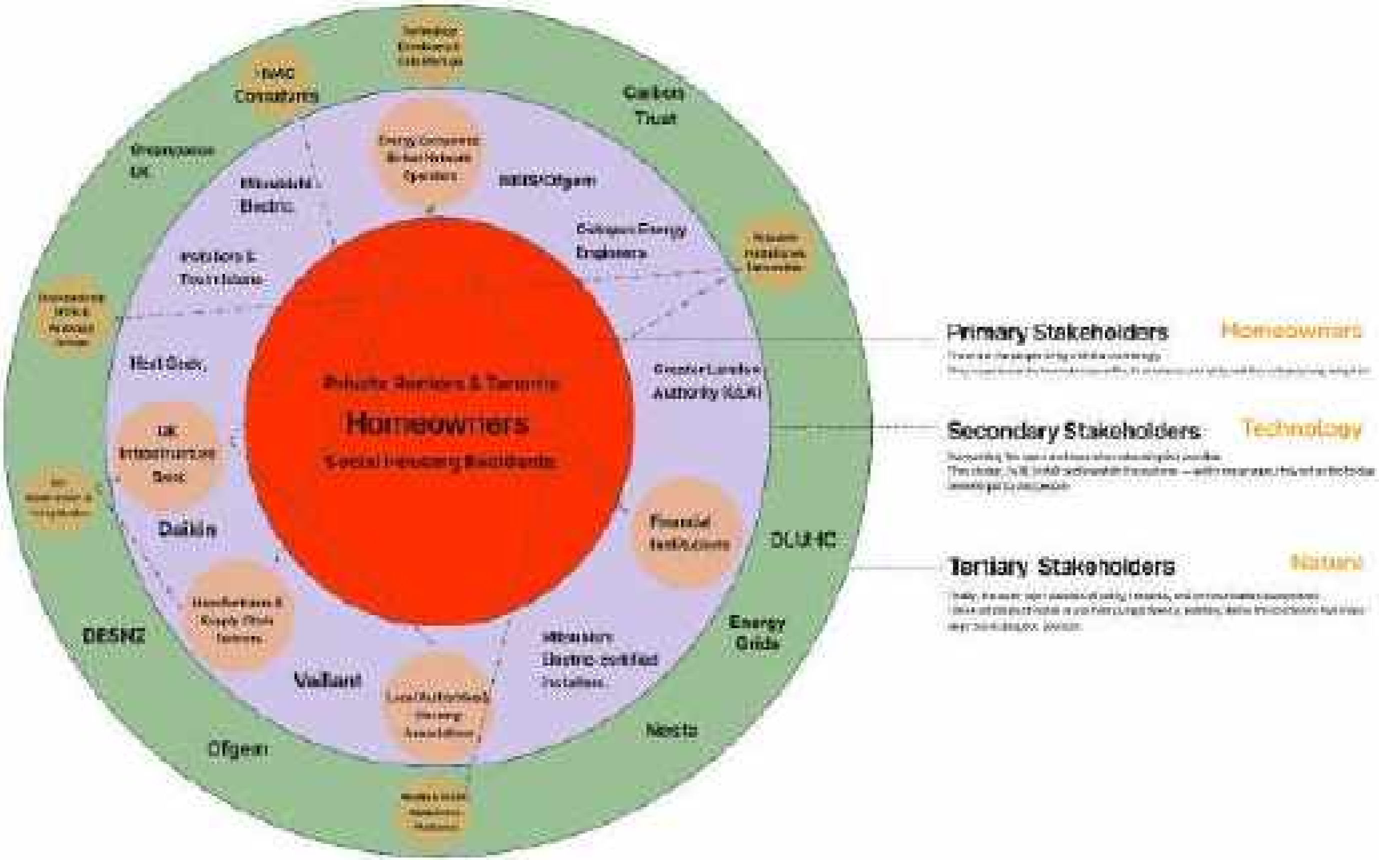
Rural-Urban London Dwellings

We **strategically position** user to draw a systemic path for better **expansion** of already **existing** technology, and **effective implementation of policies**, to inform personal perspectives about **climate crises and sustainability.**

Concequences

Futures Prediction

STAKEHOLDER STUDY



"How can **user-centred adaptability** be **operationalised** through **design** and **policy frameworks** to accelerate equitable and efficient heat pump adoption in the **UK residential sector** by 2050?"

SUB-RESEARCH QUESTIONS

Why This Research Question Matters

Policy Relevance: Policy Relevance: UK low-carbon heating transition is critical to achieving 2050 net zero targets.

Stakeholder Impact: Homeowners are obstructed by price, technicality, and lack of knowledge.

Design Futures Lens: A design-led approach is human-focused rather than tech-focused — reframing homeowners' experience, trust, and relationship with heat pumps.

Sustainability: Resource and byproduct consideration ensures the transition avoids creating new problems (e.g., electricity [illegible]).

Technical: Performance metrics, lifecycle efficiency, adaptability across housing stock.

Technology

How can adaptability be defined and measured beyond energy efficiency (kWh)?

What Social & Economical barriers currently limit widespread adoption?

Environmental: Resource requirements, emissions trade-offs, waste/byproducts.

Social

Environment

Social: Homeowner attitudes, equity considerations, trust in institutions.

How can policy implementation be accelerated to achieve UK's net zero emission?

What roles can co-design and user participation play in shaping future retrofit policies?

Policy

Policy/Design: Support mechanisms, incentives and systemic strategies for widespread adoption.

Knowledge Gaps

Lack of clarity on how "efficiency" should be defined for future contexts (not just kWh, but adaptability and resilience).

Limited homeowner-centered insights on barriers to transition.

Under-explored systemic view of resources → impacts → byproducts of heat pump scaling.

Following is a case study taken from Heat Pump Association to illustrate the topic.

Summary

"With aspirations to **retrofit** its main sites, **£5 million** in funding unlocked a major opportunity to improve **air quality** around the borough whilst taking a big step towards meeting its **net zero pledge** by 2030." (NIBE Energy Systems, 2024)

Results

"This transformation really highlights the benefits of combining multiple **technologies** to deliver **efficient, low-carbon** solutions. Whilst the full capacity could have been delivered using boreholes, which would have been a **less costly option**, the University welcomed the installation of PVT as an **innovative** and **space-saving** option.

The major project will save an estimated **500 tonnes** of **carbon** each year, and **9,460 tonnes** across the equipment's lifetime. It will also save **3,116,738 kWh** of gas-derived energy per year (equivalent to 70 heated homes) whilst improving local air quality.

The project is thought to be one of the world's largest **PVT projects**, and positions UWL as a leader in higher education for addressing the climate crisis. The project was recognised by the **Energy Managers Association's** (EMA) Energy Management Awards, receiving the Highly Commended designation in the **Decarbonisation** Project Category." (NIBE Energy Systems, 2024)

Background

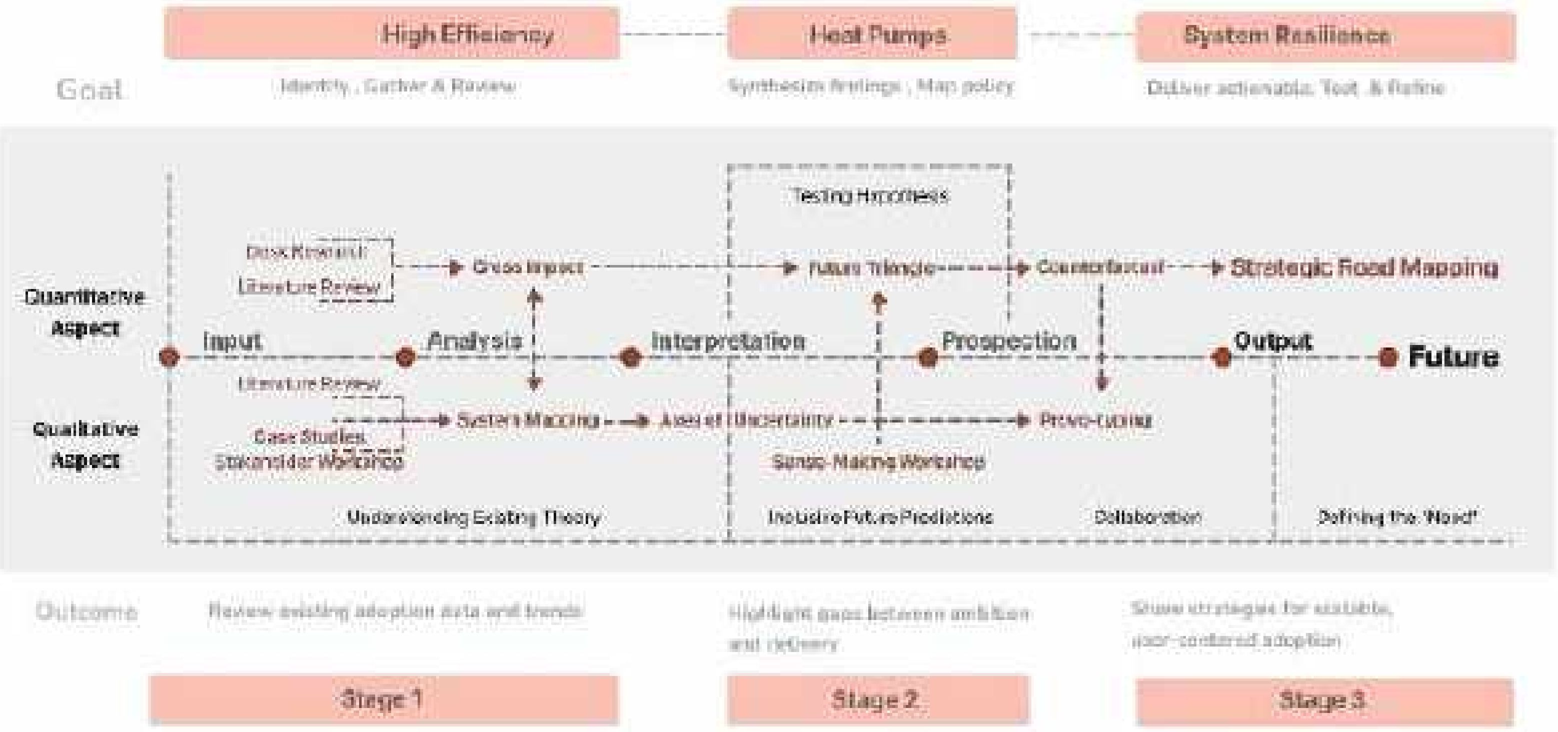
"UWL contracted Ameresco as principal contractor and designer, who partnered with **NIBE Energy Systems** and **JKN Renewables**, Ltd. The first and main challenge was to design a **ground source heat pump (GSHP)** system for the university without disrupting the main car park on the campus to reduce the impact on students. This, in turn, resulted in an innovative solution, combining a **ground source heat pump system** working with boreholes and **solar PVT panels**. The designed system not only supplies **222 kW** of **PV electricity generation** but, crucially, acts as a collector system for the GSHP, capturing naturally occurring energy in the air to drive the heat pump process, and therefore reducing the number of boreholes required. (NIBE University of West London, 2024) The old gas boilers previously heating the campus were replaced with **584 solar PVT** panels in combination with 34 100-meter boreholes to provide **900 kW** of heating and hot water throughout the site." (NIBE Energy Systems, 2024)

CASE STUDY

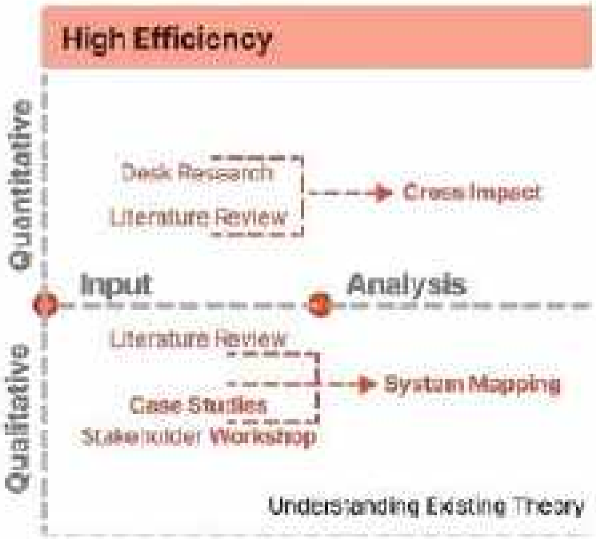
Heat Pump Association (n.d.) NIBE University of West London. Available at: [illegible]

LITERATURE REVIEW

Source	Focus	Methods Used	Identified Gaps
Heat Pump Retrofit in London (GLA & Carbon Trust, 2018)	**What retrofit options exist in London's building stock; what policy & support needed at building level**	**Case studies** of 15 buildings; options-appraisals; fabric & energy efficiency assessment	Does not deeply explore homeowner perceptions or **behavioural barriers**; limited to London; less attention to **social equity.**
Energy Company Obligation (ECO3): Final Determination Report (Ofgem, 2020)	**Efficiency improvements** and heating/ low-carbon alternatives for **low-income/** vulnerable **households; policy obligations**	Scheme evaluation / **public reports; quantitative metrics** (bill savings, number of measures installed etc.)	Less **qualitative insight** on usability or homeowner satisfaction; limited in exploring **retrofit complexities** in **older housing** or heritage buildings.
Heat Pump Net Zero Investment Roadmap (UK Govt, 2024)	**Forecasting need** and **scale** for heat pump installations; suitability analysis of UK housing stock	**Modelling**, suitability and cost comparisons; analysis of insulation and grid/electrical capacity	Future **deployment challenges** (finance, installers, public trust) less explored; limited **case study** or user feedback in many regions outside London.
"Nationwide National Space Heating Flexibility Potential," (Halloran, Lizana, McCulloch, 2024)	Estimating how existing housing stock can provide demand **flexibility** when using heat pumps; **spatial variation** of usage	**Data analytics**; high spatial resolution modelling using historical heating consumption and temperature data	Technical modelling heavy; less on **social/policy levers**; doesn't deeply engage with homeowner decision factors.



METHODOLOGY PROPOSAL



Purpose: Review existing adoption data and trends : Stage 1

Input

1. Desk Research
(understanding technological efficiency quotient)

2. Literature Review
(theoretical gaps and stakeholder engagement)

3. Case Studies
(comparable retrofit adoption programs & equity-study of location, Retrofit scale, user typology)

4. Stakeholder Workshop

Key "Actors" insights to understand the challenges and opportunity in adoption of Heat Pump Technology, using **participatory mapping**, **by collecting lived experiences and narrative.** This will help us build **future scenarios,** feeding data for Axes of Uncertainty into the Analysis stage. This is crucial as it clarifies the current musts of **design and policy framework**.

Analysis

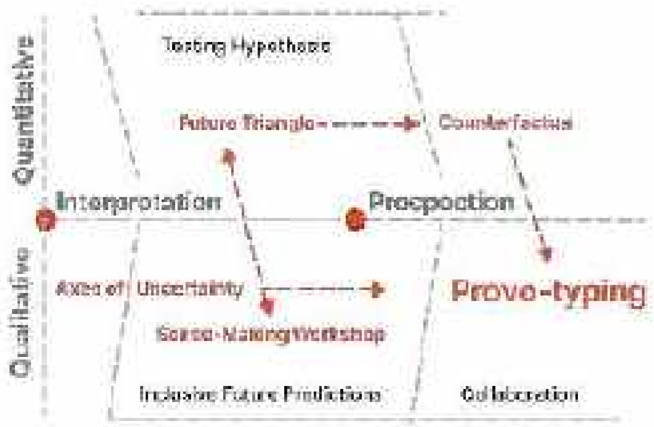
5. Cross Impact

Building themes between behavioural adoption, policy intervention and socio-technical systems to understand the influences and potential impacts within the system of levers. This includes Housing Typologies as well.

6. System Mapping

Workshop output can be structures into a **Map** to identify loops, dependencies, and potential points to intervention. This foundation will be used for **Intrepretation** and **Scenario Development** Stage.

Heat Pumps



Highlights Gaps between ambition and delivery : Stage 2

Interpretation

7. Axes of Uncertainty

understanding diverse housing typologies as the barrier and key uncertainty towards shaping the future of heat pumps in existing housing structures

8. Futures Triangle

to understand the essential Drivers shaping the Possible futures to understand desired outcomes, and begin to identify preferred and alternative pathways

9. **Sense Making Workshop**

Testing Hypothesis

Prospection

10. Counterfractual

Evaluating resilience and adaptability of strategies under changing conditions by developing alternative scenarios

11. **Provo-typing**

To test speculative concept technology and prototype policy through user feedback

Scalable Plan of Actions with User- Centric Vision : Stage 3

Output

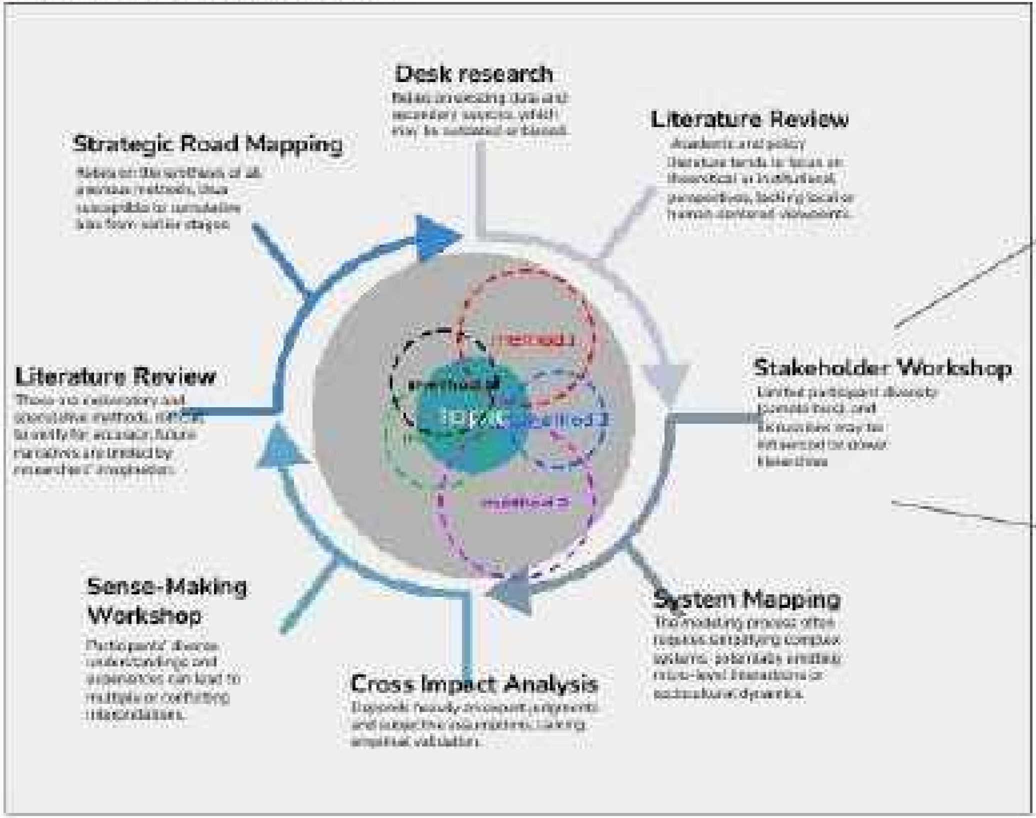
12. Strategic Road Mapping

Mapping the **Preferable direction** and reframing **"Inclusivity"**, integrating data from previous methods to design an **equitable adoption of heat pumps** in existing London Dwellings.

Futures

Communicating the "need" to its usetr and potentially change presceptions and build a clear value proposition.

ETHICS



Assign each participant an "anonymous name" instead of their real names, the personal experiences shared in the game (such as budget, housing situation) will only be recorded and will not be associated with any identity information.

Clearly inform about the data usage: Distribute the "Informed Consent Form" before the workshop begins, stating that "The data will only be used for local policy suggestions and strategy design, not for commercial promotion, and the results report will only present the group trend and will not mention individual cases", and allow participants to withdraw any shared information at any time.

1. Ethical Framework

"Our research is guided by principles of **transparency, inclusivity, and responsibility.** Because our topic directly impacts **households, policies, and local communities**, ethical awareness is embedded at every stage of our process — from **data gathering** to **future speculation**."

2. Inclusion Strategy

Methodology Phase	Potential Ethical Issue	Our Approach to Address It
Input (Desk Research, Literature Review, Stakeholder Workshop)	Risk of **bias** in data selection and representation of stakeholder voices	Use **multiple, diverse data** sources and ensure **equal** stakeholder representation in workshops (homeowners, installers, policymakers, social housing). Obtain informed **consent** for participation.
Analysis (Cross-Impact, System Mapping)	**Oversimplification** of complex relationships or **misinterpretation** of stakeholder influence	Apply **transparent** mapping criteria and **validate** findings through **peer review** or expert **feedback** sessions.
Interpretation & Prospection (Axes of Uncertainty, Futures Triangle, Provotyping)	**Ethical tension** in creating speculative futures — may reinforce bias or exclude **marginalized groups**	Facilitate **inclusive** futures workshops with **diverse participants**; encourage multiple possible futures (not one idealized vision). Use **ethical foresight** frameworks to avoid **techno-solutionism**
Output (Strategic Roadmap)	Risk of policy recommendations **favoring privileged** groups or market actors	Test recommendations for **equity, accessibility, and affordability** impacts. Cross-check proposals with fuel poverty and **social justice** metrics before publication.

ETHICS

3. Data Ethics

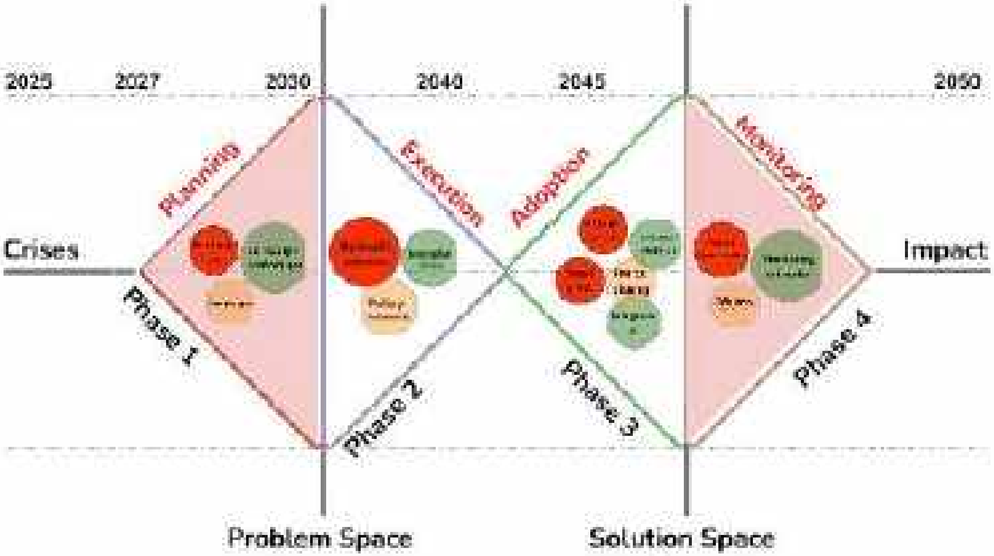
- All **qualitative data** (interviews, workshops) will be collected under informed **consent** and **anonymized.**
- Participants can withdraw at **any time** without consequence.
- Data stored **securely** and used only for **educational or research purposes.**
- Any secondary data follows **open-access** and **citation** ethics standards.

4. Design & Futures Ethics

- Avoid **technological determinism** — ensure **future scenarios** consider **social systems** and human agency, not **just innovation**
- Use **counterfactuals and prototypes** responsibly — clarify they are **explorations,** not predictions.
- Prioritize **sustainability, justice,** and **well-being** in all imagined futures.

5. Reflection

Our **ethical** approach ensures that design methods do not just produce solutions,but also question whose futures are being designed and who benefits from them.By embedding ethics into each stage, our methodology stays accountable, equitable, and aligned with the principles of sustainable design futures.



OUTPUT

Strategic Roadmap for Heat Pump Transition (2025–2050)

Solving complex problems of **social variation** and **system adaptability**, pushing sustainability through technological advancement, is essential. **Implementation** of already existing policies and defining the role of different stakeholders is essential for the success, along with technology compensating for the barrier of Housing adaptability. The **uncertainty lies** in questioning the **"need" and "usefulness" of adopting this advancement at a personal social level.**

Data analysis plan

Phase 1

Right now, the UK stands at a crucial transition point. We're shifting away from gas boilers — but awareness, affordability, and policy clarity remain barriers. Our journey begins here, with a mission to make heat pumps not just a policy mandate, but a public movement by focusing on homeowners of existing dwellings.

Phase 2-3

As awareness grows, we move into the decade of action with the **secondary and tertiary stakeholders**. Policies mature, communities adapt, and technology begins to evolve rapidly. This is when planning meets execution — where design thinking and systemic collaboration come alive.

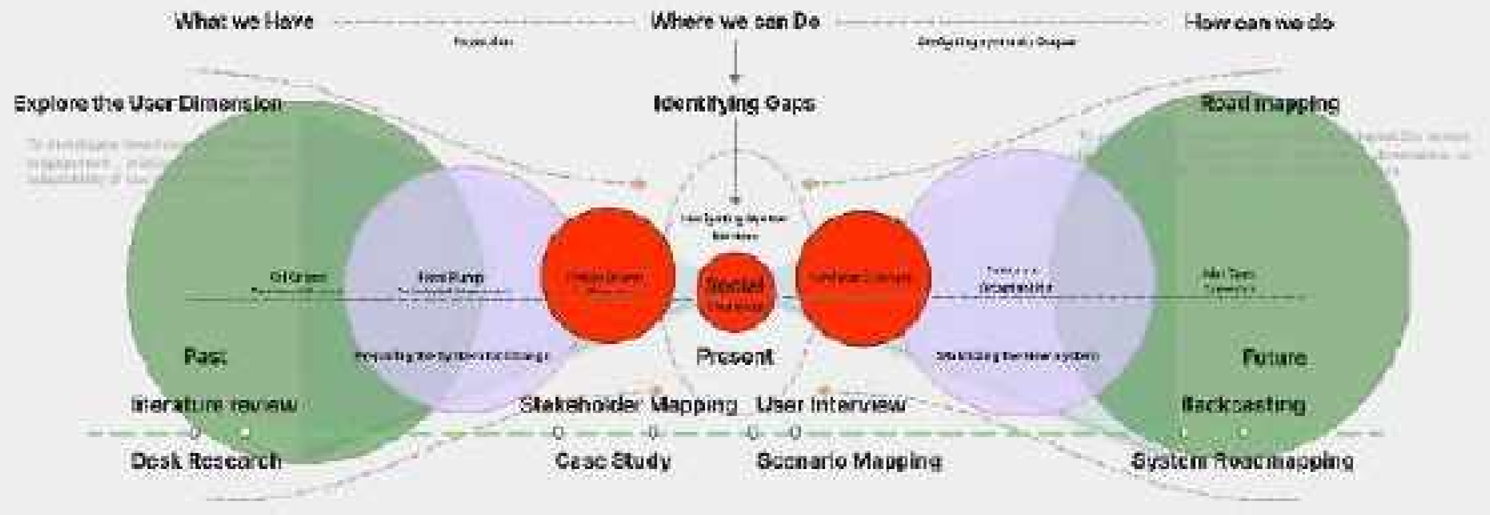
Phase 4

By this stage, the transformation is embedded in daily life of the homeowners. Heat pumps are no longer new technology — they're part of a smarter, cleaner, and more equitable energy ecosystem. Our focus shifts from deployment to long-term monitoring, refinement, and resilience.

Methodology & Impact

Our roadmap aligns with our chosen methodology, with a view of the design futures approach. It doesn't just predict potential outcomes, but it guides an adaptive system for implementation, which is a proactive, homeowner-centred transformation. Each phase supports iterative learning, making it reusable for other systems — from primary to tertiary stakeholders.

Bridging Technology, Design, and Society in the Heat Pump Transition



METHOD JUSTIFICATION

Assess Policy Governance Implications

Implemen

Examine Technical and Infrastructural Adaptability

REFERENCE LIST

[illegible]

[illegible]

Sonya's Reference

[illegible]

Xiao's Reference

[illegible]

Charlie's Reference

[illegible]

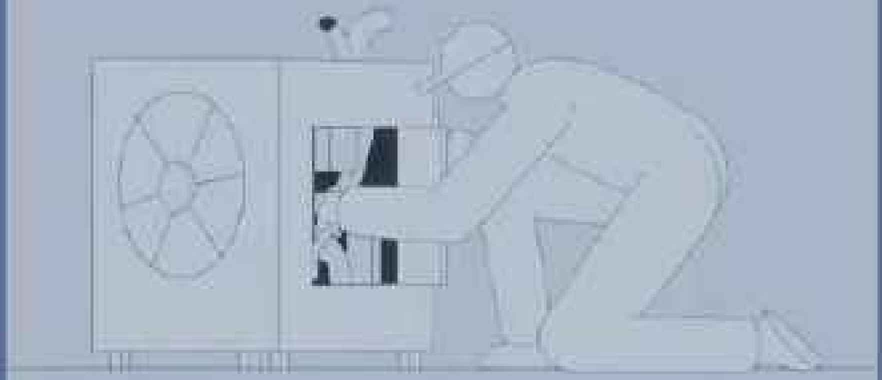
"Crises Integrates Community"

Thankyou

Varun, Somya, Xiao, Charles

HIGH EFFICIENCY HEAT PUMPS

Using system for both heating and cooling



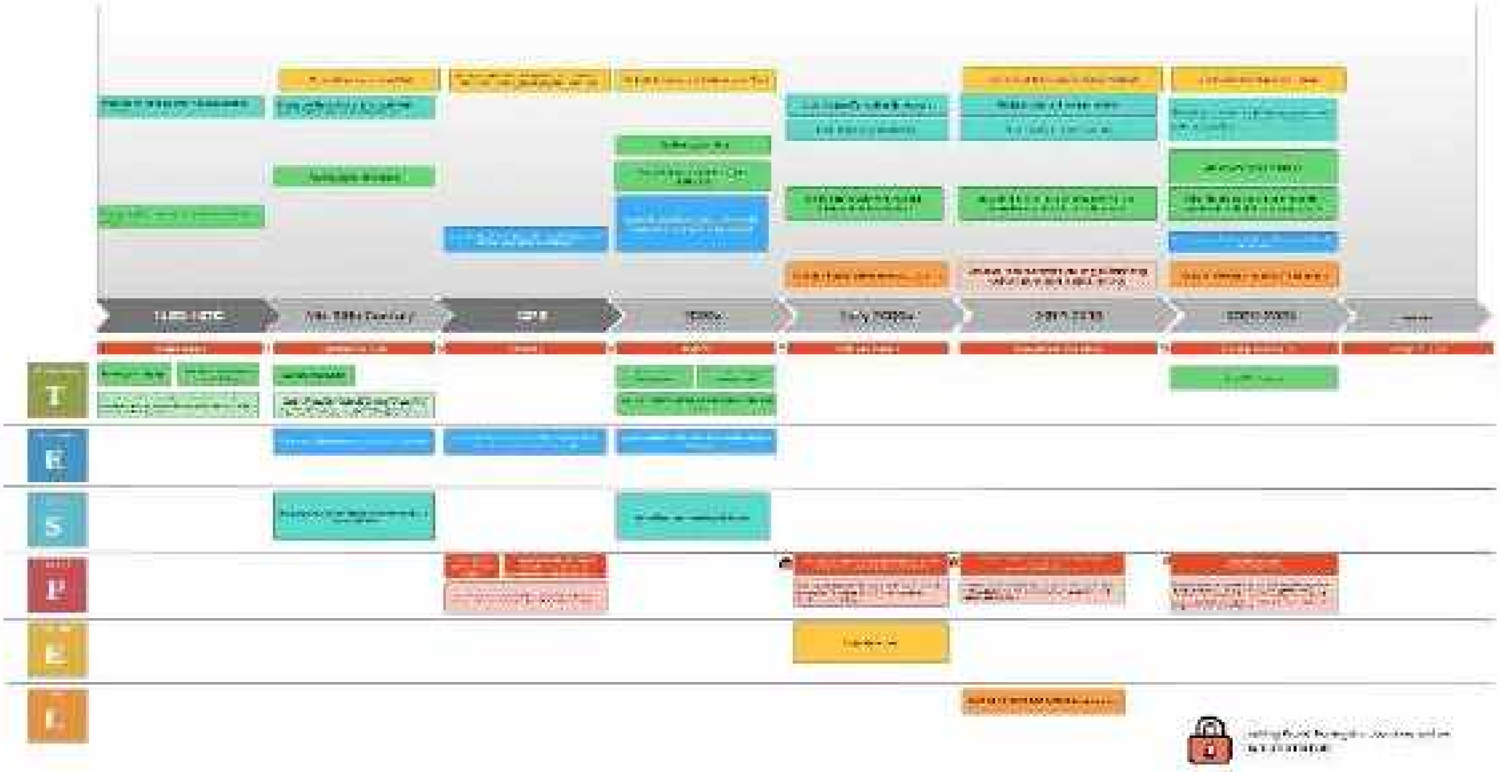
Group 6:

Varun, Somya, Xiao, Charles

RESEARCH METHODOLOGIES UNIT

Sprint 1

SPRINT 1-Timeline and PETSEL



SPRINT 1-Timeline and PETSEL

1850-1970

Breakthrough

Early theoretical experiments by scientists such as Lord Kelvin established the principles of heat recovery and thermodynamics. However, high costs and technological immaturity limited real-world applications.

→ **Significance:** Marks the conceptual origin of heat pump technology — a phase of scientific imagination before practical use.

1973

Oil Crisis

The global oil crisis exposed the vulnerability of fossil fuel dependence, sparking political and public interest in renewable heating alternatives.

→ **Significance:** Acts as a historical **acceleration point**, where external shocks redirected energy innovation priorities.

2014-2016

[illegible]

The UK launched the **Renewable Heat Incentive (RHI)** and **MCS certification**, creating the first regulated market for renewable heating systems.

→ **Significance: A policy consolidation phase**, embedding heat pumps into national decarbonisation strategies.

2020-2025

Social implementation

The UK's legally binding **Net Zero 2050** target and the **Boiler Upgrade Scheme (BUS)** accelerated adoption through funding and regulation.

→ **Significance:** Represents the **social implementation stage**, where heat pumps shift from niche to mainstream in the energy transition timeline.

SPRINT 1-Timeline and PETSEL

Political

Economic

Technological

Social

Environmental

Legal

Summary of Sprint 1

Combining the **PETSEL** with a **timeline approach** offers both structural and temporal clarity in analysing the **heat pump transition**. PETSEL reveals how political, economic, technological, social, environmental, and legal forces interact, while the timeline visualises their evolution and dependencies over decades. Together, they expose key lock-ins—such as gas infrastructure and policy delays—and turning points like RHI and BUS. The strength lies in connecting policy history with systemic change, though it may simplify complex interrelations. Overall, this combined method effectively maps the multi-layered progression of the UK heat pump landscape.

Problems Statement of Sprint 1

We aim to investigate the preferable future of residential heating and cooling in 2035, where high-efficiency heat pumps are widely adopted across households. Our focus will be on how this technology can enhance comfort and indoor well-being, while also driving significant improvements in energy efficiency and reducing environmental impact. We will further explore the role of heat pumps in creating more flexible and resilient living environments, capable of adapting to the changing needs of future generations. In addition, we will examine the involvement of governments, energy providers, and housing authorities in promoting and regulating these advancements. This will ensure that the deployment of heat pumps not only meets the demand for sustainable heating and cooling but also supports inclusive, future-ready communities.

Signals

Noises

- Early work on **refrigeration/heat transfer**
- developed the first practical heat-pump
- **GSHPs** and electrically driven compression heat pumps became more practical

- Online debates & homeowner complaints about heat pump space or upfront cost.
- Small-scale experimental technologies (e.g. hybrid heat pumps, shared ground loops).
- Advocacy groups pushing social media campaigns, but not mainstream awareness.

Weak Signals

- **RHI** (2014 domestic launch): First dedicated policy for renewable heat.
- **Growth of MCS** (Microgeneration Certification Scheme) creating a standardised installer base.
- Early niche adopters in **eco-conscious households in London suburbs.**

- Public perception shift: More neutral/positive press coverage; heat pumps mentioned in home-buying advice.
- London Borough pilots (e.g. Camden, Hackney) testing heat networks with heat pumps.
- Growth of skilled workforce programs (training colleges in Greater London offering heat pump installer courses).
- Property developers starting to market "heat pump-ready homes."

Strong Signals

- UK **Net Zero 2050 law** (2019): Put decarbonisation of heating firmly on policy agenda.
- **Declining cost of heat pump tech globally** (esp. in Scandinavia).
- **Recognition in London Environment Strategy** (2018) that fossil heating must be phased out.

- Boiler Upgrade Scheme (2022; grant increased 2024): Making upfront cost competitive.
- Future Homes Standard (2025): Gas boiler ban in new builds → inevitable lock-in of heat pumps.
- Clean Heat Market Mechanism (2025 launch): Pushing supply chain upgrades.
- Record installations (2023–2024): 250k+ heat pumps certified UK-wide → shift from niche to mainstream.
- Net Zero strategy updates repeatedly highlight heat pumps as central to UK's energy transition.

Past till 2020

Present 2021 - 2025

Sprint 2-Signal, Trends, Driver, Wildcard

Signals

Boiler Upgrade Scheme (BUS)

Applicable in England and Wales. This scheme provides an upfront subsidy of £7,500 for both air-source and ground-source heat pumps for residential and small non-residential installations. The scheme runs from 23 May 2022 to 31 December 2027. The budget for the 2025/26 fiscal year is £295 million.

The government provided subsidies to encourage

The Clean Heat Market Mechanism (CHMM)

It takes effect on April 1, 2025, and will run until at least 2029. It is not a household subsidy, but rather an annual "clean heat quota" obligation for fossil fuel boiler manufacturers: boiler manufacturers must match their boiler sales with "credits" earned from installing their own or purchased heat pumps, and failure to meet these requirements will result in civil penalties. This mechanism aims to "force the boiler industry chain to shift production capacity, channels, and services toward heat pumps," and is currently the UK's most direct policy tool influencing manufacturing investment decisions.

The government ask companies to reduce cost

Zero-Rated Value Added Tax (0% VAT) - Energy-Efficient Material Installation

From April 1, 2022, to March 31, 2027, the installation of "energy-efficient materials" (including heat pumps) in residential buildings will be subject to 0% VAT (after which the reduced rate will revert to 5% under current legislation, unless further extended). This significantly reduces overall costs for residents and indirectly increases the certainty of manufacturers' order forecasts.

The government cuts taxes to encourage

On April 30, 2025, the government announced an additional £5m to continue the Heat Training Grant until March 2026, expanding the installation and operation and maintenance talent pool and alleviating the talent bottleneck facing industry expansion.

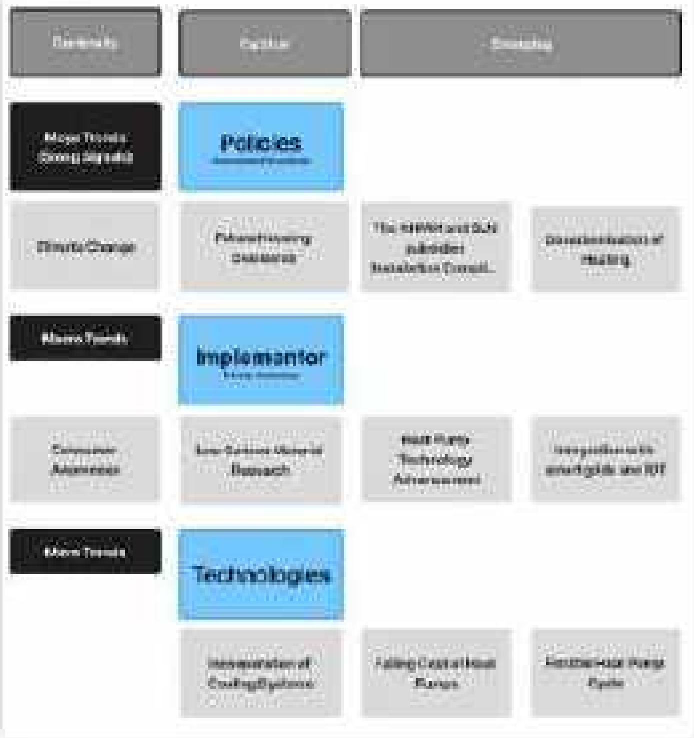
Government training of technical personnel

Government are seeking views on proposals and draft statutory instrument to improve ecodesign and energy labelling legislation to increase the performance of space heating products.

Government raises standards for space heating products

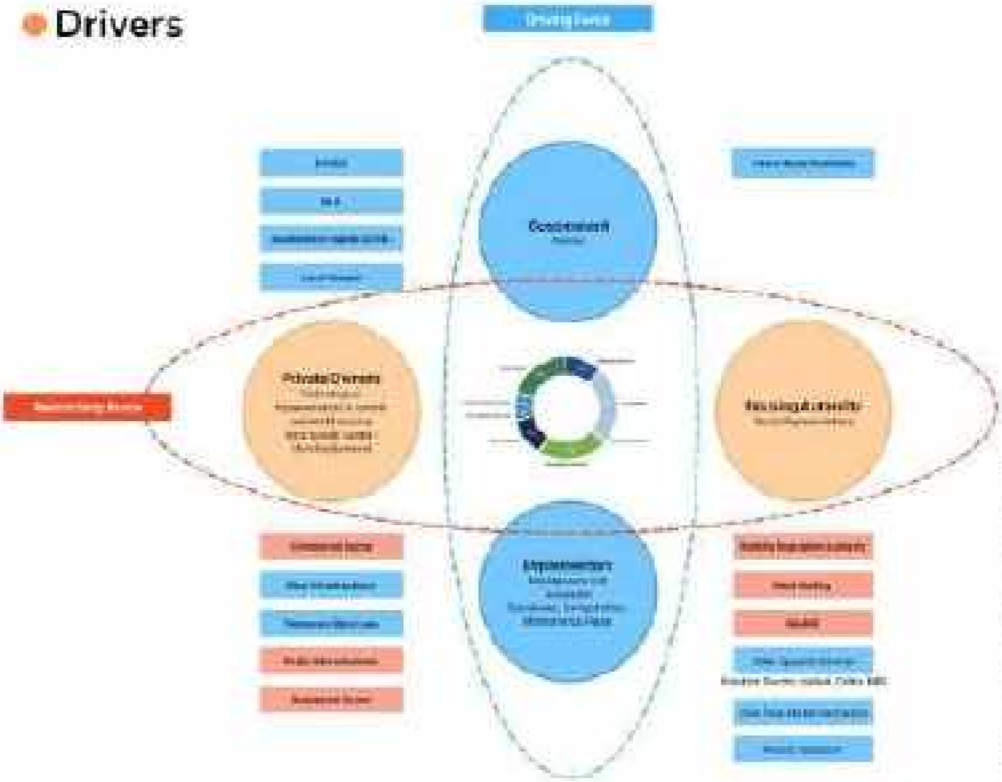
Sprint 2-Signal, Trends, Driver, Wildcard

Trends



The government is promoting industry development through policies and subsidies, while companies are continuously innovating in low-carbon materials and intelligent technologies. Technically, this is reflected in cost reduction, functional integration, and system optimization. Overall, policy guidance, market momentum, and technological advancement have jointly promoted the popularization and development of heat pumps.

Drivers



Why are we doing this?

- CLIMATE CHANGE
- Environmental Emergencies
- Summer Cooling Needs
- Residential Carbon Emission (10%)

The government is promoting the widespread adoption of heat pumps through policies, subsidies, and housing standards. Manufacturers and implementers are accelerating the implementation of the technology through production, installation, and maintenance. However, the main obstacles for private owners are the difficulties and high costs of retrofitting older homes, as well as the limitations of housing authorities in enforcing regulations. Overall, the development of heat pumps is driven by policy and the market, but also constrained by practical technical and institutional challenges.

Wildcards

Futures?

- **Plausible Future**

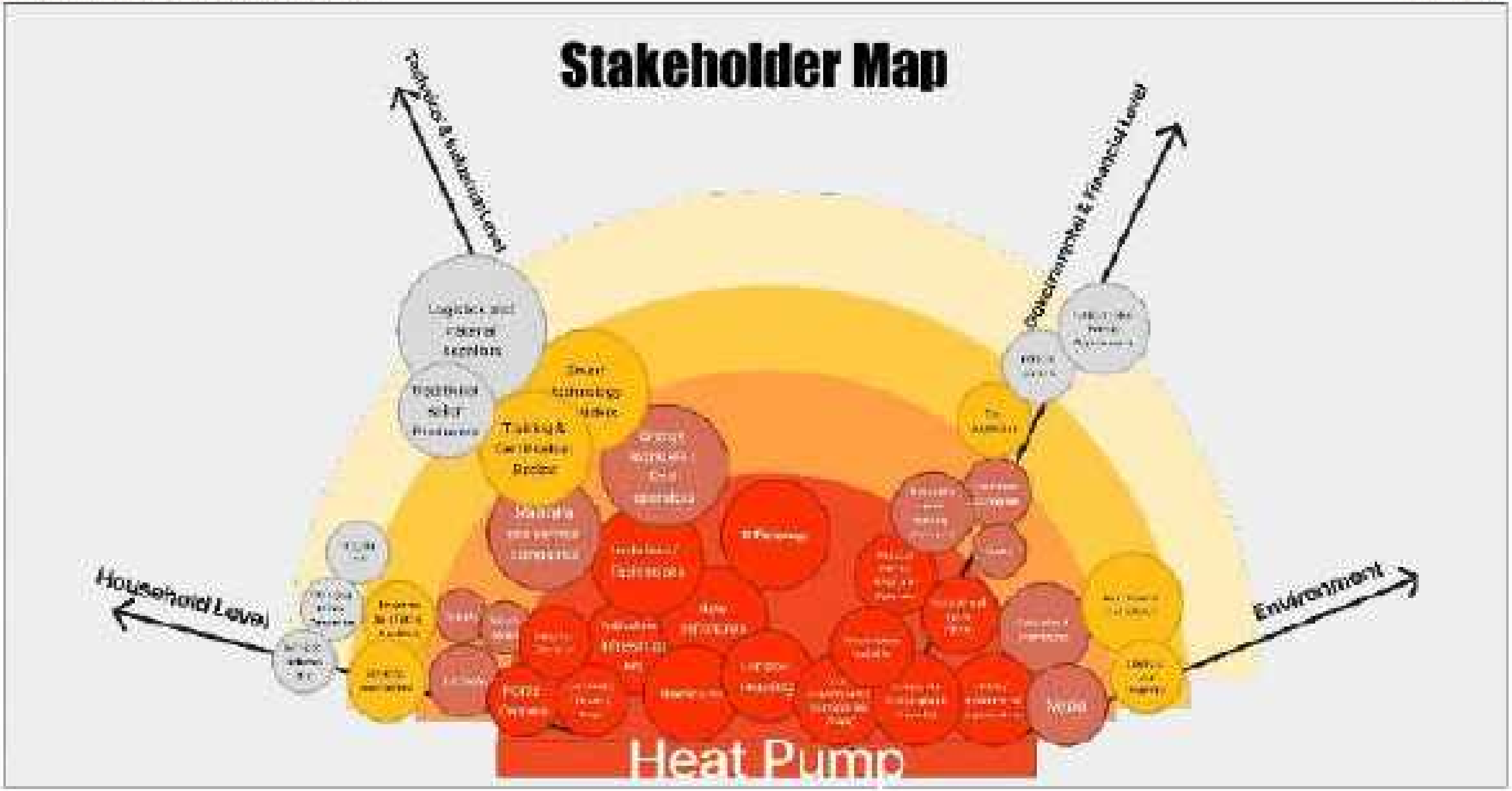
  Adaptable System Technology

- **Preferable Future**

  By 2050
  Aim-To Achive Net Zero Emissions

- **Probable Future**

  Hybrid Technology for Heating and Cooling
  Effective Implementation of High Efficiency
  District Heating


Stakeholder Map
Household Level
Governmental & Financial Level
Environment
Training & Certification Bodies
Heat Pump

Homeowners at the Heart of Change

Why Homeowners Matter Most

- **Most Affected:** Directly impacted by government energy policies and housing regulations.
- **Largest Group:** Represent the highest share of potential adopters of heat pumps across the UK.
- **Direct Users:** Live with the technology daily — influencing comfort, energy bills, and overall satisfaction.

What We Want To Unlock

- **Understand Pain Points:** Identify barriers homeowners face in adopting heat pumps.
- **Map Opportunities:** Explore incentives, support systems, and innovations that can accelerate adoption.
- **Co-Design Futures:** Develop homeowner-centered strategies for efficient, scalable installation of heat pumps.
- **Inform Policy & Practice:** Provide insights to local authorities, housing associations, and policymakers for sustainable roll-out.

Sprint 4-Stakeholder map, Gameplay, Analysis

Game Rules

Roll the dice → players move forward the number of squares.

Landing on a square:

Regular square → nothing happens, just wait for your next turn.

"Question" square → the player (or group) must answer the interview question before staying on that square.

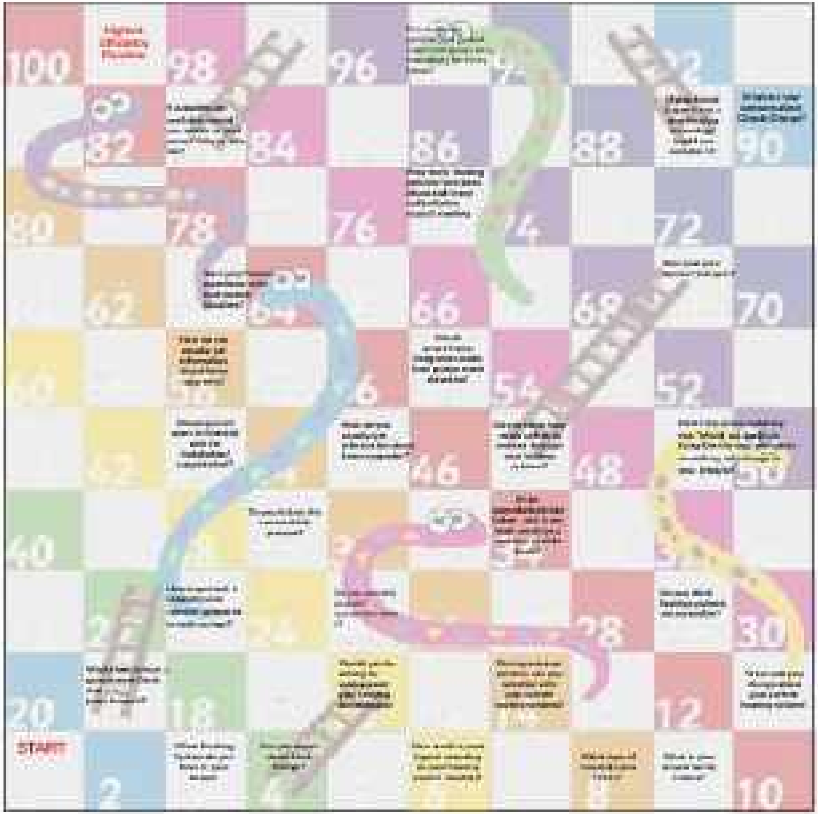
Snake → slide back to the lower square (represents a barrier).

Ladder → climb up to the higher square (represents an opportunity).

How Questions Work

1. If a player lands on a question square, the facilitator (or game leader) reads aloud the question from the playbook/legend.
2. The player answers based on their real-life perspective (as a homeowner), or the group can discuss.
3. After answering, they remain on that square until their next turn.

Sprint 4-Stakeholder map, Gameplay, Analysis



Achievements

1. Playful Learning & Visualization

Turned the complex issue of heat pump adoption into a fun, accessible, and visual experience through the metaphor of "ladders" (opportunities) and "snakes" (barriers).

2. Question Design Encouraging Critical Reflection

The board includes multi-layered questions about technology, economy, policy, and user behavior, promoting reflection on both personal and systemic factors.

3. Methodological Innovation

Combines qualitative research with gamification, bridging social research and design practice in a participatory co-design tool.

Failures

1. Weak Logical Progression

Some questions lack clear progression, mixing personal reflections with macro policy issues.

2. Undefined Player Roles

The absence of defined roles (e.g., homeowner vs policymaker) limits the depth of insights.

Playing

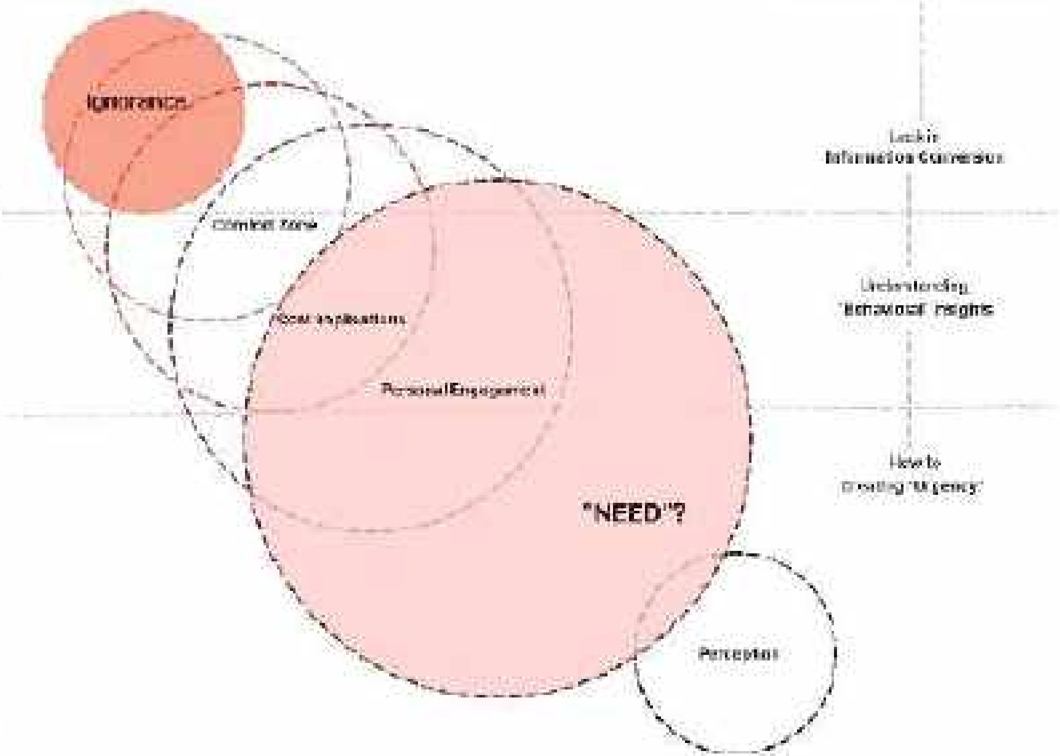





Sprint 4-Stakeholder map, Gameplay, Analysis

Game Analysis

Potential Methodology



Painpoint

Ignorance:

Lack in interpretative information leads to public not being aware about the concerns of this (energy and heating) sector.

Promotion of information on media, interactive platforms is not prominent for people to be aware of the existing policies, concerns or global trends.

Comfort: Cost: Commitment

People are not open to changes considering it requires personal effort, and there is no "need" or urgency as of now.

Cost of change is not readily affordable for a large middle-class mass. "Want" is not enough.

The commitment to be involved in installation, maintenance, and uncertain future constraint seems too much for too little.

Need

The urgency for Climate Change seems a controversial topic with opinions on both wings.

People like "Sustainability" but not necessary practice it.

Summary of Sprint 4

The *Heat Pump Snakes & Ladders Game* serves as an interactive research tool to explore public attitudes toward sustainable heating and cooling systems under climate change. By transforming complex socio-technical discussions into a playful and participatory format, the game encourages players to reflect on personal choices, policy awareness, and environmental responsibility. Through questions linked to real-life barriers and opportunities, it reveals how social perception, financial incentives, and technological literacy shape the adoption of heat pumps. Although further refinement is needed in structure and data collection, the project successfully demonstrates how gamification can promote engagement, dialogue, and collective learning around energy transition and home well-being.

Problem Statement of Sprint 4

As the transition toward low-carbon heating accelerates, the role of users, particularly homeowners becomes central to shaping an inclusive and adaptive energy future. Beyond technical efficiency, the success of heat pump adoption depends on emotional acceptance, behavioral adaptability, and the co-creation of meaningful domestic experiences. Our research investigates how residential environments can evolve as *participatory systems*, where design acts as a mediator between policy frameworks, technological infrastructures, and the intimate scale of everyday life.

Using visual and narrative mapping, we explore how households move through distinct stages—awareness, decision-making, adoption, and co-design—each reflecting shifting relationships between humans and technology. By integrating insights from social practice theory, systems design, and speculative futures, we aim to prototype design strategies that foster collective agency, emotional resilience, and situated learning in the heat transition. This approach reimagines domestic heating not merely as a technical upgrade, but as a living process of adaptation, negotiation, and shared imagination toward sustainable futures.