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Systematic Review

A Systematic Literature Review of the Interplay between Renewable Energy Systems and Occupant Practices

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Abstract: The development of renewable energy systems offers a potential solution to energy consumption in the residential sector. These systems face many barriers and challenges regarding the nature of home energy demand and behaviors of household occupants. These barriers are discussed in innovation theory, which describes how people assess new technologies. A systematic literature review of 123 journals was conducted to explore the interrelationship between energy systems, home energy demand and occupant practices. This identified key gaps in the literature and important takeaways from past research showing the limitations of renewable energy systems in integrating into everyday lives. There are numerous personal and social barriers that inhibit behavior change and limit the penetration of renewable systems. Additionally, the development of social norms and institutional rhythms have resulted in people living in a lock-in lifestyle, with limited flexibility for change. This review discusses the role of technology, consumers and policies, and how they must all interact to create a sustainable and effective energy solution to this climate emergency. The next step is to reevaluate the design of home automation and energy management systems to consider the impacts of different lifestyles and routines.

Keywords: behavior; habits; practice; renewable energy; sustainability; home; energy demand

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1. Introduction

The motivations and attitudes of individuals significantly impact the way they consume resources and how they respond to efforts to change this consumption behavior [1]. These, together with the habits and routines of people within the home, are ingrained into their lifestyle and daily practices, resulting in difficulty in changing the way they live their lives in achieving energy reduction and sustainability [2]. These routines can facilitate inflexibility and restriction to allow energy consumption to be shifted in time, thus becoming more beneficial for the distribution network or distributed energy systems [3]. The concept of flexibility is important when discussing policymaking and developing interventions due to some households' inability to move away from their normal routines of energy-consuming practices [4]. Furthermore, these routines are developed and provide a sense of comfort for the occupants, and any changes to such routines can cause discomfort [5,6].

The use of social theories can assist in our understanding of why energy is consumed at specific times of the day and how this can be shifted. Energy management is crucial when aiming to shift energy consumption and increase the utilization of distributed energy systems [7,8]. The ability to understand when energy will be consumed can assist in this management to allow the network to operate on a preemptive schedule rather than a responsive schedule [9].

This paper discusses the relevance societal context has on home energy demand and how this can be incorporated into the design and implementation of renewable energy systems. The systematic literature review considers papers that relate to social and psychological theories, energy consumption in the household and distributed energy systems.

Firstly, the major themes from this literature review are identified and discussed to combine the findings to recognize the significance of individual and societal context on energy consumption. This paper explores how the timing of energy consumption relates to routines and practices performed by the occupants and how this behavior can be adjusted to achieve self-sufficiency and energy efficiency.

1.1. Psychological and Social Theories

Social practice theory (SPT) theory provides a different way of analyzing human actions by moving away from socio-psychology theories [10–16]. The underlining conclusion from this theory is that individuals' lifestyles are made up of half-conscious and routinised practices performed every day [17]. Additionally, this theory states that individuals do not directly consume resources, instead resources are consumed indirectly when individuals are performing practices to achieve a desired outcome [18]. This concludes that life is made up of collective practices that humans perform to achieve a specific outcome, resulting in resource usage. These practices can be understood in terms of technology, skill and meaning, which are all interconnected [19,20]. Technology refers to the artefacts or materials that are required to undertake the activity, the skills relate to the occupant's ability to perform the practice using these objects and meaning is the significance the activity has to the occupant and how it interacts with their values and attitudes. Understanding the role of these elements provides an insight into how influencing practices reduces resource consumption.

Everyone performs repeated practices during their daily life, practices dependent on their lifestyle and context. This set of collective practices performed during the day is restricted to specific temporal and spatial constraints defined by social and institutional rhythms. These bundles of practices are interlocked with each other, and the order of the practices may be repeated over days and weeks, creating a personal system of practice [SOP] [16,21,22]. The SOP represents the routine nature of everyday life and how certain tasks need to be completed at a specific time and place. In the context of a household with multiple residents, there are multiple SOPs that interrelate and interlock with each other, creating a home equilibrium that is called the home system of practice (HSOP) [20]. This equilibrium is correlated with the household consumption pattern and the inherent flexibility in the households that follow routine work, school or socializing patters. The development of this equilibrium is caused by the comfort experienced by the occupants when performing their daily routines or established work or school routines (or SOPs) [23]. This comfort is the driving force of practices at certain times of the day, resulting in this routinized way of living [18]. The concept of comfort in this paper relates to the ease of living and the feeling of comfort in the routine nature of practices. Any changes in these routines will be resisted, unless the new equilibrium can achieve the same level of comfort for the occupants [18]. Some routines will remain set due to external factors such as work or school times. The HSOP can be analyzed and defined to understand how change can be incurred to achieve lower energy consumption and reduce peak demand.

Each practice consumes energy indirectly, thus the equilibrium of the home and interaction of individual SOPs will develop a constant consumption pattern. Studies have focused on isolating individual practices [24–32] to achieve energy reduction, however, these are interlocked with other practices and the HSOP, and failing to consider the other practices in the home can provide an incomplete picture of the practice. The HSOP must be studied as a whole to understand the equilibrium and interaction before practices can be isolated and changed. Additionally, the repetitive nature of these practices form household routines with temporal and spatial characteristics [19,33]. These spatial and temporal aspects determine the degree of their interlocking with each other [19,34,35]. The need to perform a certain practice that fits within the routines and lifestyles of an individual is due to the meaning of that practice, thus this can result in restrictive behavior when it comes to when it is performed. Additionally, the development of routines occurs, as this allows individuals to achieve comfort in their lifestyle due to the fact that they can perform the practices they desire routinely. This comfort is crucial in the development of routine, as without it, no routine can be created. Typically, practices are performed at the same time of day to fit within the routine, thus locking in that activity for that time of day. Using this logic, a household with multiple occupants requires all these routines to interact with each other to create the HSOP. This HSOP ensures all occupants are allowed to perform their desired practice during the day, which thus results in comfort. Furthermore, this results in household practices being performed at the same time of day every day, resulting in that practice being locked in. This directly relates to the flexibility of the household when it comes to changing and adjusting their lifestyle to shift their energy consumption.

Changing or influencing the HSOP to achieve reduction in resource consumption is difficult when considering both the time and spatial restrictions and routine nature of individuals. These changes or interventions must be adopted by occupants and incorporated into new routines to reconfigure their HSOP, otherwise the changes will not be embedded in their HSOP [36]. Additionally, the home equilibrium and individual lifestyles depend on institutional rhythms, cultural background, economic position and other contextual factors within the household [14]. This reinforces how each household can be unique, with varying routines and rhythms; therefore, changing resource consumption must consider each household differently (to an extent).

1.2. Home Energy Demand

The aggregation of household energy consumption produces network load, resulting in peak demand periods. This reflects how energy is consumed across the distribution network [37]. Reflecting on the discussion of socio-psychological theories, the increased load on the network is caused by the synchronization of different household practices and routines. These routines contain practices that are socially shared and orchestrated across households, such as cooking, laundry, dining and homecomings [37]. These are performed in the early evening when the majority of individuals have returned home from work, resulting in peak consumption for the distribution network. The presence of peak demand periods requires resilient power systems that must ensure sufficient capacity to meet the demands while ensuring reliable distribution [38].

Energy policy makers and grid operators have shifted focus from reducing total energy consumption through increasing energy efficiency to changing the contours of residential demand curves. These changes aim to move network and peak loads from the evening period to other times of the day, resulting in the flattening of the demand curve [39]. This helps on two accounts: (1) by reducing the required capacity of the distribution network during peak periods and (2) achieving better demand alignment with renewable energy generation. The responsibility of network control and flexibility has been placed on power distribution stakeholders to investigate how end users can achieve flexibility in response to the reduced supply flexibility from renewable sources [37].

Using social theories in this systematic literature review, we investigate the connection between practices and consumption. Residential energy consumption from a practice theory perspective focuses on cooking, laundry, water heating, space heating, and cooling and lighting practices that consume energy [37]. Relating to flexibility, understanding the timing and order of practices that shape residential energy demand will assist in developing robust solutions. Residential consumption is connected to everyday life and is affected by routines, social dynamics and technical infrastructure [21,40–46].

1.3. Related Works

In the past, the literature has discussed the technical and social challenges of residential energy consumption. This paper aims to discuss the interplay between the technical aspect of renewable energy systems and the social aspect of resource consumption within the home. A common problem identified is achieving long-term behavior change [47] and increased utilization of renewable energy systems [48]. Demand management can assist with shifting energy consumption to better integrate and utilize renewable energy systems [49–56].

However, the routines of the occupants play an important role in shaping energy demand profiles and aligning with future energy systems [19,33].

2. Methodology

This paper aims to answer the following research question through a systematic literature review: How do everyday practices affect energy demand in the home, and what then is the role of building automation systems?

The systematic literature review approach aims to reduce the bias during the research stage to summarize the purpose, methods, context and findings in the existing literature relevant to the field of study. This structured methodology ensures this review captures all the published literature relating to the research question. This paper reviews the literature that has a focus on SPT and how this influences home energy demand. The search strategy was established incorporating the research question, databases to be used, keywords and languages. Using the search strategy, the literature is collected and screened according to their relevance to the study, and irrelevant articles are identified and excluded from the analysis. The content analysis includes exploring the geographical, temporal and methodological distribution of the relevant articles and synthesizing the themes based on the research question.

The development of a search strategy helped to identify studies relevant to the research question. This limited the studies so as to fit with the three aspects of the question: (1) renewable energy systems, (2) home energy demand and (3) occupant practices. Initial searches produced a high volume of studies, with Table 1 outlining the inclusion criteria developed to narrow down the search. A Boolean search string was formulated using keywords based off the research question, which is stated in Table 1. The search string was manipulated for databases that required a shortened short string.

Table 1. Search string used for the SLR.

Renewable energy	Renewable sources, low carbon energy, photovoltaic, PV, solar, wind, heat pump, energy Efficiency
Home	Household, house, dwelling, residential
Demand	Energy, electricity, demand management, consumption
Occupant practices	Behavior, lifestyle, routine, social practice
Sustainability	Energy transition, energy saving, innovation, environment, sustainable development
Search String	(“renewable energy” OR “renewable source%” OR “smart energy” OR “low carbon energy” OR “photovoltaic” OR “solar” OR “wind” OR “heat pump” OR “energy efficiency”) AND (“home” OR “household” OR “house” OR “dwelling” OR “residential”) AND (“energy” OR “consumption” OR “residential demand” OR “demand management”) AND (“practice” OR “behaviour” OR “behavior” OR “lifestyle” OR “routine” OR “social practice”) AND (sustainability OR “energy transition” OR “energy saving” OR “innovation” OR “environment” OR “sustainable development”)

The search string was applied to 3 databases, SCOPUS, ProQuest and Web of Science, yielding 3782 articles published between 2013 and 2022. The search string was used, and the results were filtered based on a date range that included any journals published after 2010. The initial exclusion criteria removed studies focusing on water consumption, house development and affordability, electric vehicles, policy making and government interventions, smart grid technical designs, transportation, business side-oriented studies, smart cities, economics, waste, house performance and life cycle analysis. The first filtering step involved using exclusion key words focused on the exclusion criteria, yielding 428 studies. The second step sifted through the titles and abstracts, excluding studies that failed to mention occupant practices or renewable energy systems or home energy demand, leaving 163 studies. Upon a thorough review of the full text of these papers, the relevant studies were selected, resulting in 70 papers to be reviewed relating to the research question. Figure 1 demonstrates the PRISMA method followed to filter and provide inclusion/exclusion of key papers for the final selection.

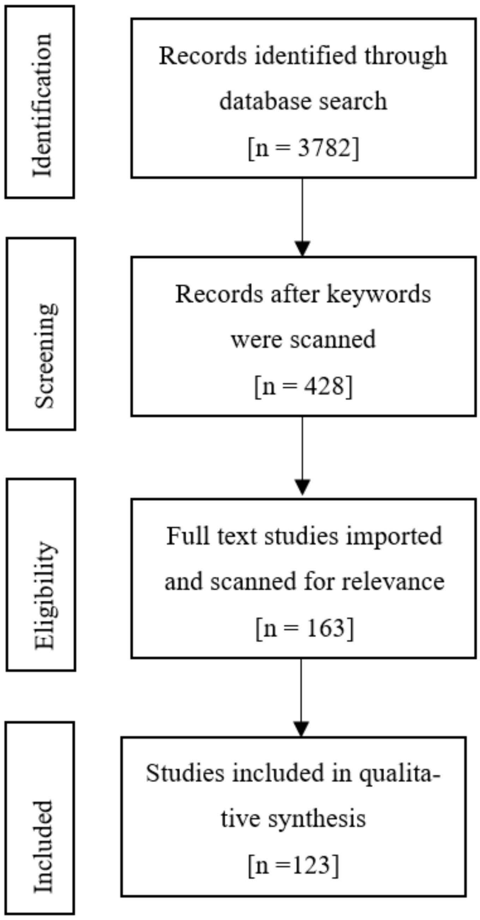

Figure 1. PRISMA methodology.

3. Results

The follow sections discuss the major themes in the literature in detail, comparing findings from the journals found using the search strategy. This review aims to bring a new look to the existing literature in the following areas: [I] home energy use, [II] behavior change, [III] smart technology, [IV] self-sufficiency, [V] energy communities, [VI] solar energy systems, [VII] home design and innovative energy technology, and [VIII] demand management. Each theme is analyzed separately based on the results from the related literature, and this paper summarizes and discusses the interrelationship between all the themes.

4. Major Themes in Literature

The major themes in the literature are summarized in Table 2. The main themes regarding residential consumption and renewable energy systems include contextual factors, household practices and patterns, household total and peak demand, self-sufficiency and independence, and barriers and challenges to behavior change. Figure 2 displays the spread of the articles based on the year of publication to show the increased interest in this research area. The sharp increase demonstrates that the area of household energy consumption and sustainability has been the focus for research recently.

Table 2. Key themes and concepts from the literature.

Key Themes	Important Concepts	References
Contextual factors	• Societal and personal norms • Background and culture • Technological context and acceptance	[3,20,27,37,48,57–81]
Household practices and patterns	• SOP and HSOP • Routines and lifestyle • Interlocking practices • Temporal and spatial characteristics	[3,27,36,37,48,49,58,59,62–72,77,82–101]
Household total and peak demand	• Energy intensive practices • Electrification of homes • Renewable energy systems • Aggregation of practices • Demand management strategies	[3,36,37,48,49,57–60,63,65,66,74,82–85,87,88,90,102–118]
Self-sufficiency and independence	• Time-shifting practices • Technology and social innovations • Participation and engagement • Collective communities and practices	[3,27,34,37,48,49,57–60,62,65,66,68,72,74,77,82–87,89,90,102–105,107–112,119–130]
Barriers and challenges to behavior change	• Personal motivations and attitudes • Societal challenges • Technology and house development	[3,27,37,47–49,57–62,64–72,76,77,82,83,85–90,102–104,106,109–111,131–140]

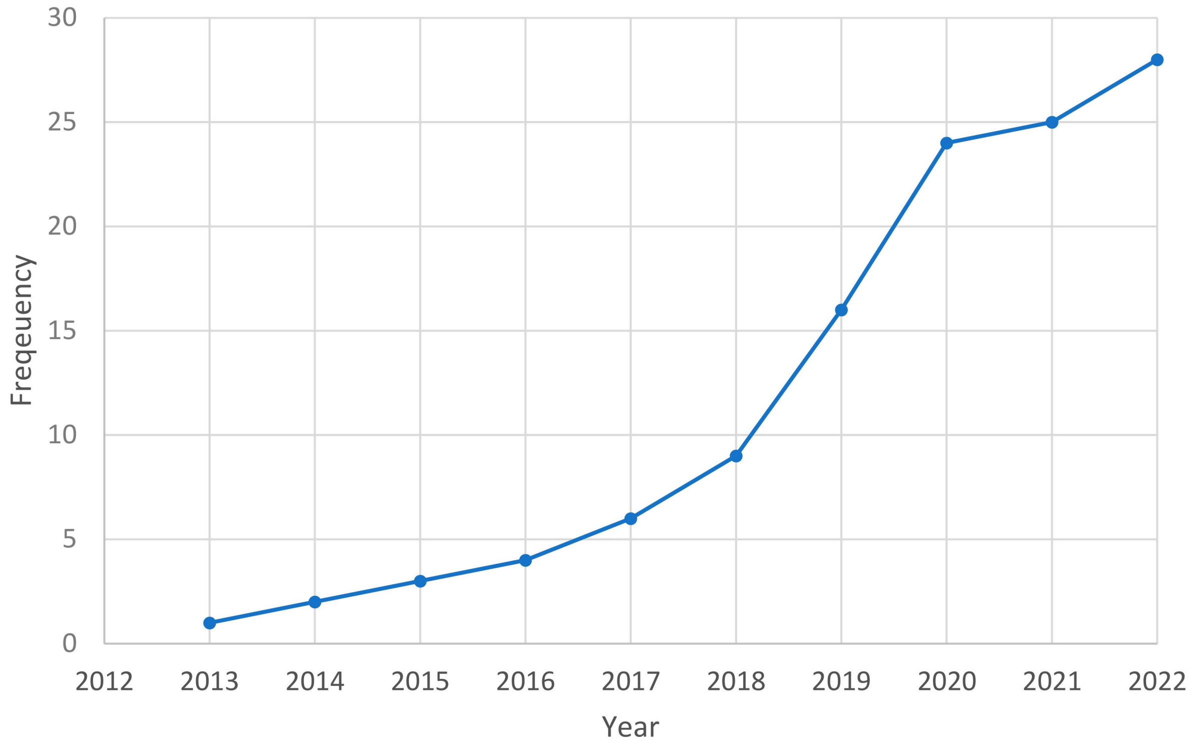

Figure 2. Spread of the articles based on published year.

Using the key themes and concepts from the relevant literature as shown in Table 2, the results section is split up into eight headings synthesizing these themes to respond to the research question.

4.1. Home Energy Use

It is important to understand the drivers for individual behaviors and the relationship between perception and action [141]. Personal and social norms stimulate energy-efficient behaviors [73,142,143] and influence individual behavior, impacting energy consumption and conservation [144–146], motivation to adopt green technologies [147] and other pro-environmental activities [148].

The widespread adoption of green technology is partly influenced by societal and personal attitudes toward the environmental benefit of these systems. The internal mechanisms of decision making are influenced by these norms, and related attitudes were focused on in [57], which explored the attitudes of acceptors and rejectors. Explaining the reasons behind decision making is complicated as there are many internal and external factors that must be considered. Decision making is governed by behavior, awareness, beliefs, values, attitudes and knowledge [149–151]. These factors will shape an individual's view of a technology based on their background and experience. This perception will influence an individual's decision making toward adopting new technologies. Encouraging and strengthening an individual's pro-environmental identity can assist pro-environmental action [76]. There is a strong connection between identity and action, and this must be explored to understand the challenges of this energy transition.

There is a significant body of research focusing on human behavior and its impact on energy efficiency and household consumption that aims to understand this dynamic. Connections have been made between energy-related concerns (environmental impact, economic benefits) and the driving force behind such concerns (comfort, desire, etc.) [152]. This understanding allows us to identify key contextual, social and institutional factors that shape individuals' consumption profiles. Using this knowledge, we can dive deeper into social sciences to assess how long-term change can be achieved regarding the use of renewable energy systems at the residential level.

The ability of individuals to assess their own lifestyle and implement changes to the way they consume resources is difficult. Research shows the lack of participation and engagement in one's consumption, with limited understanding of the amount of energy they use in the household [153–157]. Without this knowledge, households are unable to evaluate their energy consumption behavior and there is no motivation to change [158]. A current strategy is to make energy use visible and tangible to educate the household on their energy behaviors and motivate lifestyle changes [159].

Another challenge is the development of individual expectations of comfort and lifestyle, resulting in people being set in their ways. The attitudes and behaviors of individuals demonstrate their expectations and considerations of energy consumption. Some studies offer an insight into feedback from participants, with some people saying they "buy solutions all the time" [65] or "the bills is not enough to make me worry" [59]. Additionally, the idea of comfort in terms of routines is described by a study participant who said that they 'would not run the dishwasher and washing machine if it was a source of irritation. No matter the price or sustainable potential" [27]. In this case, any changes to this routine that cause irritation will be resisted, hence such changes are not a viable strategy to achieve change in resource consumption.

Efforts have been undertaken to develop computational modeling to predict human behavior and its relationship to energy consumption [160]. This work does not relate the modeling used to identifying personal and societal determinants of behavior, instead focusing on the social, economic, organizational and regulatory aspects [161] which relate to the market response and consumption patterns. The study conducted by [162] discusses how these pure technical approaches to residential energy consumption can mislead energy policies as people's behaviors are not integrated into this analysis [162]. This focus on the correlation between consumer behavior dynamics and pro-environmental systems demonstrates this shift in approach from the current business-as-usual approach. In [67], they discussed the key concepts of behavior and innovation studies and evaluated the dialogue between these. The study tries to facilitate a collaborative approach (combining behavior and innovation) to discuss human interaction with building energy systems.

The use of building energy systems has created the concept of the smart home, which aims to 'supplant' the role of occupants in achieving energy reductions [103]. There can be differentiation between traditional homes and smart homes and the associated energy demand from the two types of homes. The expectation is that occupants influence energy consumption more in a traditional home compared to a smart home. However, the complex nature of personal and cultural aspects of occupants results in smart homes not achieving their goal, and this differentiation between energy demand from the two homes can be minimal [103].

4.2. Barriers to Behavior Change

Referring to socio-psychological theories, the psychological barriers to behavior change include: action inertia, social norms, emotion, perceived behavioral control, delay discounting and habit [64]. Additionally, socio-demographic factors such as, age, gender, location, education, household size, income and working situation can limit an individual's ability to change [47,70,150]. This reiterates the complexity of the way individuals live and make decisions. Simply developing new technology cannot achieve reduced energy consumption without considering these psychological barriers. Hence, the role of building automation systems must involve complimenting and assisting the lifestyles of the occupants.

Social and psychological theories state how personal norms and attitudes highly influence the actions and behaviors of an individual, thus we must understand how these are developed. The variance in norms and attitudes between individuals covers a large spectrum, resulting in people living care-free and not being worried about their energy usage nor the resultant environmental impact [163,164]. This group of people will resist interventions and changes relating to sustainable living as they do not align with these pro-environmental values [165]. This group of people can be described as individuals with strong hedonic values [166]. The focus must be on other methods in order to impart change for these people, such as advertising the financial benefits.

Understanding the value–belief–norm (VBN) theory allows for analysis of environmental behaviors and the drivers behind such behaviors. Individual values and environmental concern are correlated with behavior-specific variables, such as problem awareness, outcome efficacy and personal norms that relate to their actions [76]. The VBN theory discusses the importance of moral obligations and how these impact the extent of engagement with pro-environmental behaviors. There are different categories of social values: biospheric, altruistic, egoistic and hedonic [76]. These values can group individuals into categories that represent their response to environmental behaviors and interventions. Strong biospheric and altruistic values correlate with a high environmental concern due to their strong connection with nature and other people [76]. Alternatively, egoistic and hedonic values observe a lower environmental concern due to a stronger motivation for money, power, comfort and pleasure [76]. These different categories should be incorporated into automation and energy systems to adjust the approach of the system depending on how the occupants are categorized. For example, occupants with egoistic and hedonic values may respond better to interventions and automation systems if they achieve a higher level of comfort or increased cost savings.

The next question refers to the willingness of household members to incorporate these time-shifted practices and technologies in their daily lives. Boait et al., (2019) showed residents changing their habits through shifting activities involving the washing machine and dishwasher [102]. However, a detailed interview conducted by [27] outlined how a resident stated that they "would not run the dishwasher and washing machine if it was a source of irritation. No matter the price or the sustainable potential from a society perspective" (quote from their paper) [27]. This reveals the value of convenience over any economic or environmental benefit, so interventions need to maintain a certain level of convenience and comfort.

A major barrier for the adoption of modern technology and practices is the impact on household member's lifestyles, as mentioned previously. The use of smart tools for energy management can impact the standard of comfort, convenience and living [69]. Studies [27,69] agree that residents' obligations toward lifestyle and comfort were considered important and outranked the need to save costs if the activity satisfied their busy schedule. This perception of convenience has been developed over the years, with the increased standard of living and the available technology resulting in people becoming comfortable and socially lazy [65]. Additionally, individuals may not aim to consume less energy, unless their savings can fund a better standard of living [113]. The motivation to change is inherently small due to the inertia of current living and comfort standards requiring a significant force to overcome this inertia. This is a significant challenge for developing automation and energy systems to achieve change in energy consumption without impacting personal convenience and comfort.

This outlines a new consideration and limitation for using technology to influence home energy demand and lifestyles. The transition to high standards of comfort and lifestyle has resulted in a lack of intention and willingness for people to change their lifestyle to achieve sustainability [69]. A common aspect discussed in the literature is how high-income households pursue convenience and comfort while lower-income households are concerned with meeting the demands of life [71]. Additionally, the higher upfront cost is appropriate for the wealthy but they have no desire to change [103], while low income households are unable to afford this transition, so they follow the path of least expense. The current low energy prices for carbon-intensive technologies inhibit a household's ability to adopt a smarter and sustainable energy culture [69].

Another barrier to behavior change is the routinized nature of peoples' lifestyles and the inherent flexibility people have to change their lifestyles. Research methodologies use high-resolution monitoring to identify the major components involved in household energy consumption. This monitoring can be used to map out the daily routines of the household and each member to create their HSOP. The usual routine practices that are carried every day include cooking, cleaning and dining [37]. These activities typically occur in all households, showing a recurring behavior presence in all households. Another practice that is common includes heating and cooling activities to achieve thermal comfort within the home [167]. This practice is dependent on the context and location of the home and the desired standard of living of the occupants [69]. Additionally, these studies have demonstrated clear rhythmic and repetitive consumption patterns around the morning and evening periods.

These patterns occur due to institutional rhythms, with work commitments in the morning and social rhythms resulting from the preparation of dinner in the evening. These rhythmic aspects of life create peak consumption periods for the distribution network due to the aggregation of all households following similar lifestyle patterns.

These peak consumption periods create problems with the distribution network, thus research has studied how to reduce these peaks. Monitoring the practices that make up these peak periods allows us to understand how these practices can be shifted or replaced to reduce the sharpness of the peak. This relates to the spatial and temporal constraints of such practices. These two constraints are discussed in the literature when looking into the flexibility of households and personal factors.

The difference between flexible and inflexible practices depends on institutional and social rhythms as well as the personal values of individuals. These values are discussed in the literature, such as family values relating to the morning routine, as it is a valuable time for togetherness before everyone separates into their individual activities [27], as is the case in the evening too. This value will limit the flexibility of the morning routine as any changes may impact this togetherness that the families appreciate. Likewise, families may value their evening routines as it creates togetherness after everyone has finished their individual activities. This creates another complication when trying to influence household routines and energy consumption. Previous interventions regarding the temporal shifting of practices can add activities such as emptying the washing machine to the morning routine, which will impact this idea of togetherness. This can fit into the discussion about the comfort and convenience aspects of people's routines and how some practices may be preferred over others. Family values and beliefs can impact which practices are considered convenient and comfortable.

The discussed literature has identified practices that have successfully been shifted to a more optimal time. This has achieved flexibility within the home, allowing better energy consumption and utilization of home technology. These practices are mainly limited to cleaning activities such as washing dishes and clothing, which utilize a timer-equipped appliance that separates the performance of the activity and the time that energy is consumed at. However, the contribution to the overall energy demand from these practices is minimal relative to more significant activities such as heating and cooling [167]. Studies have concluded that these practices are more difficult as they are restricted in time and space, with high interlinking with occupancy and attitudes [75,168,169]. Heating and cooling activities are restricted in time as they depend on the temperature, time of day and household occupancy, and are obviously restricted in space. As gas technology is removed from households, there is an opportunity for hot water systems powered by electricity to also move to automated times when renewable energy is available and not being used on other practices such as those during the middle of the day.

Practices constrained by social conventions are restricted in time, such as cooking practices, which are performed in the evening as a social convention identified as 'dinner time' that is often followed by many households. Socially constrained practices are difficult to develop in terms of flexibility as the activity is programmed into our everyday lives. However, focusing on cooking practices, the food preparation activity can be shifted while maintaining the eating activity that is socially constrained. For example, the use of slow cookers has been discussed in the literature as a way of providing flexibility for food preparation while still following societal conventions of eating at 'dinner time' [37,170].

Some practices are difficult to separate from their energy consumption nature as the performance of the activity is related to consumption. For example, the electrification of heating and cooling systems has tightly linked energy consumption and heating and cooling practices. The performance of the practice cannot be separated from energy consumption; hence, it is constrained in time and space. The literature has discussed techniques to reduce the need for heating and cooling activities through a Passivhaus design and increasing the thermal performance of the home, as well as incorporating modern technology in the home [171]. However, these techniques are limited in their ability to remove the need for HVAC systems in households and may not be appropriate for the many poorly designed homes already built [172].

The development of renewable energy systems offers promising technology that can influence home energy demand and reduce energy consumption. The balance between household consumption and renewable energy generation is important to fully utilize these energy systems.

Household consumption can be influenced through the temporal shifting of practices, as discussed previously; however, this shift can be motivated by renewable energy systems [173]. Many studies have identified the willingness of individuals to engage and change their lifestyle as a major barrier to the utilization of renewable energy systems [174–176]. These systems are beneficial to households as they can reduce their reliance on the grid and produce cheaper and cleaner electricity. It is important to gauge what society values more: whether finances triumph over independence, or whether environmental performance outweighs the rest.

In any case, the education and delivery of these benefits to the public is important when assessing how this technology can penetrate the residential sector. The literature has identified that the handover of this technology to residents has been poor, resulting in minimal knowledge of how such systems work. Without this knowledge, the system has little potential of being fully utilized by the household. Consequently, this technology is not achieving the expected results, with minimal demand reduction. Additionally, the locked-in nature of the home and the development of the HSOP can impact the performance of these systems; however, the development of storage technology offers a potential solution.

The use of the value–identity–personal norm and VBN theories helps us understand the personal values that causes individuals to resist change. Problem awareness plays a key role in this transition as it encourages the feeling of moral obligation when it comes to reducing our environmental impact. Policies should consider factors that promote pro-environmental behaviors and try to activate one's biospheric values, or motivate one's environmental self-identity to stimulate these behaviors [76]. Furthermore, policies should reinforce the efficacy of using renewable energy systems to outline the actual environmental benefits achieved. This will fulfill the moral obligation felt by biospheric and altruistic individuals.

The literature discusses the idea that modern technology and interventions should not impact comfort and individual lifestyles. This creates a significant barrier to renewable technology and complicates this energy transition. However, many studies have identified that a high standard of living, convenience and comfort is expected nowadays. This expectation has locked individuals into energy-intensive lifestyles, thus making it difficult for any change to occur. From a technological standpoint, renewable energy systems are limited in their ability to meet household consumption patterns, thus work needs to be conducted from a social standpoint.

Individuals expect heating and cooling systems to be present in their households without any restricted use. The habit of automatically turning on these systems, even at moderate temperatures to achieve the most ideal thermal comfort, has resulted in high residential energy consumption. The first thought when experiencing thermal discomfort is to turn on the heating and cooling system without thinking of other ways to achieve ideal comfort. This expectation combined with the low cost of electricity does not motivate individuals to monitor their consumption. The development of habits and routines in society has locked humanity into this style of living that follows the paths of least effort and resistance. Additionally, in-optimal house design and construction can result in poor thermal performance, with people relying on these systems to maintain thermal comfort within the home, thus resulting in habits [177].

4.3. Smart Technology and Behavior Change

The use of control and information systems including feedback technologies have been thoroughly researched to stimulate behavioral changes within the household [178–180]. The development of smart technology allows feedback mechanisms and interaction with individuals that have been designed with behavior theories and models [181,182]. An underlining principle of these systems is to make energy visible for occupants [66] as under normal conditions there is a lack of awareness and knowledge of energy consumption in the household. The design of these systems must follow behavior model principles to present effective feedback information to the occupants to achieve engagement followed by persuasion [183,184].

A common limitation found in research is a lack of long-term engagement with these systems [102]; for example, the use of in-home displays, prompts, nudges and goal-setting strategies causes an initial novelty period, which then reverts to a business-as-usual approach to living [185]. This is reinforced by [102], who showed household members engaging with a central information system initially, but forgetting to check the system after six months of use [102]. The study participants began to engage with the feedback system irregularly, with the majority of people reporting that they hardly ever used the system after six months of the study. A minimal number of people reported that they used the system more than once a week, outlining the limitation of this approach. There are many studies that demonstrate a lack of maintained behavioral change with feedback systems [149,186].

The perceived usefulness and simplicity of modern technology influences the extent to which individuals will accept the technology. The first step is evaluating an individual's knowledge and awareness of the technology and their understanding of how to use it to fully achieve the benefits. Education has a major influence on decision making, with studies finding higher education levels correlating with higher environmental awareness, resulting in aligning personal norms and attitudes [187–194]. Referring to the values of rejectors [57], the small weighting of environmental benefit in this decision-making process outlines the lack of education surrounding the need for energy transition.

It is shown in the literature that a 'design-out' for occupants in approaches to a sustainable future is naïve and fails to achieve sustainable goals. The development of demand response technology with smart meters and feedback systems can be effective when the design considers the occupants [195]. The technology must motivate and engage the consumer to inspire change without the consumer feeling they are being forced to change. A common theme seen in the literature is the importance of maintaining comfort and convenience when targeting energy consumption.

Consumers also have a role to play in the energy transition when it comes to changing their behaviors and practices where possible. The first step is identifying the benefits of making this change, either from an economic standpoint or an environmental one. The second step is to assist in this change through educating them on how to change their consumption profile and ensuring that they have the necessary technology and skills to do so. These steps are difficult when facing individuals with strong hedonic values and those who resist changing due to their norms, attitudes and expectation of comfort [76]. Engagement requires shifting energy consumption, which may be difficult or reduce comfort for the consumer, resulting in resistance from hedonic individuals. These individuals require further motivation to adopt these innovative technologies and must be addressed.

There are other forms of user participation and engagement that can address a user's behaviors and practices. In [61], different approaches to increasing societal engagement with energy systems with an increasing number of decentered forms of engagement with the development of distributed technology were discussed. Additionally, the paper discusses how some approaches to societal engagement (e.g., energy feedback and communications) simply miss complex socio-material relations, and hence engagement is not maintained.

4.4. Towards Individual Self-Sufficiency

An approach to increasing self-sufficiency is discussed by [65], who focused on the effectiveness of downshifting and re-connecting the home with provision management and encouraging the sharing of resources [65]. This follows the concept of 'living with less', moving away from the idea of 'buying into' a new lifestyle or housing concept. This is supported by [66], who demonstrated downsizing to a smaller dwelling can de-clutter and reduce reliance on appliances [66]. This approach raises issues with an individual's expectations of a certain standard of living [71] and the societal norm of an energy-intensive lifestyle [109]. As discussed previously, the expectation of individuals to live a certain lifestyle has resulted in the purchasing of more household technology and appliances to achieve comfort and a certain level of sophistication. Therefore, we must change the way individuals view lifestyle in order to encourage a shift from a possessive nature to a simplified lifestyle in order to encourage less reliance on technology. This is a difficult transition to encourage when linking back to the discussion regarding personal barriers and strong hedonic values.

The concept from [65] places provision management onto the consumers instead of a third-party supplier. This will increase the visibility of resources for each individual as they are responsible for ensuring the effective management of resources. This visibility can motivate residents to reconfigure their practices to reduce consumption and encourage a more deliberate use of provisions [66].

Placing provision management on the householders requires education and behavior changes, which can add stress to their daily lives [66]. Busy families or those with children who have a highly planned and restricted lifestyle can find it challenging to incorporate this extra practice in their lives. This is another personal barrier that can restrict behavior change due to the lock-in nature of people's lives.

4.5. Energy Communities

The introduction of energy communities has provided a way to encourage the adoption of clean energy, achieve environmental goals and develop different behaviors and attitudes. Renewable Energy Communities are social niches that motivate participants to develop new practices and behaviors focusing on social innovations in society instead of technological innovations [62]. These housing communities produce or invest in renewable energy systems to cover their own energy needs, with all members aligning their motivations and attitudes toward using this renewable energy. This idea is related to eco-villages and sustainability precincts which consist of people who integrate their activities and routines and are supportive of human development and sustainability [196]. In [62], it was found that the major consideration for residents to join these communities and participate in these projects is the resulting environmental benefit.

This approach may not be effective when trying to interact with individuals with a less environmentally driven persona, and other factors are rated much higher in regard to their decision making. In [57] it was shown that the negative environmental values of rejectors, hence their decision to join a Renewable Energy Community, will be difficult and resisted. Alternatively, these communities aim to spark social innovations to develop more pro-environmental behaviors which may influence these types of individuals to identify the environmental problem we are facing.

The idea of these Renewable Energy Communities aligns with the principles of social practice theory as it relates to the attitudes of the individual. Developing social norms in the community can impact the behaviors of individuals and change the way they consume resources [197]. SPT discusses the impact of societal context and how people respond to social norms by developing personal norms and attitudes, thus resulting in behavior change.

This focus on community participation and interaction could increase self-consumption and energy exchange between households [85]. In [72] it was demonstrated that residents participating in these projects appreciated the reduced financial risk, the personal contact and interactions, and moving away from commercial interest [72]. The ability to share risk among the community as well as becoming independent from commercial energy companies are other benefits individuals may value, especially those who do not value the environmental benefit as much. However, residents may resist this arrangement due to not being "the community type", and conflict may arise with no formal rules and the lack of authority [72].

4.6. Home Solar and Behavior

This knowledge–behavior gap is described in the literature as a factor that reduces the utilization of renewable energy systems. This is observed when customers focus on their total power generation from their PV system when this generation is irrelevant if the household's daily consumption profile does not coincide with it. Furthermore, poor handover and installation, and incorrect design assumptions contribute to this gap due to minimal interaction between installer/developer and the user [59]. This is reinforced by [60], who observed users not being involved in the design of technology, thus resulting in a lack of knowledge on how to engage and use it [60].

The on-site consumption of solar PV-generated electricity depends on many factors, such as the occupancy pattern and electricity load of the household [48]. This relates to the home system of practice and the specific routines performed by each household and their occupants. A general social routine has been developed, with typical working hours following a 9 a.m.–5 p.m. interval, resulting in peak consumption in the morning and late evening. In [48] it was demonstrated that a high self-consumption ratio for residents with high occupancy exists during the day (e.g., retires, working from home). The objective of research is to increase self-sufficiency by utilizing households' PV systems and other renewable technology, resulting in less reliance on grid energy.

Homeowners can be divided into groups based on their educational background, level of environmental concern and level of influence of their social network [114]. These groups have different views on rooftop solar PV and their perceived complexity, aesthetics and impact on energy costs. These groups can provide insight into the decisions of policymakers in order to target specific groups more effectively, since each group is drawn to various aspects of this technology.

4.7. Home Design and Innovation Technology

An alternative approach involving removing the occupant from the equation through focusing on house design and technology has been studied. Passivhaus and smart home designs require residents to learn how to operate these designs to achieve optimal results and savings. The transition to achieve net-zero development is prevalent, with designs aiming to use 100% renewable energy [198]. As with the downsizing approach, this requires the coordination of new routines and practices into everyday life [103]. The Passivhaus design follows a simplistic approach to heating requirements by focusing on the "fabric of the building" to achieve improved air quality and thermal efficiency [199]. Reduced heating and cooling requirements can be achieved through the sensitive planning of buildings [200–202]. This relates to building energy assessments that relate to the thermal performance of the building and ensure heat gain/loss is limited [203–205]. An important issue with home designs is ensuring high awareness from people regarding the benefits of high-performance buildings [206]. The occupants are required to adapt to this new environment and actively ensure that they are not impacting the performance of the home by leaving windows/doors open during hot days. This design requires changes to routines, lifestyles and shifts away from individual control over heating levels and timings [103].

Alternatively, the smart home design includes innovative technology within the home and uses information and communication systems to provide feedback and implement automation within the household [207]. This design tries to reduce demand and peak consumption while utilizing intermittent renewable energy systems [103]. An example is the development of electrochromic systems for windows to enhance energy efficiency and reduce heating and cooling requirements [119,208]. Feedback systems are often used in research to spark behavioral change within the household [185]. The inclusion of automation inside the home has also been reviewed by many studies [71,72,121]. This approach has been discussed in social and psychological theories to deal with highly interlocked activities to achieve more flexibility in the home. Automation of some large-energy-consuming appliances in homes, such as hot water systems or pool pumps, may have more success than automating HVAC systems or smaller appliances such as dishwashers.

The integration of renewable energy sources in the built environment introduces an aspect of uncertainty into power systems due to the intermittency [209]. This technology can increase energy efficiency for existing and new buildings but depends on the energy behaviors of the occupants [144–146]. The development of smart and Passivhaus homes can contribute to this uncertainty challenge by reducing and shifting energy consumption. These design considerations can perform differently depending on the type of building (standalone home or apartment buildings). However, flexibility that is required for renewable energy sources can be achieved by reviewing energy cultures and the household environment [1]. The drivers for energy consumption were discussed previously using social and psychological theories, and these can be used to assist with the integration of renewable energy sources.

4.8. Energy Practices and Demand Management

The timing of energy consumption closely relates to the social and psychological theories discussed previously, which focus on the routines of individuals. The balance between renewable energy generation and energy consumption has been a major focus in residential research.

Synchronization is an important concept to understand the rhythms of everyday life and energy consumption patterns. There are two types: social synchronization and natural–social synchronization. The former relates to practices that occur together in time and space and socially aggregate during synchronization, resulting in consumption peaks [210]. The latter relates to natural rhythms and the connection to social rhythms [89]. The development of technology can decouple social rhythms from natural rhythms, evident in the fact that electric light has decoupled practices from the sun [27]. The natural rhythms of the sun influence the social rhythms of typical working hours, demonstrating natural–social synchronization.

Normally, the performance of a practice and the related energy consumption occur simultaneously. The ability to separate the performance and energy consumption could be beneficial to shifting the pattern of household consumption. A common example is developing technology to allow individuals to perform washing practices, such as loading the dishwasher; however, dishwashers are equipped with a timer to turn on later, separating the actual energy consumption from this activity. This maintains social conventions that influence household routines but also achieves temporal shifting of energy consumption. Another example includes the social convention of dinner time with the family. Usually, meal preparation occurs after homecoming and during the peak consumption period; however, the development of the slow cooker allows for meal preparation to be shifted to during the day while maintaining the dinner time social convention.

These two examples can achieve slight shifts to household energy profiles; however, the material source of consumption relates to the use of heating, cooling and air ventilation systems. The challenge of shifting and/or reducing the use of HVAC systems continues with the increased reliance on these systems to achieve thermal comfort. Automation and energy systems can offer a potential solution to this challenge, with such systems capable of turning HVAC systems on at optimal times of the day (during periods where surplus solar power or wind power is being generated). This can avoid the excessive use of HVAC systems when people come home to an uncomfortable environment (too hot or too cold) and turn these systems on “HIGH” to quickly achieve their desired indoor temperatures.

The flexibility of practice depends on two factors: (1) rhythmic rhythms and (2) the individuals/household’s attitude toward social conventions and their concept of normality [37]. Living styles are constrained with fixed working hours, shopping schedules, mealtimes and sometimes television program schedules [37].

Domestic practices are locked into temporal and spatial characteristics that depend on the relationships between household members, social conventions and time structures for each occupant [37,211]. SPT relates to this aspect of the home, identifying sets of collective practices and helping create a state of equilibrium in the home. Studies demonstrate how each household is impacted by their institutional rhythms, cultural background, economic position and other contextual factors [14]. This results in similarities and differences between household routines and their daily consumption profiles as well as their inherent flexibility. There is a challenge in using these social theories to impart behavior change, as a ‘one size fits all’ solution is inappropriate and unrealistic for all households [66].

In [48] the solar PV self-consumption rates in Qatar were analyzed and compared with the results of studies conducted in Sweden, Germany and Australia, demonstrating that Qatar households achieved a higher self-consumption rate due to their lifestyles and consumption, which inherently aligning with PV production [48]. This was reinforced by [68], who compared the laundry practices of Danish and Pakistani households [68]. The study showed Danish households were restricted by institutional rhythms while Pakistani households had a different administrative set up involving household staff compared to the typical nuclear families in Denmark [68].

Domestic cleaning practices have been targeted by research in assessing the flexibility of such practices within the household [70]. These practices include using the dishwasher and washing machine, a practice which involves a technological medium and is potentially highly flexible [105]. These consumption activities can be shifted through manual and/or semi-automated demand response strategies [49–56]. In [27] the effectiveness of temporally shifting dishwashing practices in Dutch households to consume power during low-tariff hours was demonstrated. However, this study revealed the drawbacks to shifting dishwashing practices to overnight periods as this requires adding an additional activity [e.g., unpacking the dishwasher] to be performed in an already tight-scheduled morning [27].

Another approach to the temporal shifting of practices without the need for timer-equipped appliances is introducing a collective arrangement among communities to complete cleaning practices. A launderette can combine clothe-washing practices for a combination of households and conduct this cleaning practice during the day using solar energy to heat the water [60]. This has a two-fold impact on lifestyles; firstly, the energy consumption is shifted from peak periods and increases the utilization of renewable energy systems; and secondly, the cleaning practice is relieved of its spatial and temporal constraints, resulting in more flexibility. Additionally, this may free up household routines by eliminating the activities of filling and emptying the washing machine as well as drying the clothes. However, it does add an additional step to the cleaning practice SOP, since people have to take the items to the laundromat for cleaning and either have to remain there during this period or return later.

Self-sufficiency and energy efficiency are important factors when transitioning to a net-zero future. Achieving self-sufficiency is difficult when users are not aware of their energy consumption, do not understand the importance of reducing their consumption and do not or cannot reduce it. Self-sufficiency reflects the amount of home energy demand is fulfilled by solar energy generated during a 24 h period [48]. Studies have demonstrated how different self-consumption ratios are achieved depending on the context and location of the household. Qatar households observe a significant difference between summer and winter loads, achieving much lower self-consumption rates during the winter [48]. Furthermore, [59] showed how households varied their alignment between PV generation and electricity consumption, especially during the summer months, when a household achieved 40% self-consumption while another achieved 80%. This large variation reinforces the impact of contextual factors on the performance of distributed energy systems.

5. Discussion

The development of social and psychological theories has assisted in producing an understanding of how individuals consume resources. These theories discuss the motivations of individuals and why and how energy is consumed within the home. The HSOP is a concept that describes the interrelationships within the household between the occupants and identifies a state of equilibrium when it comes to living. This state intertwines each individual system of practice to achieve a routinized lifestyle within the home. This understanding can be used to provide recommendations and interventions to change the energy use of a household to achieve sustainability.

The key themes that arose from the literature were discussed to provide an insight into how these theories can be utilized regarding occupant practices and routines, energy demand and building automation systems. The lifestyle of the individual has an important impact when identifying flexibility and implementing changes to these routines. Some lifestyles are strict in terms of time, and practices cannot be moved around to suit energy consumption. The contextual factors of each individual must be considered, including each individual's beliefs and values regarding energy consumption and sustainability.

These factors result in a unique HSOP being developed, with an associated household energy consumption profile following the HSOP. The temporal and spatial characteristics of energy-intensive practices must be discussed to evaluate the peak demand periods of the household. This introduces societal and institutional rhythms that encourage individuals to follow a specific HSOP, resulting in an aggregation of practices and peak demand over the precinct/suburb. This synchronization between households provides an insight into the commonality of certain practices and identifies common practices that are socially shared among a community. The literature discusses combining these practices into one singular event for the community to achieve flexibility. All households must perform cleaning practices [e.g., dishwashing]; thus, on a community level, these practices create the opportunity to perform all these cleaning practices at the same time.

This is beneficial on two accounts. Firstly, these practices can be performed during the day to utilize solar power to heat the water and shift the energy consumption away from peak periods. Secondly, this eliminates practices for each household, providing flexibility within the home to allow for further shifting of practices.

From this discussion, the subject moves to achieving self-sufficiency, energy efficiency and the time-shifting of energy consumption. The development of renewable energy systems provides a challenge for end users to use only the energy generated from these systems. The timing of supply and demand has been a major limitation of these technologies, and the reach of such energy utilization has been limited. However, with the combination of social and psychological theories with developing technologies, households can be assisted in increasing their utilization of renewable systems. The ability to shift practices becomes very important, since the natural rhythms of society result in energy consumption becoming misaligned with renewable supply. The principles of social practice theory and the HSOP can provide insight into how to increase a household's self-sufficiency and achieve energy efficiency.

Home design and technology can increase energy efficiency and achieve the temporal shifting of energy demand. The solutions discussed in Section 4.7 in terms of the development of smart homes can achieve energy savings through the use of technology. Some considerations for this approach include the alignment of smart home technology with occupant behaviors and routines to maintain or increase their comfort, as well as continuing to encourage energy visibility to avoid rebound effects that may hinder the performance of these smart homes.

The integration of renewable energy sources in current energy systems is a challenge for the built environment in this energy transition. The intermittent natural flow of these energy sources introduces uncertainty into power systems [209]. Current studies have discussed this challenge from a technological standpoint; however, the outcomes of this review show the potential of solving this challenge from a societal perspective. Flexibility can be achieved through fossil fuel generation to support these renewable energy systems; in addition, demand management can be achieved by changing home energy demand and developing new energy practices within the home.

The use of a PV system and storage system provides flexibility for end users without the need for changes to their daily routines. However, the literature has shown the presence of a rebound effect where their routines change, canceling out the benefits provided by the PV and storage systems. Occupants may increase their energy consumption or become less aware of their energy behaviors due to thinking they are solely reliant on their energy system. The use of storage systems can achieve flexibility; however, this can influence user behavior and decrease the visibility of energy in households. Alternatively, the social approach aims to change the way energy is consumed by encouraging changes to the occupant behaviors and the HSOP.

The next step is to evaluate the effectiveness of this social approach to outline whether households can be subjected to change whilst maintaining comfort within the home. The inclusion of automation systems within the home and persuasive technologies have been discussed in the literature. These strategies all rely on user participation and engagement, which relates to the values and beliefs of individuals as well as their lifestyle. Individuals with hedonic values will be unlikely to respond to feedback regarding improving their resource consumption due to these consumers valuing comfort and pleasure. Furthermore, individuals who show aligning values with these technologies may be limited by their lifestyles and are unable to properly engage with the technology to achieve consumption change.

The development and implementation of these technologies must utilize the principles of HSOP to achieve effectiveness. The identification of strict HSOPs within the household can assist these systems in optimizing energy supply and management. Households who follow strict routines resulting in minimal variation in the HSOP will allow automation systems to be effective within the home. However, occupants who do not follow strict routines, with their energy consumption being random, may not help to align these systems. The ability to accurately predict energy consumption between households and across precincts can allow for optimal energy management and reduce stress on the distribution network. Furthermore, the identification of specific HSOPs within the home can allow systems to identify practices that can be automated and shifted to optimal times of the day.

Challenges and Future Perspectives

This review has identified challenges in changing the way occupants consume energy within their home. The complex personal and cultural dimensions of occupant practices make it difficult to incorporate smart technology and encourage behavior change to achieve shifts in periods of energy consumption. Research has shown how novel technology can underperform due to not considering the influence of occupants on home energy demand [149,185,186]. The approach to 'design-out' homes for occupants in this energy transition does not achieve a sustainable solution [103].

Alongside the technical challenges of renewable energy sources, energy storage solutions and building energy systems, the social perspective is becoming more prevalent in the literature and for understanding the drivers behind energy consumption [73,147]. This review discussed the relationship between occupants, technology and policies, and how these three aspects play key roles in the future of residential energy demand. The challenge to overcome is the variation in occupant routines across households and modeling the different scenarios to achieve alignment with energy systems.

Future policies and technology development should incorporate this variation by encouraging occupants to play a role in this energy transition. Another challenge discussed in this review is the willingness of occupants to play this role and change their energy behaviors to achieve better performance from energy systems [102,154] [Boait et al., 2019, Day et al., 2020]. The clash between an occupant's comfort levels and lifestyles and living sustainably due to cleaner energy sources is limiting the progress of this energy transition. Hence, the development of smart energy systems should maintain occupants' comfort levels and desired lifestyles [27,69,113].

6. Conclusions

The aim of this research was to explore how everyday practices affect energy demand in the home, as well as to explore what the role building automation systems play. Through an SLR that analyzed 123 papers published between 2010 and 2022, the literature demonstrates the influence of people's lifestyles and everyday routines on household energy demand, which varies based on peoples' societal contexts and behaviors. The effectiveness of building automation systems and low-carbon energy systems varies with these different lifestyles and routines, therefore a one-size-fits-all solution is not viable. These systems must consider the context of the household in order to become effective and to synchronize with the HSOP. Without this synchronization, the system can create discomfort for the occupants, resulting in minimal change in behavior or energy consumption.

The next step is to evaluate whether an HSOP can be modelled within the home and identify when the household follows multiple HSOPs. This will indicate when the household will be suited to a complete automation and energy management system, or, in other cases, when a household may instead suit a scaled-down version (applying to a subset of practices) that allows the occupant to have more control to achieve their desired level of comfort. These two strategies will depend on the routinized nature of the occupants, thus we must understand the contextual factors and institutional rhythms that influence the HSOP and how these will impact the effectiveness of such management systems.

This review demonstrated the potential of a multiple-discipline approach to home energy demand through technological and societal solutions. The literature identified limitations of both approaches in achieving long-term changes in behaviors. The development of renewable energy and automation systems is becoming more prevalent in residential spaces; however, such developments should consider the findings from this review, which show the importance of the social side of resource consumption. Without the willingness of the end user to change their behaviors, the energy systems may not achieve the required performance for the desired energy transition. The occupants will always play a role in this energy transition, and they should be the subject of future policies and technology development.

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Abbreviations

HSOP	Home system of practice
HVAC	Heating, ventilation and air conditioning
PV	Photovoltaic
SLR	Systematic literature review
SOP	System of practice
SPT	Social practice theory
VBN	Value–belief–norm

References

1. Rau, H.; Moran, P.; Manton, R.; Goggins, J. Changing energy cultures? Household energy use before and after a building energy efficiency retrofit. *Sustain. Cities Soc.* **2020**, *54*, 101983. [CrossRef]
2. Martiskainen, M. Household Energy Consumption and Behavioural Change—The UK Perspective. In Proceedings of the 2nd Conference of the Sustainable Consumption Research Exchange (SCORE!) Network: Framework for Action, Brussels, Belgium, 10–11 March 2008.
3. Smale, R.; van Vliet, B.; Spaargaren, G. When social practices meet smart grids: Flexibility, grid management, and domestic consumption in The Netherlands. *Energy Res. Soc. Sci.* **2017**, *34*, 132–140. [CrossRef]
4. Nicholls, L.; Strengers, Y. Peak demand and the 'family peak' period in Australia. *Energy Res. Soc. Sci.* **2015**, *9*, 116–124. [CrossRef]
5. Yang, L.; Yan, H.; Lam, J.C. Thermal comfort and building energy consumption implications—A review. *Appl. Energy* **2014**, *115*, 164–173. [CrossRef]
6. Newsham, G.R. Clothing as a thermal comfort moderator and the effect on energy consumption. *Energy Build.* **1997**, *26*, 283–291. [CrossRef]
7. Guerrero, J.; Gebbran, D.; Mhanna, S.; Chapman, A.C.; Verbič, G. Towards a transactive energy system for integration of distributed energy resources: Home energy management, distributed optimal power flow, and peer-to-peer energy trading. *Renew. Sustain. Energy Rev.* **2020**, *132*, 110000. [CrossRef]

8. Salinas, S.; Li, M.; Li, P.; Fu, Y. Dynamic Energy Management for the Smart Grid with Distributed Energy Resources. *IEEE Trans. Smart Grid* **2013**, *4*, 2139–2151. [CrossRef]
9. Tooryan, F.; HassanzadehFard, H.; Collins, E.R.; Jin, S.; Ramezani, B. Optimization and energy management of distributed energy resources for a hybrid residential microgrid. *J. Energy Storage* **2020**, *30*, 101556. [CrossRef]
10. Shove, E.; Pantzar, M.; Watson, M. *The Dynamics of Social Practice: Everyday Life and How it Changes*; SAGE Publications Ltd.: London, UK, 2012. [CrossRef]
11. Reckwitz, A. Toward a Theory of Social Practices: A Development in Culturalist Theorizing. *Eur. J. Soc. Theory* **2002**, *5*, 243–263. [CrossRef]
12. Shove, E. Converging Conventions of Comfort, Cleanliness and Convenience. *Consum. Issues Law Econ. Behav. Sci.* **2003**, *26*, 395–418. [CrossRef]
13. Chappells, H.; Shove, E. Debating the future of comfort: Environmental sustainability, energy consumption and the indoor environment. *Build. Res. Inf.* **2005**, *33*, 32–40. [CrossRef]
14. Warde, A. Consumption and Theories of Practice. *J. Consum. Cult.* **2005**, *5*, 131–153. [CrossRef]
15. Southerton, D. Analysing the Temporal Organization of Daily Life: Social Constraints, Practices and their Allocation. *Sociology* **2006**, *40*, 435–454. [CrossRef]
16. Røpke, I. Theories of practice—New inspiration for ecological economic studies on consumption. *Ecol. Econ.* **2009**, *68*, 2490–2497. [CrossRef]
17. Røpke, I. New technology in everyday life—Social processes and environmental impact. *Ecol. Econ.* **2001**, *38*, 403–422. [CrossRef]
18. Hargreaves, T. Practice-ing behaviour change: Applying social practice theory to pro-environmental behaviour change. *J. Consum. Cult.* **2011**, *11*, 79–99. [CrossRef]
19. Eon, C.; Breadsell, J.K.; Morrison, G.M.; Byrne, J. The home as a system of practice and its implications for energy and water metabolism. *Sustain. Prod. Consum.* **2018**, *13*, 48–59. [CrossRef]
20. Eon, C.; Breadsell, J.; Morrison, G.; Byrne, J. Shifting Home Energy Consumption through a Holistic Understanding of the Home System of Practice. In *Decarbonising the Built Environment*; Palgrave Macmillan: Singapore, 2019.
21. Gram-Hanssen, K. Standby Consumption in Households Analyzed with a Practice Theory Approach. *J. Ind. Ecol.* **2010**, *14*, 150–165. [CrossRef]
22. Watson, M. How theories of practice can inform transition to a decarbonised transport system. *J. Transp. Geogr.* **2012**, *24*, 488–496. [CrossRef]
23. Madsen, L.V.; Gram-Hanssen, K. Understanding comfort and senses in social practice theory: Insights from a Danish field study. *Energy Res. Soc. Sci.* **2017**, *29*, 86–94. [CrossRef]
24. Delaney, C.; Fam, D. The 'meaning' behind household rainwater use: An Australian case study. *Technol. Soc.* **2015**, *42*, 179–186. [CrossRef]
25. Sahakian, M.; Wilhite, H. Making practice theory practicable: Towards more sustainable forms of consumption. *J. Consum. Cult.* **2014**, *14*, 25–44. [CrossRef]
26. Eon, C.; Liu, X.; Morrison, G.M.; Byrne, J. Influencing energy and water use within a home system of practice. *Energy Build.* **2018**, *158*, 848–860. [CrossRef]
27. Friis, F.; Haunstrup Christensen, T. The challenge of time shifting energy demand practices: Insights from Denmark. *Energy Res. Soc. Sci.* **2016**, *19*, 124–133. [CrossRef]
28. Hansen, A.R. The social structure of heat consumption in Denmark: New interpretations from quantitative analysis. *Energy Res. Soc. Sci.* **2016**, *11*, 109–118. [CrossRef]
29. Gram-Hanssen, K.; Bech-Danielsen, C. House, home and identity from a consumption perspective. *Hous. Theory Soc.* **2004**, *21*, 17–26. [CrossRef]
30. Hess, A.-K.; Samuel, R.; Burger, P. Informing a social practice theory framework with social-psychological factors for analyzing routinized energy consumption: A multivariate analysis of three practices. *Energy Res. Soc. Sci.* **2018**, *46*, 183–193. [CrossRef]
31. Rathnayaka, K.; Malano, H.; Maheepala, S.; George, B.; Nawarathna, B.; Arora, M.; Roberts, P. Seasonal Demand Dynamics of Residential Water End-Uses. *Water* **2015**, *7*, 202–216. [CrossRef]
32. Hand, M.; Shove, E.; Southerton, D. Explaining Showering: A Discussion of the Material, Conventional, and Temporal Dimensions of Practice. *Sociol. Res. Online* **2005**, *10*, 101–113. [CrossRef]
33. Torriti, J. Understanding the timing of energy demand through time use data: Time of the day dependence of social practices. *Energy Res. Soc. Sci.* **2017**, *25*, 37–47. [CrossRef]
34. Breadsell, J.; Eon, C.; Morrison, G.; Kashima, Y. Interlocking practices and their influence in the home. *Environ. Plan. B Urban Anal. City Sci.* **2019**, *46*, 1405–1421. [CrossRef]
35. Spurling, N.J.; McMeekin, A.; Southerton, D.; Shove, E.A.; Welch, D. *Interventions in Practice: Re-Framing Policy Approaches to Consumer Behaviour*; Sustainable Practices Research Group: Manchester, UK, 2013.
36. Breadsell, J.K.; Eon, C.; Morrison, G.M. Understanding resource consumption in the home, community and society through behaviour and social practice theories. *Sustainability* **2019**, *11*, 6513. [CrossRef]
37. Powells, G.; Bulkeley, H.; Bell, S.; Judson, E. Peak electricity demand and the flexibility of everyday life. *Geoforum* **2014**, *55*, 43–52. [CrossRef]
38. Roberts, J.; Elliott, D.; Houghton, T. *Privatising Electricity: The Politics of Power*; Belhaven Press: London, UK, 1991.

39. Arteconi, A.; Hewitt, N.J.; Polonara, F. Domestic demand-side management (DSM): Role of heat pumps and thermal energy storage (TES) systems. *Appl. Therm. Eng.* **2013**, *51*, 155–165. [CrossRef]
40. Wilhite, H.; Shove, E.; Lutzenhiser, L.; Kempton, W. The Legacy of Twenty Years of Energy Demand Management: We know more about Individual Behaviour but next to Nothing about Demand. In *Society, Behaviour, and Climate Change Mitigation*; Jochem, E., Sathaye, J., Bouille, D., Eds.; Springer: Dordrecht, The Netherlands, 2000; pp. 109–126. [CrossRef]
41. Lutzenhiser, L. A cultural model of household energy consumption. *Energy* **1992**, *17*, 47–60. [CrossRef]
42. Ellegård, K.; Palm, J. Visualizing energy consumption activities as a tool for making everyday life more sustainable. *Appl. Energy* **2011**, *88*, 1920–1926. [CrossRef]
43. Bartiaux, F. Does environmental information overcome practice compartmentalisation and change consumers' behaviours? *J. Clean. Prod.* **2008**, *16*, 1170–1180. [CrossRef]
44. Bartiaux, F.; Salmón, L. Family Dynamics and Social Practice Theories: An Investigation of Daily Practices Related to Food, Mobility, Energy Consumption, and Tourism. *Nat. Cult.* **2014**, *9*, 204–224. [CrossRef]
45. Palm, J.; Ellegård, K. Visualizing energy consumption activities as a tool for developing effective policy. *Int. J. Consum. Stud.* **2011**, *35*, 171–179. [CrossRef]
46. Ellegård, K.; Palm, J. Who Is Behaving? Consequences for Energy Policy of Concept Confusion. *Energies* **2015**, *8*, 7618–7637. [CrossRef]
47. Chodkowska-Miszczuk, J.; Kola-Bezka, M.; Lewandowska, A.; Martinát, S. Local communities' energy literacy as a way to rural resilience—An insight from inner peripheries. *Energies* **2021**, *14*, 2575. [CrossRef]
48. Alrawi, O.; Bayram, I.S.; Al-Ghamdi, S.G.; Koc, M. High-resolution household load profiling and evaluation of rooftop PV systems in selected houses in Qatar. *Energies* **2019**, *12*, 3876. [CrossRef]
49. Klaassen, E.A.M.; Kobus, C.B.A.; Frunt, J.; Slootweg, J.G. Responsiveness of residential electricity demand to dynamic tariffs: Experiences from a large field test in the Netherlands. *Appl. Energy* **2016**, *183*, 1065–1074. [CrossRef]
50. Labeeuw, W.; Stragier, J.; Deconinck, G. Potential of Active Demand Reduction With Residential Wet Appliances: A Case Study for Belgium. *IEEE Trans. Smart Grid* **2015**, *6*, 315–323. [CrossRef]
51. Widén, J. Improved photovoltaic self-consumption with appliance scheduling in 200 single-family buildings. *Appl. Energy* **2014**, *126*, 199–212. [CrossRef]
52. Finn, P.; O'Connell, M.; Fitzpatrick, C. Demand side management of a domestic dishwasher: Wind energy gains, financial savings and peak-time load reduction. *Appl. Energy* **2013**, *101*, 678–685. [CrossRef]
53. Gottwalt, S.; Ketter, W.; Block, C.; Collins, J.; Weinhardt, C. Demand side management—A simulation of household behavior under variable prices. *Energy Policy* **2011**, *39*, 8163–8174. [CrossRef]
54. Nilsson, A.; Bergstad, C.J.; Thuvander, L.; Andersson, D.; Andersson, K.; Meiling, P. Effects of continuous feedback on households' electricity consumption: Potentials and barriers. *Appl. Energy* **2014**, *122*, 17–23. [CrossRef]
55. Dütschke, E.; Paetz, A.-G. Dynamic electricity pricing—Which programs do consumers prefer? *Energy Policy* **2013**, *59*, 226–234. [CrossRef]
56. Gyamfi, S.; Krumdieck, S. Price, environment and security: Exploring multi-modal motivation in voluntary residential peak demand response. *Energy Policy* **2011**, *39*, 2993–3004. [CrossRef]
57. Alrashoud, K.; Tokimatsu, K. Factors influencing social perception of residential solar photovoltaic systems in Saudi Arabia. *Sustainability* **2019**, *11*, 5259. [CrossRef]
58. Anderson, B.; Torriti, J. Explaining shifts in UK electricity demand using time use data from 1974 to 2014. *Energy Policy* **2018**, *123*, 544–557. [CrossRef]
59. Baborska-Narozny, M.; Stevenson, F.; Ziyad, F.J. User learning and emerging practices in relation to innovative technologies: A case study of domestic photovoltaic systems in the UK. *Energy Res. Soc. Sci.* **2016**, *13*, 24–37. [CrossRef]
60. Van Mierlo, B. Users Empowered in Smart Grid Development? Assumptions and Up-To-Date Knowledge. *Appl. Sci.* **2019**, *9*, 815. [CrossRef]
61. Chilvers, J.; Pallett, H.; Hargreaves, T. Ecologies of participation in socio-technical change: The case of energy system transitions. *Energy Res. Soc. Sci.* **2018**, *42*, 199–210. [CrossRef]
62. Dóci, G.; Vasileiadou, E.; Petersen, A.C. Exploring the transition potential of renewable energy communities. *Futures* **2015**, *66*, 85–95. [CrossRef]
63. Eon, C.; Morrison, G.M.; Byrne, J. Unraveling everyday heating practices in residential homes. *Energy Procedia* **2017**, *121*, 198–205. [CrossRef]
64. Hafner, R.J.; Elmes, D.; Read, D. Promoting behavioural change to reduce thermal energy demand in households: A review. *Renew. Sustain. Energy Rev.* **2019**, *102*, 205–214. [CrossRef]
65. Hagbert, P.; Bradley, K. Transitions on the home front: A story of sustainable living beyond eco-efficiency. *Energy Res. Soc. Sci.* **2017**, *31*, 240–248. [CrossRef]
66. Hope, A.; Roberts, T.; Walker, I. Consumer engagement in low-carbon home energy in the United Kingdom: Implications for future energy system decentralization. *Energy Res. Soc. Sci.* **2018**, *44*, 362–370. [CrossRef]
67. Keskin, C.; Mengüç, M.P. On occupant behavior and innovation studies towards high performance buildings: A transdisciplinary approach. *Sustainability* **2018**, *10*, 3567. [CrossRef]

68. Khalid, R.; Christensen, T.H.; Gram-Hanssen, K.; Friis, F. Time-shifting laundry practices in a smart grid perspective: A cross-cultural analysis of Pakistani and Danish middle-class households. *Energy Effic.* **2019**, *12*, 1691–1706. [CrossRef]
69. Lazowski, B.; Parker, P.; Rowlands, I.H. Towards a smart and sustainable residential energy culture: Assessing participant feedback from a long-term smart grid pilot project. *Energy Sustain. Soc.* **2018**, *8*, 27. [CrossRef]
70. Li, P.H.; Keppo, I.; Xenitidou, M.; Kamargianni, M. Investigating UK consumers' heterogeneous engagement in demand-side response. *Energy Effic.* **2020**, *13*, 621–648. [CrossRef]
71. Liu, W.; Spaargaren, G.; Heerink, N.; Mol, A.P.J.; Wang, C. Energy consumption practices of rural households in north China: Basic characteristics and potential for low carbon development. *Energy Policy* **2013**, *55*, 128–138. [CrossRef]
72. Naus, J.; van Vliet, B.J.M.; Hendriksen, A. Households as change agents in a Dutch smart energy transition: On power, privacy and participation. *Energy Res. Soc. Sci.* **2015**, *9*, 125–136. [CrossRef]
73. Niamir, L.; Ivanova, O.; Filatova, T.; Voinov, A.; Bressers, H. Demand-side solutions for climate mitigation: Bottom-up drivers of household energy behavior change in the Netherlands and Spain. *Energy Res. Soc. Sci.* **2020**, *62*, 101356. [CrossRef]
74. Obinna, U.; Joore, P.; Wauben, L.; Reinders, A. Comparison of two residential Smart Grid pilots in the Netherlands and in the USA, focusing on energy performance and user experiences. *Appl. Energy* **2017**, *191*, 264–275. [CrossRef]
75. Sovacool, B.K.; Osborn, J.; Martiskainen, M.; Lipson, M. Testing smarter control and feedback with users: Time, temperature and space in household heating preferences and practices in a Living Laboratory. *Glob. Environ. Chang.* **2020**, *65*, 102185. [CrossRef]
76. van der Werff, E.; Steg, L. The psychology of participation and interest in smart energy systems: Comparing the value-belief-norm theory and the value-identity-personal norm model. *Energy Res. Soc. Sci.* **2016**, *22*, 107–114. [CrossRef]
77. Verkade, N.; Höffken, J. Collective energy practices: A practice-based approach to civic energy communities and the energy system. *Sustainability* **2019**, *11*, 3230. [CrossRef]
78. Egner, L.E.; Klöckner, C.A.; Pellegrini-Masini, G. Low free-riding at the cost of subsidizing the rich. Replicating Swiss energy retrofit subsidy findings in Norway. *Energy Build* **2021**, *253*, 111542. [CrossRef]
79. Jijie, D.T.; Maxim, A.; Roman, T.; Roșcovan, M. Public acceptance and support of renewable energy in the north-east development region of Romania. *Energies* **2021**, *14*, 5834. [CrossRef]
80. Hossain, I.; Fekete-Farkas, M.; Nekmahmud, M. Purchase Behavior of Energy-Efficient Appliances Contribute to Sustainable Energy Consumption in Developing Country: Moral Norms Extension of the Theory of Planned Behavior. *Energies* **2022**, *15*, 4600. [CrossRef]
81. Li, X.; Xu, X.; Liu, D.; Han, M.; Li, S. Consumers' Willingness to Pay for the Solar Photovoltaic System in the Post-Subsidy Era: A Comparative Analysis under an Urban-Rural Divide. *Energies* **2022**, *15*, 22. [CrossRef]
82. Bisaga, I.; Parikh, P. To climb or not to climb? Investigating energy use behaviour among Solar Home System adopters through energy ladder and social practice lens. *Energy Res. Soc. Sci.* **2018**, *44*, 293–303. [CrossRef]
83. Gercek, C.; Schram, W.; Lampropoulos, I.; van Sark, W.; Reinders, A. A Comparison of Households' Energy Balance in Residential Smart Grid Pilots in the Netherlands. *Appl. Sci.* **2019**, *9*, 2993. [CrossRef]
84. Gill, N.; Osman, P.; Head, L.; Voyer, M.; Harada, T.; Waitt, G.; Gibson, C. Looking beyond installation: Why households struggle to make the most of solar hot water systems. *Energy Policy* **2015**, *87*, 83–94. [CrossRef]
85. Kloppenburg, S.; Smale, R.; Verkade, N. Technologies of Engagement: How Battery Storage Technologies Shape Householder Participation in Energy Transitions. *Energies* **2019**, *12*, 4384. [CrossRef]
86. Levesque, A.; Pietzcker, R.C.; Luderer, G. Halving energy demand from buildings: The impact of low consumption practices. *Technol. Forecast. Soc. Chang.* **2019**, *146*, 253–266. [CrossRef]
87. McKenna, E.; Thomson, M. Demand response behaviour of domestic consumers with photovoltaic systems in the UK: An exploratory analysis of an internet discussion forum. *Energy Sustain. Soc.* **2014**, *4*, 13. [CrossRef]
88. Niamir, L.; Kiesewetter, G.; Wagner, F.; Schöpp, W.; Filatova, T.; Voinov, A.; Bressers, H. Assessing the macroeconomic impacts of individual behavioral changes on carbon emissions. *Clim. Chang.* **2020**, *158*, 141–160. [CrossRef]
89. Öhrlund, I.; Stikvoort, B.; Schultzberg, M.; Bartusch, C. Rising with the sun? Encouraging solar electricity self-consumption among apartment owners in Sweden. *Energy Res. Soc. Sci.* **2020**, *64*, 101424. [CrossRef]
90. Verkade, N.; Höffken, J. Is the Resource Man coming home? Engaging with an energy monitoring platform to foster flexible energy consumption in the Netherlands. *Energy Res. Soc. Sci.* **2017**, *27*, 36–44. [CrossRef]
91. de Feijter, F.J.; van Vliet, B.J.M. Housing retrofit as an intervention in thermal comfort practices: Chinese and Dutch householder perspectives. *Energy Effic.* **2021**, *14*, 2. [CrossRef]
92. Gródek-Szostak, Z.; Malinowski, M.; Suder, M.; Kwiecień, K.; Bodziacki, S.; Vaverková, M.D.; Maxianová, A.; Krakowiak-Bal, A.; Ziemiańczyk, U.; Uskij, H.; et al. Energy conservation behaviors and awareness of polish, czech and ukrainian students: A case study. *Energies* **2021**, *14*, 5599. [CrossRef]
93. Tleuken, A.; Tokazhanov, G.; Serikbay, A.B.; Zhalgasbayev, K.; Guney, M.; Turkyilmaz, A.; Karaca, F. Household water and energy consumption changes during covid-19 pandemic lockdowns: Cases of the kazakhstani cities of almaty, shymkent, and atyrau. *Buildings* **2021**, *11*, 663. [CrossRef]
94. Wang, Q.C.; Xie, K.X.; Liu, X.; Shen, G.Q.P.; Wei, H.H.; Liu, T.Y. Psychological drivers of hotel guests' energy-saving behaviours—Empirical research based on the extended theory of planned behaviour. *Buildings* **2021**, *11*, 401. [CrossRef]
95. Yoshida, K.; Rijal, H.B.; Bogaki, K.; Mikami, A.; Abe, H. Field study on energy-saving behaviour and patterns of air-conditioning use in a condominium. *Energies* **2021**, *14*, 8572. [CrossRef]

96. Dincă, V.M.; Busu, M.; Nagy-Bege, Z. Determinants with Impact on Romanian Consumers' Energy-Saving Habits. *Energies* **2022**, *15*, 4080. [CrossRef]
97. Kazmi, H.; Keijsers, M.; Mehmood, F.; Miller, C. Energy balances, thermal performance, and heat stress: Disentangling occupant behaviour and weather influences in a Dutch net-zero energy neighborhood. *Energy Build* **2022**, *263*, 112020. [CrossRef]
98. Rana, A.; Kamali, M.; Riyadh, M.M.; Sultana, S.R.; Kamal, M.R.; Alam, M.S.; Hewage, K.; Sadiq, R. Energy efficiency in residential buildings amid COVID-19: A holistic comparative analysis between old and new normal occupancies. *Energy Build* **2022**, *277*, 112551. [CrossRef] [PubMed]
99. Safarova, S.; van Hoof, J.; Law, L.; Zander, K.K.; Garnett, S.T. Thermal comfort in a tropical savanna climate: The case of home occupants in Darwin, Australia. *Energy Build* **2022**, *266*, 112074. [CrossRef]
100. Surahman, U.; Hartono, D.; Setyowati, E.; Jurizat, A. Investigation on household energy consumption of urban residential buildings in major cities of Indonesia during COVID-19 pandemic. *Energy Build* **2022**, *261*, 111956. [CrossRef] [PubMed]
101. Szymańska, E.J.; Kubacka, M.; Woźniak, J.; Polaszczyk, J. Analysis of Residential Buildings in Poland for Potential Energy Renovation toward Zero-Emission Construction. *Energies* **2022**, *15*, 9327. [CrossRef]
102. Boait, P.; Snape, J.R.; Morris, R.; Hamilton, J.; Darby, S. The practice and potential of renewable energy localisation: Results from a UK field trial. *Sustainability* **2019**, *11*, 215. [CrossRef]
103. Cherry, C.; Hopfe, C.; MacGillivray, B.; Pidgeon, N. Homes as machines: Exploring expert and public imaginaries of low carbon housing futures in the United Kingdom. *Energy Res. Soc. Sci.* **2017**, *23*, 36–45. [CrossRef]
104. García-Garre, A.; Gabaldón, A.; Álvarez-Bel, C.; Ruiz-Abellón, M.C.; Guillamón, A. Integration of demand response and photovoltaic resources in residential segments. *Sustainability* **2018**, *10*, 3030. [CrossRef]
105. Gercek, C.; Reinders, A. Smart appliances for efficient integration of solar energy: A Dutch case study of a residential smart grid pilot. *Appl. Sci.* **2019**, *9*, 581. [CrossRef]
106. Innocent, M.; Francois-Lecompte, A.; Roudaut, N. Comparison of human versus technological support to reduce domestic electricity consumption in France. *Technol. Forecast. Soc. Chang.* **2020**, *150*, 119780. [CrossRef]
107. Kohlhepp, P.; Harb, H.; Wolisz, H.; Waczowicz, S.; Müller, D.; Hagenmeyer, V. Large-scale grid integration of residential thermal energy storages as demand-side flexibility resource: A review of international field studies. *Renew. Sustain. Energy Rev.* **2019**, *101*, 527–547. [CrossRef]
108. Marini, D.; Buswell, R.A.; Hopfe, C.J. Sizing domestic air-source heat pump systems with thermal storage under varying electrical load shifting strategies. *Appl. Energy* **2019**, *255*, 113811. [CrossRef]
109. Niamir, L.; Filatova, T.; Voinov, A.; Bressers, H. Transition to low-carbon economy: Assessing cumulative impacts of individual behavioral changes. *Energy Policy* **2018**, *118*, 325–345. [CrossRef]
110. Palm, J.; Eidenskog, M.; Luthander, R. Sufficiency, change, and flexibility: Critically examining the energy consumption profiles of solar PV prosumers in Sweden. *Energy Res. Soc. Sci.* **2018**, *39*, 12–18. [CrossRef]
111. Sovacool, B.K.; Griffiths, S. The cultural barriers to a low-carbon future: A review of six mobility and energy transitions across 28 countries. *Renew. Sustain. Energy Rev.* **2020**, *119*, 109569. [CrossRef]
112. Sweetnam, T.; Fell, M.; Oikonomou, E.; Oreszczyn, T. Domestic demand-side response with heat pumps: Controls and tariffs. *Build. Res. Inf.* **2019**, *47*, 344–361. [CrossRef]
113. Bohdanowicz, Z.; Łopaciuk-Gonczaryk, B.; Kowalski, J.; Biele, C. Households' electrical energy conservation and management: An ecological break-through, or the same old consumption-growth path? *Energies* **2021**, *14*, 6829. [CrossRef]
114. Broers, W.; Vasseur, V.; Kemp, R.; Abujidi, N.; Vroon, Z. Not all homeowners are alike: A segmentation model based on a quantitative analysis of Dutch adopters of residential photovoltaics. *Energy Effic.* **2021**, *14*, 30. [CrossRef]
115. Cozza, S.; Chambers, J.; Brambilla, A.; Patel, M.K. In search of optimal consumption: A review of causes and solutions to the Energy Performance Gap in residential buildings. *Energy Build* **2021**, *249*, 111253. [CrossRef]
116. Nie, H.; Zhou, T.; Lu, H.; Huang, S. Evaluation of the efficiency of Chinese energy-saving household appliance subsidy policy: An economic benefit perspective. *Energy Policy* **2021**, *149*, 112059. [CrossRef]
117. González-Torres, M.; Pérez-Lombard, L.; Coronel, J.F.; Maestre, I.R.; Paolo, B. Activity and efficiency trends for the residential sector across countries. *Energy Build* **2022**, *273*, 112428. [CrossRef]
118. Ji, Q.; Bi, Y.; Makvandi, M.; Deng, Q.; Zhou, X.; Li, C. Modelling Building Stock Energy Consumption at the Urban Level from an Empirical Study. *Buildings* **2022**, *12*, 385. [CrossRef]
119. Cerezo-Narváez, A.; Bastante-Ceca, M.J.; Piñero-Vilela, J.M. Economic and environmental assessment on implementing solar renewable energy systems in spanish residential homes. *Energies* **2021**, *14*, 4183. [CrossRef]
120. Gallego-Castillo, C.; Heleno, M.; Victoria, M. Self-consumption for energy communities in Spain: A regional analysis under the new legal framework. *Energy Policy* **2021**, *150*, 112144. [CrossRef]
121. Hafezparast Moadab, N.; Olsson, T.; Fischl, G.; Aries, M. Smart versus conventional lighting in apartments—Electric lighting energy consumption simulation for three different households. *Energy Build* **2021**, *244*, 111009. [CrossRef]
122. Lovati, M.; Huang, P.; Olsmats, C.; Yan, D.; Zhang, X. Agent based modelling of a local energy market: A study of the economic interactions between autonomous pv owners within a micro-grid. *Buildings* **2021**, *11*, 160. [CrossRef]
123. Sánchez-Vergara, J.I.; Ginieis, M.; Papaoikonomou, E. The emergence of the sharing city: A systematic literature review to understand the notion of the sharing city and explore future research paths. *J. Clean. Prod.* **2021**, *295*, 126448. [CrossRef]

124. Sovacool, B.K.; Martiskainen, M.; Furszyfer Del Rio, D.D. Knowledge, energy sustainability, and vulnerability in the demographics of smart home technology diffusion. *Energy Policy* **2021**, *153*, 112196. [CrossRef]
125. van Bommel, N.; Höffken, J.I. Energy justice within, between and beyond European community energy initiatives: A review. *Energy Res. Soc. Sci.* **2021**, *79*, 102157. [CrossRef]
126. Dall-Orsoletta, A.; Cunha, J.; Araújo, M.; Ferreira, P. A systematic review of social innovation and community energy transitions. *Energy Res. Soc. Sci.* **2022**, *88*, 102625. [CrossRef]
127. Hampton, H.; Foley, A.; Del Rio, D.F.; Smyth, B.; Laverty, D.; Caulfield, B. Customer engagement strategies in retail electricity markets: A comprehensive and comparative review. *Energy Res. Soc. Sci.* **2022**, *90*, 102611. [CrossRef]
128. Mihailova, D.; Schubert, I.; Martinez-Cruz, A.L.; Hearn, A.X.; Sohre, A. Preferences for configurations of Positive Energy Districts—Insights from a discrete choice experiment on Swiss households. *Energy Policy* **2022**, *163*, 112824. [CrossRef]
129. Sommerfeldt, N.; Lemoine, I.; Madani, H. Hide and seek: The supply and demand of information for household solar photovoltaic investment. *Energy Policy* **2022**, *161*, 112726. [CrossRef]
130. Wahlund, M.; Palm, J. The role of energy democracy and energy citizenship for participatory energy transitions: A comprehensive review. *Energy Res. Soc. Sci.* **2022**, *87*, 102482. [CrossRef]
131. Breadsell, J.; Byrne, J.; Morrison, G. Household energy and water practices change post-occupancy in an Australian low-carbon development. *Sustainability* **2019**, *11*, 5559. [CrossRef]
132. Mata, É.; Peñaloza, D.; Sandkvist, F.; Nyberg, T. What is stopping low-carbon buildings? A global review of enablers and barriers. *Energy Res. Soc. Sci.* **2021**, *82*, 102261. [CrossRef]
133. Neves, J.; Oliveira, T. Understanding energy-efficient heating appliance behavior change: The moderating impact of the green self-identity. *Energy* **2021**, *225*, 120169. [CrossRef]
134. Schneider, S.M.; Sanguinetti, A. Positive reinforcement is just the beginning: Associative learning principles for energy efficiency and climate sustainability. *Energy Res. Soc. Sci.* **2021**, *74*, 101958. [CrossRef]
135. Słupik, S.; Kos-łabędowicz, J.; Trzęsiok, J. How to encourage energy savings behaviours? The most effective incentives from the perspective of european consumers. *Energies* **2021**, *14*, 8009. [CrossRef]
136. Żywiołek, J.; Rosak-Szyrocka, J.; Mrowiec, M. Knowledge management in households about energy saving as part of the awareness of sustainable development. *Energies* **2021**, *14*, 8207. [CrossRef]
137. Jaciow, M.; Rudawska, E.; Sagan, A.; Tkaczyk, J.; Wolny, R. The Influence of Environmental Awareness on Responsible Energy Consumption—The Case of Households in Poland. *Energies* **2022**, *15*, 5339. [CrossRef]
138. Klint, E.; Johansson, L.-O.; Peters, G. No stain, no pain—A multidisciplinary review of factors underlying domestic laundering. *Energy Res. Soc. Sci.* **2022**, *84*, 102442. [CrossRef]
139. Qalati, S.A.; Qureshi, N.A.; Ostic, D.; Sulaiman, M.A.B.A. An extension of the theory of planned behavior to understand factors influencing Pakistani households' energy-saving intentions and behavior: A mediated–moderated model. *Energy Effic.* **2022**, *15*, 40. [CrossRef]
140. Ruokamo, E.; Meriläinen, T.; Karhinen, S.; Räihä, J.; Suur-Uski, P.; Timonen, L.; Svento, R. The effect of information nudges on energy saving: Observations from a randomized field experiment in Finland. *Energy Policy* **2022**, *161*, 112731. [CrossRef]
141. Batel, S.; Castro, P.; Devine-Wright, P.; Howarth, C. Developing a critical agenda to understand pro-environmental actions: Contributions from Social Representations and Social Practices Theories. *Wiley Interdiscip. Rev. Clim. Chang.* **2016**, *7*, 727–745. [CrossRef]
142. Dietz, T.; Whitley, C.T. Environmentalism, norms, and identity. *Proc. Natl. Acad. Sci. USA* **2018**, *115*, 12334–12336. [CrossRef]
143. Allcott, H. Social norms and energy conservation. *J. Public Econ.* **2011**, *95*, 1082–1095. [CrossRef]
144. Chen, C.-F.; Knight, K. Energy at work: Social psychological factors affecting energy conservation intentions within Chinese electric power companies. *Energy Res. Soc. Sci.* **2014**, *4*, 23–31. [CrossRef]
145. Chen, C.-F.; Xu, X.; Day, J.K. Thermal comfort or money saving? Exploring intentions to conserve energy among low-income households in the United States. *Energy Res. Soc. Sci.* **2017**, *26*, 61–71. [CrossRef]
146. Abrahamse, W.; Steg, L. Factors Related to Household Energy Use and Intention to Reduce It: The Role of Psychological and Socio-Demographic Variables. *Hum. Ecol. Rev.* **2011**, *18*, 30–40.
147. Hansla, A.; Gamble, A.; Juliusson, A.; Gärling, T. The relationships between awareness of consequences, environmental concern, and value orientations. *J. Environ. Psychol.* **2008**, *28*, 1–9. [CrossRef]
148. Kaiser, F.G.; Gutscher, H. The Proposition of a General Version of the Theory of Planned Behavior: Predicting Ecological Behavior 1. *J. Appl. Soc. Psychol.* **2003**, *33*, 586–603. [CrossRef]
149. AlSkaif, T.; Lampropoulos, I.; van den Broek, M.; van Sark, W. Gamification-based framework for engagement of residential customers in energy applications. *Energy Res. Soc. Sci.* **2018**, *44*, 187–195. [CrossRef]
150. Fouseki, K.; Newton, D.; Camacho, K.S.M.; Nandi, S.; Koukou, T. Energy effciency, thermal comfort, and heritage conservation in residential historic buildings as dynamic and systemic socio-cultural practices. *Atmosphere* **2020**, *11*, 604. [CrossRef]
151. Liu, X.; Wang, Q.; Wei, H.H.; Chi, H.L.; Ma, Y.; Jian, I.Y. Psychological and demographic factors affecting household energy-saving intentions: A TPB-based study in northwest China. *Sustainability* **2020**, *12*, 836. [CrossRef]
152. Jackson, T. Motivating Sustainable Consumption: A Review of Evidence on Consumer Behaviour and Behavioural Change. In *Sustainable Development Research Network*; EAUC: Cheltenham, UK, 2005; Volume 15.

153. Francisco, A.; Truong, H.; Khosrowpour, A.; Taylor, J.E.; Mohammadi, N. Occupant perceptions of building information model-based energy visualizations in eco-feedback systems. *Appl. Energy* **2018**, *221*, 220–228. [CrossRef]
154. Day, J.K.; McIlvennie, C.; Brackley, C.; Tarantini, M.; Piselli, C.; Hahn, J.; O'Brien, W.; Rajus, V.S.; De Simone, M.; Kjærgaard, M.B.; et al. A review of select human-building interfaces and their relationship to human behavior, energy use and occupant comfort. *Build. Environ.* **2020**, *178*, 106920. [CrossRef]
155. Jain, R.K.; Taylor, J.E.; Culligan, P.J. Investigating the impact eco-feedback information representation has on building occupant energy consumption behavior and savings. *Energy Build* **2013**, *64*, 408–414. [CrossRef]
156. Francisco, A.; Taylor, J.E. Understanding citizen perspectives on open urban energy data through the development and testing of a community energy feedback system. *Appl. Energy* **2019**, *256*, 113804. [CrossRef]
157. Yoo, S.; Eom, J.; Han, I. Factors driving consumer involvement in energy consumption and energy-efficient purchasing behavior: Evidence from Korean residential buildings. *Sustainability* **2020**, *12*, 5573. [CrossRef]
158. Khosrowpour, A.; Jain, R.K.; Taylor, J.E.; Peschiera, G.; Chen, J.; Gulbinas, R. A review of occupant energy feedback research: Opportunities for methodological fusion at the intersection of experimentation, analytics, surveys and simulation. *Appl. Energy* **2018**, *218*, 304–316. [CrossRef]
159. Kashif, A.; Ploix, S.; Dugdale, J.; reignier, p.; Shahzad, M. Virtual Simulation with Real Occupants using Serious Games. In Proceedings of the 14th International Conference of the International Building Performance Simulation Association, Hyderabad, India, 7–9 December 2015.
160. Hong, T.; Yan, D.; D'Oca, S.; Chen, C.-F. Ten questions concerning occupant behavior in buildings: The big picture. *Build. Environ.* **2017**, *114*, 518–530. [CrossRef]
161. Fagerberg, J.; Verspagen, B. Innovation studies—The emerging structure of a new scientific field. *Res. Policy* **2009**, *38*, 218–233. [CrossRef]
162. Cayre, E.; Allibe, B.; Laurent, M.-H.; Osso, D. There are people in the house!: How the results of purely technical analysis of residential energy consumption are misleading for energy policies. In Proceedings of the ECEEE 2011, Belambra Presqu'île de Giens, France, 6–11 June 2011; Volume 7.
163. Burger, P.; Bezençon, V.; Bornemann, B.; Brosch, T.; Carabias-Hütter, V.; Farsi, M.; Hille, S.L.; Moser, C.; Ramseier, C.; Samuel, R.; et al. Advances in Understanding Energy Consumption Behavior and the Governance of Its Change—Outline of an Integrated Framework. *Front. Energy Res.* **2015**, *3*, 29. [CrossRef]
164. Lingyun, M.; Rui, N.; Hualong, L.; Xiaohua, L. Empirical Research of Social Norms Affecting Urban Residents Low Carbon Energy Consumption Behavior. *Energy Procedia* **2011**, *5*, 229–234. [CrossRef]
165. Wang, J.; Wu, L. The impact of emotions on the intention of sustainable consumption choices: Evidence from a big city in an emerging country. *J. Clean. Prod.* **2016**, *126*, 325–336. [CrossRef]
166. Steg, L.; Perlaviciute, G.; van der Werff, E.; Lurvink, J. The Significance of Hedonic Values for Environmentally Relevant Attitudes, Preferences, and Actions. *Environ. Behav.* **2014**, *46*, 163–192. [CrossRef]
167. Jylhä, K.; Jokisalo, J.; Ruosteenoja, K.; Pilli-Sihvola, K.; Kalamees, T.; Seitola, T.; Mäkelä, H.M.; Hyvönen, R.; Laapas, M.; Drebs, A. Energy demand for the heating and cooling of residential houses in Finland in a changing climate. *Energy Build* **2015**, *99*, 104–116. [CrossRef]
168. Kuijer, L.; de Jong, A. Identifying design opportunities for reduced household resource consumption: Exploring practices of thermal comfort. *J. Des. Res.* **2012**, *10*, 67–85. [CrossRef]
169. Fratean, A.; Dobra, P. Control strategies for decreasing energy costs and increasing self-consumption in nearly zero-energy buildings. *Sustain. Cities Soc.* **2018**, *39*, 459–475. [CrossRef]
170. Hoolohan, C.; McLachlan, C.; Mander, S. Food related routines and energy policy: A focus group study examining potential for change in the United Kingdom. *Energy Res. Soc. Sci.* **2018**, *39*, 93–102. [CrossRef]
171. Goodchild, B.; Ambrose, A.; Berry, S.; Maye-Banbury, A.; Moore, T.; Sherriff, G. Modernity, Materiality and Domestic Technology: A Case Study of Cooling and Heating from South Australia. *Hous. Theory Soc.* **2020**, *37*, 357–377. [CrossRef]
172. Zhao, J.; Carter, K. Perceived Comfort and Adaptive Process of Passivhaus 'Participants'. *Energy Procedia* **2015**, *83*, 121–129. [CrossRef]
173. Gram-Hanssen, K.; Hansen, A.R.; Mechlenborg, M. Danish PV prosumers' time-shifting of energy-consuming everyday practices. *Sustainability* **2020**, *12*, 4121. [CrossRef]
174. Brody, S.; Grover, H.; Vedlitz, A. Examining the willingness of Americans to alter behaviour to mitigate climate change. *Clim. Policy* **2012**, *12*, 1–22. [CrossRef]
175. Hayles, C.S.; Dean, M. Social housing tenants, Climate Change and sustainable living: A study of awareness, behaviours and willingness to adapt. *Sustain. Cities Soc.* **2015**, *17*, 35–45. [CrossRef]
176. Hedlund-de Witt, A.; de Boer, J.; Boersema, J.J. Exploring inner and outer worlds: A quantitative study of worldviews, environmental attitudes, and sustainable lifestyles. *J. Environ. Psychol.* **2014**, *37*, 40–54. [CrossRef]
177. Cui, Y.; Sun, N.; Cai, H.; Li, S. Indoor temperature improvement and energy-saving renovations in rural houses of China's cold region—A case study of Shandong Province. *Energies* **2020**, *13*, 870. [CrossRef]
178. Quintal, F.; Nunes, N.J.; Ocneanu, A.; Berges, M. *SINAIS*; ACM Press: New York, NY, USA, 2010.
179. Schwartz, T.; Stevens, G.; Jakobi, T.; Denef, S.; Ramirez, L.; Wulf, V.; Randall, D. What People Do with Consumption Feedback: A Long-Term Living Lab Study of a Home Energy Management System. *Interact. Comput.* **2015**, *27*, 551–576. [CrossRef]

180. Murugesan, L.K.; Hoda, R.; Salcic, Z. Investigating Visualization of Energy Consumption. In Proceedings of the 14th Annual ACM SIGCHI_NZ Conference on Computer-Human Interaction 2013, Christchurch, New Zealand, 15–16 November 2013; p. 12.
181. Ahmad, M.W.; Mourshed, M.; Mundow, D.; Sisinni, M.; Rezgui, Y. Building energy metering and environmental monitoring—A state-of-the-art review and directions for future research. *Energy Build* **2016**, *120*, 85–102. [CrossRef]
182. Meier, A.; Aragon, C.; Peffer, T.; Perry, D.; Pritoni, M. Usability of residential thermostats: Preliminary investigations. *Build. Environ.* **2011**, *46*, 1891–1898. [CrossRef]
183. Ramos, A.; Gago, A.; Labandeira, X.; Linares, P. The role of information for energy efficiency in the residential sector. *Energy Econ.* **2015**, *52*, S17–S29. [CrossRef]
184. Foster, D.; Lawson, S.; Blythe, M. Wattsup?: Motivating Reductions in Domestic Energy Consumption Using Social Networks. In Proceedings of the 6th Nordic Conference on Human-Computer Interaction, Reykjavik, Iceland, 16–20 October 2010; pp. 178–187. [CrossRef]
185. Brynjarsdottir, H.; Håkansson, M.; Pierce, J.; Baumer, E.; Disalvo, C.; Sengers, P. Sustainably unpersuaded: How persuasion narrows our vision of sustainability. In Proceedings of the CHI Conference on Human Factors in Computing Systems, Austin, TX, USA, 5–10 May 2012; pp. 947–956. [CrossRef]
186. Belaïd, F.; Joumni, H. Behavioral attitudes towards energy saving: Empirical evidence from France. *Energy Policy* **2020**, *140*, 111406. [CrossRef]
187. Mills, B.F.; Schleich, J. Profits or preferences? Assessing the adoption of residential solar thermal technologies. *Energy Policy* **2009**, *37*, 4145–4154. [CrossRef]
188. Sardianou, E.; Genoudi, P. Which factors affect the willingness of consumers to adopt renewable energies? *Renew. Energy* **2013**, *57*, 1–4. [CrossRef]
189. Mills, B.; Schleich, J. What's driving energy efficient appliance label awareness and purchase propensity? *Energy Policy* **2010**, *38*, 814–825. [CrossRef]
190. Michelsen, C.C.; Madlener, R. Homeowners' preferences for adopting innovative residential heating systems: A discrete choice analysis for Germany. *Energy Econ.* **2012**, *34*, 1271–1283. [CrossRef]
191. Nair, G.; Gustavsson, L.; Mahapatra, K. Factors influencing energy efficiency investments in existing Swedish residential buildings. *Energy Policy* **2010**, *38*, 2956–2963. [CrossRef]
192. Brohmann, B. *What's Driving Sustainable Energy Consumption? A Survey of the Empirical Literature*; ZEW—Zentrum für Europäische Wirtschaftsforschung/Center for European Economic Research: Mannheim, Germany, 2009.
193. Sardianou, E. Estimating energy conservation patterns of Greek households. *Energy Policy* **2007**, *35*, 3778–3791. [CrossRef]
194. Heinonen, J.; Junnila, S. Residential energy consumption patterns and the overall housing energy requirements of urban and rural households in Finland. *Energy Build.* **2014**, *76*, 295–303. [CrossRef]
195. Morton, A.; Reeves, A.; Bull, R.; Preston, S. Empowering and Engaging European building users for energy efficiency. *Energy Res. Soc. Sci.* **2020**, *70*, 101772. [CrossRef]
196. van Eck dos Santos, M. Potential of ecovillages as alternative models of sustainable development—A review. 2017. Available online: https://www.researchgate.net/publication/317415222_Potential_of_ecovillages_as_alternative_models_of_sustainable_development-_a_review (accessed on 23 May 2021).
197. Torabi Moghadam, S.; Di Nicoli, M.V.; Manzo, S.; Lombardi, P. Mainstreaming energy communities in the transition to a low-carbon future: A methodological approach. *Energies* **2020**, *13*, 1597. [CrossRef]
198. Byrne, J.; Mouritz, M.; Taylor, M.; Breadsell, J.K. East village at Knutsford: A case study in sustainable urbanism. *Sustainability* **2020**, *12*, 6296. [CrossRef]
199. Hopfe, C. *The Passivhaus Designer's Manual: A Technical Guide to Low and Zero Energy Buildings*; Routledge: London, UK, 2015.
200. Bardhan, R.; Debnath, R.; Gama, J.; Vijay, U. REST framework: A modelling approach towards cooling energy stress mitigation plans for future cities in warming Global South. *Sustain. Cities Soc.* **2020**, *61*, 102315. [CrossRef]
201. Johnston, D.; Siddall, M.; Ottinger, O.; Peper, S.; Feist, W. Are the energy savings of the passive house standard reliable? A review of the as-built thermal and space heating performance of passive house dwellings from 1990 to 2018. *Energy Effic.* **2020**, *13*, 1605–1631. [CrossRef]
202. Zhao, J.; Carter, K. Do passive houses need passive people? Evaluating the active occupancy of Passivhaus homes in the United Kingdom. *Energy Res. Soc. Sci.* **2020**, *64*, 101448. [CrossRef]
203. Al-Addous, M.; Albatayneh, A. Knowledge gap with the existing building energy assessment systems. *Energy Explor. Exploit.* **2020**, *38*, 783–794. [CrossRef]
204. Dascalaki, E.G.; Argiropoulou, P.A.; Balaras, C.A.; Droutsa, K.G.; Kontoyiannidis, S. Benchmarks for embodied and operational energy assessment of hellenic single-family houses. *Energies* **2020**, *13*, 4384. [CrossRef]
205. Merini, I.; Molina-García, A.; Socorro García-Cascales, M.; Mahdaoui, M.; Ahachad, M. Analysis and comparison of energy efficiency code requirements for buildings: A Morocco-Spain case study. *Energies* **2020**, *13*, 5979. [CrossRef]
206. Andrea, V.; Tampakis, S.; Karanikola, P.; Georgopoulou, M. The citizens' views on adaptation to bioclimatic housing design: Case study from Greece. *Sustainability* **2020**, *12*, 4984. [CrossRef]
207. Stevenson, F.; Carmona-Andreu, I.; Hancock, M. The usability of control interfaces in low-carbon housing. *Archit. Sci. Rev.* **2013**, *56*, 70–82. [CrossRef]

208. Cannavale, A.; Ayr, U.; Fiorito, F.; Martellotta, F. Smart electrochromic windows to enhance building energy efficiency and visual comfort. *Energies* **2020**, *13*, 1449. [CrossRef]
209. Coban, H.H.; Lewicki, W. Flexibility in Power Systems of Integrating Variable Renewable Energy Sources. *J. Adv. Res. Nat. Appl. Sci.* **2023**, *9*, 190–204. [CrossRef]
210. Walker, G. The dynamics of energy demand: Change, rhythm and synchronicity. *Energy Res. Soc. Sci.* **2014**, *1*, 49–55. [CrossRef]
211. Naus, J.; van Der Horst, H.M. Accomplishing information and change in a smart grid pilot: Linking domestic practices with policy interventions. *Environ. Plan. C Politics Space* **2017**, *35*, 379–396. [CrossRef]