SUSTAINABLE ENERGY AUTHORITY OF IRELAND

Behavioural insights for electricity demand flexibility

TECHNICAL APPENDIX

SEAI Behavioural Economics Unit

Behavioural insights for policy: evidence review

Behavioural insights for electricity demand flexibility

Barriers and enablers to behaviour change and engagement with smart energy services
TECHNICAL APPENDIX

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Sustainable Energy Authority of Ireland
SEAI is Ireland's national energy authority investing in, and delivering, appropriate, effective and sustainable solutions to help Ireland's transition to a clean energy future. We work with the public, businesses, communities and the Government to achieve this, through expertise, funding, educational programmes, policy advice, research and the development of new technologies.

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Contents

1. Introduction

This Technical Appendix provides a detailed account of the methodology used to develop the main report, "Behavioural Insights for Electricity Demand Flexibility: Barriers and enablers to behaviour change and engagement with smart energy services".

The primary purpose of this document is to describe how the insights and assets presented in the main report were developed. By presenting this information separately, the main report remains accessible, actionable, and user-friendly. By detailing the methodology used and its limitations, this report can also help future research build on this project.

Where relevant, the main report references this Technical Appendix, allowing readers to use it as a complementary resource. It provides supporting evidence for the insights presented in the main report and offers a deeper understanding of key elements, particularly the behavioural taxonomies. While the main report includes a simplified, general behavioural taxonomy for accessibility, this report features three more detailed taxonomies included in the annex.

This Technical Appendix begins with a description of the methodology and approach used in conducting the literature review. This section outlines how insights were gathered to develop the behavioural taxonomy, demand flexibility roadmaps, and policy recommendations featured in the main report. Following this, it details the stakeholder interviews, including the participants involved and how the information gathered was used to inform the report. Subsequently, it explains the methodology for developing the behavioural taxonomies. This includes the selection of criteria, the development of criteria values, and the classification of behaviours. It then elaborates on the process used to create the behavioural roadmaps, describing the frameworks that informed their structure, how the behaviours and barriers were identified for each phase, and finally, how relevant policy recommendations were developed. Lastly, it includes a limitations section covering the behavioural taxonomies, roadmaps, and policy recommendations and an annex with the additional taxonomies.

2. Literature review

2.1. Introduction

The project was initiated with a review of existing literature, both academic and grey. The purpose of this review was to gather insights to develop the behavioural taxonomy, demand flexibility roadmaps and policy recommendations applicable to the Irish landscape. The literature review was divided into three activities: reviewing academic articles, reviewing grey literature, and compiling and summarizing findings. The methodology for each activity is detailed below.

2.2. Methodology

2.2.1. Review of academic articles

The first phase involved re-screening approximately 120 academic papers identified during a related project on consumer engagement in demand flexibility with the IEA Users Centred Energy System Technology Collaboration Platform (Users TCP), SEAI, and several other partners. The team then conducted an additional Google Scholar search to identify demand flexibility studies conducted specifically in Ireland. Articles that passed the screening stage then proceeded to a data extraction stage. The following data was extracted:

Category of extracted data	Description
Policy/Programme description	Relevant programmes or policies promoting a given flexibility behaviour mentioned in the article
Current level of take-up, engagement & awareness	Statistics on technology uptake and adoption in Ireland and globally (e.g. proportion of Irish homes with a heat pump installed)
Behaviour macro-category	Broad category of flexibility-related behaviour or technology (e.g. smart tariffs, EV, peak shaving)
Behaviour/technology description	Description of the behaviour or technology category
Barriers	Behavioural barriers associated with the behaviour / technology adoption mentioned in the article (e.g. lack of awareness)
Enablers	Behavioural enablers associated with the behaviour / technology adoption mentioned in the article (e.g. environmental values)
Predictors	Predictors associated with the behaviour / technology adoption mentioned in the article (e.g. educational level)
Customer journey description	References to different stages of a customer journey mentioned in the article (e.g. awareness phase, exploration phase)
Sub-group & segment insights	Group-specific insights about behaviour (e.g. Households with children or low-income families are less likely to show significant improvements in reducing electricity usage.)

2.2.2. Review of grey literature

To complement the academic search, the team identified 25 policy documents and reports from the Department of Energy, the Commission for Regulation of Utilities, ESB Networks, the Sustainable Energy Authority of Ireland, and Irish energy companies. The primary objective of this search was to gather information on existing and planned initiatives in Ireland to unlock electricity demand flexibility in the residential sector and in SMEs. After the screening phase, 16 documents were selected for the data extraction phase. The same data extraction categories were used as in the academic literature review (see the table in the previous section).

2.2.3. Compiling and summarising insights

Combining the extracted data from the academic and literature searches, we first distilled the main behaviour categories for which separate roadmaps were later developed (see Demand Flexibility Roadmaps section). The final set of behaviour categories were (1) heat pump adoption and flexible use, (2) electric vehicle adoption and flexible use, (3) solar panel adoption and flexible use, (4) smart appliances, (5) switching to smart tariffs, (6) participation in demand response programmes, (7) peak shaving, and (8) peak shifting. The behavioural enablers, barriers, predictors and sub-group insights identified in the literature review then served as the basis for developing the behavioural taxonomy, behavioural roadmaps and policy recommendations presented in the following sections.

3. Stakeholder interviews

3.1. Introduction

As part of the research and scoping phase of this project, a series of interviews were conducted with representatives from various organisations and companies involved in electricity demand flexibility efforts in Ireland. The primary objective of these interviews was to gather comprehensive information on the current policy landscape in Ireland concerning electricity demand flexibility. This included insights from government entities, regulatory bodies, distribution system operators (DSOs) and energy providers.

3.2. Purpose of the interviews

The interviews served several purposes:

1. To identify and understand the key technologies, behaviours, and services prioritised by these organisations, such as smart meters, in-house displays, time-of-use and dynamic tariffs, demand response programmes, electric vehicles, heat pumps, smart appliances, solar photovoltaics, and home storage batteries.
2. To collect information on past and ongoing initiatives, as well as the strategic priorities and plans of these organisations for the next 5-10 years.
3. To examine barriers experienced in implementing these technologies and programmes, including issues related to policy design, user adoption, and public attitudes.
4. To understand their perspectives on promising policy recommendations or interventions that could support electricity demand flexibility efforts.

The insights gathered from these interviews informed several sections of the main report, including:

- The identification of the key technologies, behaviours, and services that the main report should cover.
- An outline of the policy landscape in Ireland for each technology, behaviour and service, which formed part of the introductory sections of the roadmaps.
- Complementary information on barriers and policy recommendations identified in the literature review, which were incorporated into the roadmaps.
- The sequence of steps involved from a user's perspective, such as small- and medium-sized enterprises (SMEs) or residential users, that went into the roadmaps.

3.3. Interview methodology

A total of six stakeholders were interviewed, each representing a key organisation involved in electricity demand flexibility in Ireland. These organisations spanned government departments, regulatory bodies, distribution system operators (DSOs), and utility providers, ensuring coverage across the policy development and implementation phases. Specifically, the organisations included:

- Department of the Environment, Climate and Communications (DECC)
- Commission for Regulation of Utilities (CRU)
- ESB Networks (state-owned DSO)
- Three utility companies: Energia, Pinergy (private-sector suppliers), and ESB (state-owned supplier)

The Sustainable Energy Authority of Ireland (SEAI) identified the stakeholders, leveraging their in-depth understanding of key figures relevant to the project. SEAI initiated contact with the stakeholders, after which the research team followed up to schedule and conduct the interviews.

The interviews – each lasting approximately one hour – were conducted remotely using a video-conferencing platform. They were semi-structured and moderated by a pre-drafted interview guide (see Annex 1). The guide was adapted for each interviewee based on their organisational remit and role. During the interviews, the research team took detailed notes, which were later used to draft the main report. The annex includes a generic version of the interview guide.

The names and roles of the individuals interviewed are listed in Table 1 below.

Table 1. List of stakeholders who were interviewed for the report.

Name	Role	Organisation
Andrew Doyle	Policy Lead Smart Energy Services & Consumer Demand Flexibility	Department of the Environment, Climate and Communications
Fergus O'Toole	Active Customers and Smart Metering Manager	Commission for Regulation of Utilities
Carol Murphy	Strategy and Customer Manager	ESB Network
Caoimhe McWeeney	Regulatory Affairs Manager Customer Solutions	Energia
Ellen Diskin	Head of ESB Networks' National Network	ESB
Philip Connor	Head of Energy Services	Pinergy

4. Behavioural taxonomies

4.1. Introduction

A key component of the main report is the behavioural taxonomy, which systematically classifies behaviours involved in electricity demand flexibility based on a set of criteria. To our knowledge, this represents the first comprehensive attempt to develop such a taxonomy specifically for electricity demand flexibility behaviours. The main report includes a generic behavioural taxonomy, while more detailed versions are provided in the annex of this Technical Appendix and as standalone spreadsheets. These additional taxonomies were excluded from the main report to maintain its readability.

The taxonomies in the annex of this Technical Appendix focus on three distinct classes of electricity demand flexibility behaviours:

- Behavioural changes
- Engagement with demand flexibility programmes and services
- Uptake and flexible use of demand flexibility enabling technologies

These classifications distinguish different approaches to electricity demand flexibility. The first category addresses direct actions that SMEs and households can undertake, irrespective of their access to specific technologies or programmes. The latter two categories focus on participation in programmes and services and the adoption and flexible use of technologies. It is important to note that there is some overlap between these categories, as participation in programmes and the flexible use of technologies involve behavioural changes.

4.2. Purpose of the behavioural taxonomies

The taxonomy serves two primary purposes:

1. To provide an exhaustive and organised list of all actions and behaviours that, directly or indirectly, contribute to electricity demand flexibility.
2. To offer a systematic classification method that helps organisations design behavioural interventions. This classification also helps in prioritising actions to focus on based on their impact and the extent to which consumers are capable to change their behaviour.

4.3. Classification criteria development

The taxonomy employs six criteria to classify behaviours. These criteria were developed based on insights from the literature review and refined through collaboration with SEAI during a workshop. They were selected to align with behavioural science principles and the practical needs of designing and prioritising interventions.

Once the criteria were selected, the values assigned to each were developed to achieve a balance between systematic classification, accessibility by having a manageable set of values, and sufficient detail to make the taxonomy actionable and insightful.

A list of the criteria, their description, values, and the sources that were used as inspiration to develop these criteria are listed in the table below.

Table 2. Taxonomy criteria, values, and related sources.

Criteria name & description	Values or constituent factors	Key sources/ references
Frequency: the expected or required rate at which the action is performed.	1. One-off behaviours 2. Habitual behaviours 3. Recurrent behaviours at irregular intervals	(Alós-Ferrer, Strack, 2014; Neal et al., 2006; Lally et al., 2010)
Primary agent: the primary source or producer of flexibility.	1. Consumer-led 2. Appliance-led 3. Utility-led	(Piano & Smith, 2022)
Behavioural effort: the level of behavioural effort typically required to perform the action.	Factors considered: • Time investment • Physical effort • Habit disruption • Emotional impact • Reduced comfort	(Lavin & Julienne, 2025; Pon, 2017; Brown et al., 2023; Belton & Lunn, 2020; SEAI, 2020; Barjaková et al., 2024; Gram-Hanssen et al., 2024)
Cognitive effort: the level of cognitive effort typically involved in performing the action.	Factors considered: • Action planning • Specific knowledge and skills • Technical complexity • Attention demand • Social coordination	
Financial Cost: the upfront or immediate costs of engaging in the action or behaviour.	1. Possible savings 2. None 3. Low: €0-€300 4. Moderate: €300-€3,000 5. High: €3,000+	Estimated based on average market prices in Ireland
Energetic Impact: the approximate effect on consumption in terms of reduction or shift, assuming a constant energy load & behaviour is performed consistently.	1. Low: change in consumption of 200 kWh per year or less 2. Moderate: 200-1,500 kWh per year 3. High: 1,500+ kWh per year	Estimated based on energy impact of individual behaviours

4.4. Behaviour identification

Behaviours included in the taxonomy were identified through a combination of interviews, literature review, and insights shared by SEAI. The research team also conducted internal workshops to develop a comprehensive list of actions contributing to electricity demand flexibility.

Given the extensive number of behaviours listed in the taxonomies, additional classifications have been included to help readers filter specific types of behaviours more easily. These behaviours are organised into three to four hierarchical levels, gradually narrowing broad behavioural categories into specific actions. The classifications are primarily based on the motive and goal of each behaviour. For instance, using the Eco mode on washing machines, opting for shorter laundry cycles, and selecting a high spin speed function are grouped under the category of "laundry activities," as they share the same motive: cleaning clothes. These are further categorised under a broader goal, such as "optimising appliance settings," which, in turn, falls under an even broader category like "peak shaving behaviours." This hierarchical structure enables readers to navigate and filter behaviours effectively at varying levels of specificity.

The detailed taxonomies are included in the annex of this Technical Appendix, providing an exhaustive list of behaviours and their classifications. To facilitate practical use, these taxonomies are also available in a spreadsheet format, allowing users to filter behaviours based on criteria of interest. This format enables systematic identification and prioritisation of behaviours for intervention.

5. Demand flexibility roadmaps

5.1. Introduction

The roadmaps aim to provide a structured understanding of the behaviours and actions required by households and businesses to achieve electricity demand flexibility. The purpose of developing roadmaps was to systematically outline and visualise the behaviours and actions that households and businesses must undertake to achieve electricity demand flexibility.

By visualising these pathways, we can identify key stages of awareness and readiness, associated behaviours and barriers to progress. These roadmaps integrate insights from behavioural science frameworks and customer journeys identified in the literature, ensuring they reflect real-world complexities and offer actionable insights for policymakers and stakeholders in light of these. They also integrate information on the Irish context and provide a foundation for developing targeted interventions that match customers' stage of behaviour change, to ultimately promote electricity demand flexibility in Ireland.

5.2. Developing overarching roadmap phases

To develop the roadmap phases, we reviewed numerous customer journeys forming part of academic papers or reports identified during the literature review. Furthermore, we also reviewed behavioural science frameworks commonly cited in energy behaviour research. Key models included:

- **Transtheoretical Model of Behaviour Change** (Prochaska and Velicer, 1997): This model outlines five stages — pre-contemplation, contemplation, preparation, action, and maintenance — that individuals move through when changing behaviours. It helped define the roadmap's progression from awareness and consideration to sustained energy-saving habits.
- **Diffusion of Innovation** (Rogers, 2010): This framework explains the diffusion of new technologies, categorising adopters as innovators, early adopters, early majority, late majority, and laggards. Central tenets of this framework include awareness and knowledge formation, followed by attitude formation, and evaluation – influenced by the perceived characteristics of the innovation, such as relative advantage, compatibility, complexity and observability – ultimately influencing the decision to adopt or reject the new technology. This was particularly useful for the development of the stages of the "Demand flexibility technologies roadmaps", such as the adoption and flexible use of smart appliances, heat pumps, EVs, or solar PVs.
- **The Habit Loop** (Duhigg, 2012): This framework emphasises the habit loop — cue, routine, and reward — in forming sustained behavioural changes. It was critical for structuring the roadmap phases focused on energy-shaving and shifting behaviours, emphasising gradual habit formation.

The roadmaps reflect a progression from awareness and decision-making to sustained engagement across three to four stages, tailored to different demand flexibility activities such as enrolling in tariffs, adopting technologies, and changing habits.

5.3. Selecting key behaviours

The key behaviours at each stage were identified through the review of the literature and an analysis of existing programmes and schemes, including details such as their sign-up processes. Demand flexibility behaviours are often interlinked—for example, using smart appliances flexibly involves peak shifting, and peak shifting can result from switching to time-of-use tariffs. Since behaviour change often complements participation in programmes or the use of flexible technologies, certain stages of the journeys overlap to reflect these co-dependencies.

In the case of the "Behaviour Change Roadmaps" and "Demand Flexibility Services Roadmaps," the behaviours are more interrelated. However, for the "Demand Flexibility Technologies Roadmaps," we focus more on flexible use as opposed to initial adoption to reflect the fact that the adoption of technologies, such as heat pumps and electric vehicles can be highly energy-intensive, and it is their operation that matters for flexibility outcomes. The final structure and selection of behaviours ensure clarity in showcasing how each behaviour contributes to ultimately achieving demand flexibility.

5.4. Identifying behavioural barriers

Behavioural barriers were identified through a review of the literature and interviews with stakeholders carried out in earlier phases of the project. While the final roadmaps do not directly group these barriers into categories like those in the COM-B model (Michie et al., 2011), the ideas behind this framework helped guide the barrier identification process. Capability barriers, (e.g. lack of understanding of energy technologies or their benefits), opportunity barriers (e.g. financial constraints or lack of access to enabling infrastructure) and motivational barriers (e.g. resistance to change, concerns about complexity) were considered to ensure we capture the most commonly experienced barriers.

The roadmaps also considered barriers specific to Ireland. For instance, the relatively low adoption of heat pumps compared to other European countries suggests there may be cultural, financial, or logistical challenges unique to the local context. Similarly, the availability of financing schemes was recognised as a key factor influencing whether people can afford to adopt new technologies. By considering both general behavioural barriers and those unique to Ireland, the roadmaps aim to reflect the most common and significant challenges people face while tailoring solutions to the local context.

5.5. Developing and classifying policy recommendations

Policy recommendations were designed to address the barriers presented in the roadmaps. The development of the recommendations was a three-step process. In the first stage, a set of initial policy recommendations was drafted based on the behavioural enablers extracted from the reviewed academic literature. In the second stage, new policy recommendations were added based on the stakeholder interviews. Finally, the draft policy recommendations were compared with the current Irish policy landscape as described in the reviewed government reports. This led to the removal of some recommendations that already being implemented by the Irish government or utilities.

To fit the purpose of the demand flexibility roadmaps, the policy recommendations have been grouped into behavioural categories and stages. Arguably, some policy recommendations may be more overarching and relevant to multiple stages of the roadmaps presented. Each recommendation has been assigned to a stage of a roadmap at which the authors believe it would be most appropriate and impactful.

6. Conclusion

The primary purpose of the Technical Appendix is to support the main report by providing detailed insights into the methodologies used to develop the behavioural taxonomies, demand flexibility roadmaps, and policy recommendations. Through integration of diverse methodological approaches, the authors aimed to deliver frameworks and recommendations that are both robust and tailored to the context of the Irish energy landscape.

As the demand flexibility landscape continues to evolve, some of the findings may need to be updated to remain relevant. However, the methodologies presented here provide a flexible foundation that can be adapted over time. By incorporating the research process presented, policy makers can continue to ensure that behavioural insights are applied at all stages of demand flexibility initiatives, ultimately supporting Ireland in achieving its national climate goals.

7. Limitations

7.1. Limitations of the behavioural taxonomies

To develop a taxonomy that is actionable and geared towards designing and prioritising behavioural interventions, it was necessary to limit the number of criteria included. While other criteria are relevant for classifying behaviours and have implications for the types of behavioural interventions that may be most effective, only a subset was selected to ensure the taxonomy remained practical. This selection process was conducted in collaboration with SEAI.

A second limitation concerns the development of the values assigned to each criterion and their application to specific behaviours. As with the criteria selection, the development of values involved balancing the need for a systematic and manageable set of values with the requirement for sufficient detail to make the taxonomy actionable. Although a more comprehensive set of values could have been developed, this might have reduced the taxonomy's usability and practicality.

Finally, in assigning values to behaviours, certain simplifications were necessary. These included making assumptions, such as estimating the level of cognitive and behavioural effort required for each behaviour, and establishing cut-off points, which are to some extent arbitrary, for categorising behaviours. For example, determining whether the financial cost of a behaviour is classified as low, moderate, or high involved setting thresholds that may not fully capture the nuances of individual behaviours. Additionally, average values, ranges, and estimates were used, such as for determining the energetic impact of specific behaviours. These assumptions, averages, and cut-off points introduce limitations to the reliability of the classification. Some behaviours may be assigned to one category but have values—such as financial cost—that are near the upper limit of that category, making them effectively closer to behaviours in another category with lower-end values.

7.2. Limitations of the roadmaps

To develop actionable and insightful roadmaps, it was necessary to break down what an overarching roadmap towards electricity demand flexibility might look like into separate roadmaps for the behaviour changes, services and programmes or technologies involved. One limitation of this process was that while the roadmaps certainly overlap (e.g. the flexible use of smart appliances involves peak shifting), some of the co-dependencies across the stages might be less explicit than if it was visualised as a single roadmap.

Developing the roadmaps involved another strategic simplification, to strike a balance between producing an actionable deliverable and creating an extensive, detailed one. While this trade-off – similarly to the behavioural taxonomies – ensures the roadmaps remain practical and user-friendly, it inevitably means some nuance and complexities are lost.

7.3. Limitations of the policy recommendations

Three limitations were encountered in the development of the policy recommendations. The first challenge was to ensure that the policy recommendations were specific enough. In most cases, the academic and grey literature reviewed provided general recommendations without providing specific evidence-based examples. As a result, policymakers may need to conduct additional research before implementing some of the recommendations. For example, conducting A/B experiments or focus groups to understand which communication frames resonate most with a consumer group of interest.

Second, while the policy recommendations presented may appear to be universally applicable, they are highly context specific. To ensure that the implementation of a recommendation will lead to the desired results, it is again important to pre-test it, for example through experiments in a sandbox environment.

Finally, the policy recommendations are grouped into specific behaviour categories and stages of the customer journey, but they are often applicable to other behaviours and stages of the roadmaps. For the sake of clarity, the recommendations are placed only within the behaviours and stages to which they are most applicable. Users of the roadmaps are encouraged to think critically about the recommendations and explore their applicability to other behaviour categories and stages.

Glossary

Behavioural barriers: psychological, social, or contextual factors that hinder individuals from adopting desired behaviours, such as lack of awareness, resistance to change, or misconceptions about the benefits of energy demand flexibility.

Behaviour change roadmap: a structured plan that outlines the actions, behavioural barriers and policy recommendations for influencing and supporting individuals or groups to adopt desired behaviours.

Behavioural enablers: factors or conditions that facilitate or motivate individuals to adopt desired behaviours. These may include incentives, clear information, social norms, or user-friendly technologies that encourage participation in energy demand flexibility initiatives.

Behavioural intervention: a strategy or action designed to influence consumer behaviour in a specific way, such as encouraging energy-saving practices or participation in demand-response programmes, often using insights from behavioural science.

Behavioural taxonomy: a systematic classification of behaviours based on their characteristics, barriers and drivers.

Energy demand flexibility: the ability of energy consumers to adjust their energy usage patterns in response to external signals, such as changes in electricity prices, incentives, or requests from grid operators, to improve energy efficiency and grid stability.

Energy demand flexibility services and programmes: initiatives or offerings designed to encourage or facilitate energy demand flexibility. These may include Time-of-Use tariffs, dynamic pricing schemes, demand-response programmes, or incentives for consumers to shift or reduce energy usage during peak demand periods.

Energy demand flexibility technologies: devices and appliances that enable or enhance the flexibility of energy demand, including smart meters, programmable thermostats, energy management systems, and smart appliances with demand-response capabilities.

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Annex

Simplified interview guide

General Overview

- What is your current role in promoting electricity demand flexibility?
- What is your organisation's strategy for the next 5–10 years?
- What are the biggest challenges you face right now?

Data Monitoring and In-House Displays

- What is your organisation's remit and involvement with data monitoring device installations and usage?
- What does the customer journey for data monitoring device installations look like?
- What challenges have you faced? what barriers do customers face?
- What initiatives do you think would help promote data monitoring device installations and usage?

Time-of-Use Tariffs

- What is your organisation's remit and involvement with Time-of-Use Tariffs adoption and flexible use?
- How does the customer journey for Time-of-Use Tariffs adoption look like?
- What challenges have you faced? what barriers do customers face?
- Going forward, what initiatives do you think would help promote Time-of-Use Tariffs adoption and flexible use?

Demand Response Programmes

- What is your organisation's remit and involvement with Demand Response Programmes enrolment and participation?
- How does the customer journey for Demand Response Programmes enrolment and participation look like?
- What challenges have you faced? what barriers do customers face?
- Going forward, what initiatives do you think would help promote Demand Response Programmes enrolment and participation?

Solar photovoltaics and Batteries

- What is your organisation's remit and involvement with Solar photovoltaics and Batteries installations and flexible use?
- How does the customer journey for Solar photovoltaics and Batteries installations and flexible use look like?
- What challenges have you faced? what barriers do customers face?
- Going forward, what initiatives do you think would help promote Solar photovoltaics and Batteries installations and flexible use?

Heat Pumps

- What is your organisation's remit and involvement with heat pump installations and flexible use?
- How does the customer journey for eat pump installations and flexible use look like?
- What challenges have you faced? what barriers do customers face?
- Going forward, what initiatives do you think would help heat pump installations and flexible use?

Electric vehicles

- What is your organisation's remit and involvement with EV adoption and flexible use?
- How does the customer journey for EV adoption and flexible use look like?
- What challenges have you faced? what barriers do customers face?
- Going forward, what initiatives do you think would help promote EV adoption and flexible use?

Smart appliances

- What is your organisation's remit and involvement with smart appliance adoption and flexible use?
- How does the customer journey for smart appliance adoption and flexible use look like?
- What challenges have you faced? what barriers do customers face?
- Going forward, what initiatives do you think would help promote smart appliance adoption and flexible use?

Future plans, vulnerable customers and SMEs

- What new technologies or behaviours will you focus on in the next 10 years?
- Are there any initiatives for vulnerable, financially disadvantaged customers?
- Are there any initiatives specific to SMEs?

Behavioural taxonomy: behaviour changes

Behaviour	Activity	Action	Frequency	Primary Agent	Behavioural effort	Cognitive effort	Cost	Energetic Impact
Reduce load ("peak shaving")								
Avoid electricity use	Heating (or cooling) space	Use warm clothing & blankets to reduce heating need.	Habitual	User	Moderate	Low	Possible savings	Moderate
		Open blinds/curtains to let in sunlight during the day and close at night	Habitual	User	Low	Moderate	Possible savings	Low
		Passive cooling techniques e.g. open windows/doors to create breeze.	Habitual	User	Low	Moderate	Possible savings	Low
	Cooking	Prepare a cold meal instead of cooking.	Recurrent	User	Moderate	Moderate	Possible savings	Moderate
	Laundry	Air dry clothes as an alternative to tumble dryer use.	Habitual/ Recurrent	User	Moderate	Low	Possible savings	Moderate
		Wash clothes by hand for small loads to avoid need for washing machine.	Habitual/ Recurrent	User	High	Low	Possible savings	Low
	Washing dishes	Wash dishes by hand for small loads to avoid need for dishwasher.	Habitual/ Recurrent	User	Moderate	Low	Possible savings	Low
	Lighting & electric devices	Turn off lights in unoccupied spaces or areas with sufficient natural light.	Habitual	User	Moderate	Low	Possible savings	Low
		Turn off devices on standby.	Habitual	User	Moderate	Low	Possible savings	Low
		Choose an alternative format (to e.g. TV), such as reading or a board game.	Recurrent/ habitual	User	Low	Moderate	Possible savings	Low
Minimise frequency or extent of activities	Heating (or cooling) space	Zoned heating: heat only occupied rooms.	Recurrent/ Habitual	User	Low	Moderate	Possible savings	Moderate
		Switch off/reduce heating when no one is home; programme the system to start shortly before returning.	Recurrent/ Habitual	User	Low	Moderate	Possible savings	Moderate

	Cooking	Batch cook on weekends, for example, & reheat meals as needed.	Recurrent/ Habitual	User	Moderate	Moderate	Possible savings	Moderate
	Laundry	Run washing machine with full loads to minimize the number of cycles.	Habitual	User	Moderate	Low	Possible savings	Low
	Washing dishes	Run dishwasher with full loads only to minimize the number of cycles required.	Habitual	User	Moderate	Low	Possible savings	Low
Change the duration of activities	Laundry	Adjust washing machine settings to run shorter cycles when cleaning smaller loads.	Habitual	User	Low	Low	Possible savings	Low
	Water heating	Take shorter showers.	Habitual	User	Moderate	Low	Possible savings	Low
Replace energy-intensive activities	Cooking	Use air fryers or microwaves rather than traditional ovens.	Recurrent/ habitual	User	Low	Moderate	Possible savings	Low
	Water heating	Take showers instead of baths.	Recurrent/ habitual	User	Moderate	Low	Possible savings	Moderate
Use shared spaces and appliances	Heating (or cooling) space	Use public heated spaces: visit libraries, community centres, or other places during peak hours to reduce home heating demand.	Recurrent/ Habitual	User	Moderate	Moderate	-	Low/ Moderate
	Cooking	Dine out during peak hours to reduce household energy consumption & overall consumption due to efficiency of scale.	Recurrent/ Habitual	User	Moderate	Moderate	Low	Low/ Moderate
	Water heating	Use public facilities: if going to a gym or facility with a shower, use the shower there.	Recurrent/ habitual	User	Moderate	Low	-	Low
Use efficient settings on appliances	Heating (or cooling) space	Set thermostat temperatures to lowest comfortable.	Recurrent	User	Low	Low	Possible savings	Moderate
	Laundry	Use cold water wash cycles to reduce energy use.	Habitual	User	Low	Low	Possible savings	Moderate
		Use eco or energy-saving modes.	Habitual	User	Low	Low	Possible savings	Low
	Water heating	Install low-flow shower heads to reduce water usage.	One-off	User	Moderate	Low	Low	Moderate
	Washing dishes	Use eco or energy-saving modes.	Habitual	User	Low	Low	Possible savings	Low

Time-shift load ("peak shifting")

Manually shift the use of appliances to off-peak	Cooking	Cook evening meal later: if cooking after 6pm wait until 7pm to begin if it's possible.	Recurrent/ habitual	User	Moderate	Moderate	Possible savings	Moderate
	Laundry	Put the wash on earlier or later or run a fast or slow cycle.	Recurrent/ habitual	User	Moderate	Low	Possible savings	Low
	Water heating	Take showers during off-peak times.	Recurrent/ habitual	User	Moderate	Low	Possible savings	Low
	Washing dishes	Run the dishwasher earlier or later or run a fast or slow cycle.	Recurrent/ habitual	User	Moderate	Low	Possible savings	Low
	Heating or cooling (space)	Turn the heating on earlier and remove draughts to minimise heat loss.	One-off/ recurrent	User	Low	Moderate	Possible savings	Moderate
Programme appliances to run off-peak	Laundry	Programme washing machine to run during off-peak hours.	Recurrent/ habitual	Appliance	Low	Moderate	Possible savings	Low
	Water heating	Set (smart) controls for immersion water heaters to provide hot water using off-peak electricity	One-off/Recurrent	Appliance	Low	Moderate	Possible savings	Moderate
	Washing dishes	Programme dishwasher to run during off-peak hours.	Recurrent/ habitual	Appliance	Low	Moderate	Possible savings	Low
	Heating or cooling (space)	Set off-peak modes on smart thermostats	One-off/Recurrent	Appliance	Low	Low	Possible savings	Moderate

Behavioural taxonomy: programmes and services

Service type	Behaviour type	Action	Frequency	Primary Agent	Behavioural effort	Cognitive effort	Cost	Energetic Impact
Energy tariffs	Sign up to time-based tariffs	Sign-up to a two-period time-of-use tariff (e.g., Day-Night or Day-Night-Peak)	One-off	User	Moderate	Moderate	Free	-
		Sign-up to a dynamic tariff	One-off	User	Moderate	High	Free	-
	Optimise energy use for time-based tariffs	Optimise consumption for static ToU tariff: programme appliances to run off-peak	Recurrent/ Habitual	Appliance	Low	Moderate	Possible savings	Moderate
		Optimise consumption for static ToU tariff: Manually shift the use of appliances to off-peak	Habitual	User	Moderate	Moderate	Possible savings	Moderate
		Optimise consumption for dynamic tariff: programme appliances to run off-peak	Recurrent/ Habitual	Appliance	Low	High	Possible savings	High
		Optimised consumption for dynamic tariff: manually shift the use of appliances to off-peak	Habitual	User	Moderate	High	Possible savings	High
Demand flexibility programmes	Enrol in Voluntary Demand Reduction Events		One-off	User	Low	Moderate	Free	-
	Participate in Voluntary Demand Reduction Events		One-off	Utility	Moderate	Low	Possible savings	Low/ Moderate
	Enrol in a direct load control programme		One-off	User	Low	Moderate	Free	Moderate/ High

Behavioural taxonomy: uptake and flexible use of demand flexibility enabling technologies.

Category	Technology	Behaviour	Frequency	Primary Agent	Behavioural effort	Cognitive effort	Financial Cost	Energetic Impact
Adoption	Energy monitoring technologies	Adopt a smart meter	One-off	User	Low	Low	Low	Low
		Adopt an in-home display	One-off	User	Moderate	Moderate	Low	Low
	Smart appliances	Adopt a smart washing machine	One-off	User	Moderate	Moderate	Moderate	Moderate
		Adopt a smart dishwasher	One-off	User	Moderate	Moderate	Moderate	Moderate
		Adopt a smart thermostat	One-off	User	Moderate	Moderate	Low	Low
		Adopt smart water heating controls	One-off	User	Moderate	Moderate	Low	Moderate
	Heat	Replace a fossil fuel boiler with a heat pump	One-off	User	High	High	High	High increase in electricity consumption
	Transport	Replace a fossil-fuel power vehicle with an electric vehicle and an electric vehicle charger	One-off	User	Moderate	High	High	High increase in electricity consumption
	Energy generating and storing technologies	Install solar photovoltaics	One-off	User	Moderate	High	High	High
		Install home battery storage	One-off	User	Moderate	Moderate	Moderate/ High	High
Flexible use	Monitoring technology	Monitor energy consumption patterns and cost using in-home displays	Habitual	User	Moderate	Moderate	None	Low
	Smart energy management systems	Integrate appliances with smart energy management systems	One-off	Appliance	Low	Moderate	Possible savings	Moderate
	Smart appliances	Schedule activities like laundry, dishwashing, or water heating to align with time-based tariffs or grid emissions	Recurrent at irregular interval	Appliance	Moderate	High	Possible savings	Moderate

	Heat pumps	Run heat pumps off-peak or at times of clean energy abundance/low prices	One-off	Appliance	Low	Moderate	Possible savings	High
	EVs	Use smart chargers to align with time-based or grid emissions	One-off	Appliance	Low	Moderate	Possible savings	High
	Solar technology	Integrate solar PVs with home battery storage to store excess solar energy	One-off	Appliance	Low	Moderate	Possible savings	High
		Export surplus solar energy to the grid during peak demand periods.	One-off	Appliance	Low	Moderate	Possible savings	High
		Align own consumption to solar generation.	Habitual	User	Moderate	High	Possible savings	High

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