sustainability

MDPI

Article

How Could People and Communities Contribute to the Energy Transition? Conceptual Maps to Inform, Orient, and Inspire Design Actions and Education

Margherita Pillan *, Fiammetta Costa and Valentina Caiola

Politecnico di Milano, Dipartimento di Design, 20133 Milan, Italy; fiammetta.costa@polimi.it (F.C.); valentina.caiola@polimi.it (V.C.)
* Correspondence: margherita.pillan@polimi.it

Abstract: Energy Transition (ET) is crucial for sustainable development, impacting inclusive prosperity and social justice. Knowledge development, innovative solutions, and awareness actions become crucial as energy systems transform. ET necessitates behavioural and cultural changes involving individuals in responsible decision making. The active engagement of all societal actors, including people and communities is essential. The article is authored by a university research team specializing in Design for Sustainability, Service Design, and Design for Experience, and it addresses two central research questions: (i) how can individuals and communities contribute to ET? and (ii) how can design theories, methods, and expertise contribute to generating knowledge and solutions for ET? The research employs a multidisciplinary literature review and case study analysis. It is structured into two main sections. The first section examines ET, drawing upon European Union (EU) official documents and academic literature to outline its values, objectives, actors, initiatives, and challenges, focusing on the role of citizens and communities. The second section explores the design's contributions, summarizing relevant philosophies and solutions aligned with ET goals, challenges, and bottlenecks. Conceptual maps were created to address the knowledge gap on ET objectives and guidelines, providing design-oriented reference knowledge and principles. The purpose of the research is to define a conceptual framework made up of maps to guide researchers, designers, and design educators in understanding the complexity of ET and to inspire their intervention proposals.

Keywords: design education; design for behaviour change; design for sustainability; design of product systems; energy transition; experience design; sustainable innovation

Citation: Pillan, M.; Costa, F.; Caiola, V. How Could People and Communities Contribute to the Energy Transition? Conceptual Maps to Inform, Orient, and Inspire Design Actions and Education. *Sustainability* **2023**, *15*, 14600. https://doi.org/10.3390/su151914600

Academic Editor: Wenjie Liao

Received: 1 August 2023
Revised: 19 September 2023
Accepted: 2 October 2023
Published: 9 October 2023

1. Introduction

Ensuring access to affordable, reliable, and sustainable energy for all citizens is one of the main challenges of our times and the focus of "Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all" for the United Nations Agenda for the planet's sustainable development. The availability of energy at accessible prices impacts lifestyles and health; it is a prerequisite for accessing services and digitization; and it affects economic and systemic development, information, and education opportunities. Energy accessibility is therefore a condition for improving well-being at all latitudes and an essential resource to enable inclusive prosperity, social justice, and progress. The production of clean energy and its efficient use impact pollution and are vital factors contrasting climate change. Energy production and use account for over 75% of the EU's greenhouse gas emissions. Decarbonizing the EU's energy system is crucial to achieving the European climate targets for 2030 and realizing the EU's long-term strategy of achieving carbon neutrality by 2050 [1].

ET, i.e., the transformations required to accomplish the objectives of Goal 7, is therefore central to social and environmentally sustainable development. ET involves changes in energy production, supply, and consumption. As energy systems undergo transformative

changes, the need for knowledge development, innovative solutions, and awareness-raising actions becomes a vital issue. ET requires behavioural and cultural changes, enabling all individuals to make responsible choices. It demands the active involvement of all societal actors, including local communities and individuals. The article is authored by a university research team specializing in Design for Sustainability, Product and Service Design, and Design for Experience. As designers and educators, we identify the cogence and urgency of contributing to ET, bringing it to the centre of our research and teaching activities. On the other hand, we recognize the complexity of the ET issues and aim to develop a non-superficial approach to the ET challenges. The research presented in this document arises from the willingness to identify the goals, values, and principles that should orient our actions and to produce synthetic knowledge suitable for orienting project and education activities.

The research addresses two central research questions: (i) how can individuals and communities contribute to ET? and (ii) how can design theories, methods, and expertise contribute to generating knowledge and solutions for ET?

The research is based on an extensive and multidisciplinary literature review and case study analysis; as shown in the Visual Abstract in Figure 1, the article is structured into two main sections corresponding to the two research questions. The first one examines ET, drawing upon European Union official documents and academic literature to outline its values, objectives, actors, initiatives, and challenges, with specific attention given to the role of citizens and communities. The second section explores the contributions of design as a discipline and practice, summarizing design theories, philosophies, solutions, and paradigms aligned with the goals and challenges for ET. Critical issues such as barriers and obstacles to behavioural changes and people engagement in ET are also discussed.

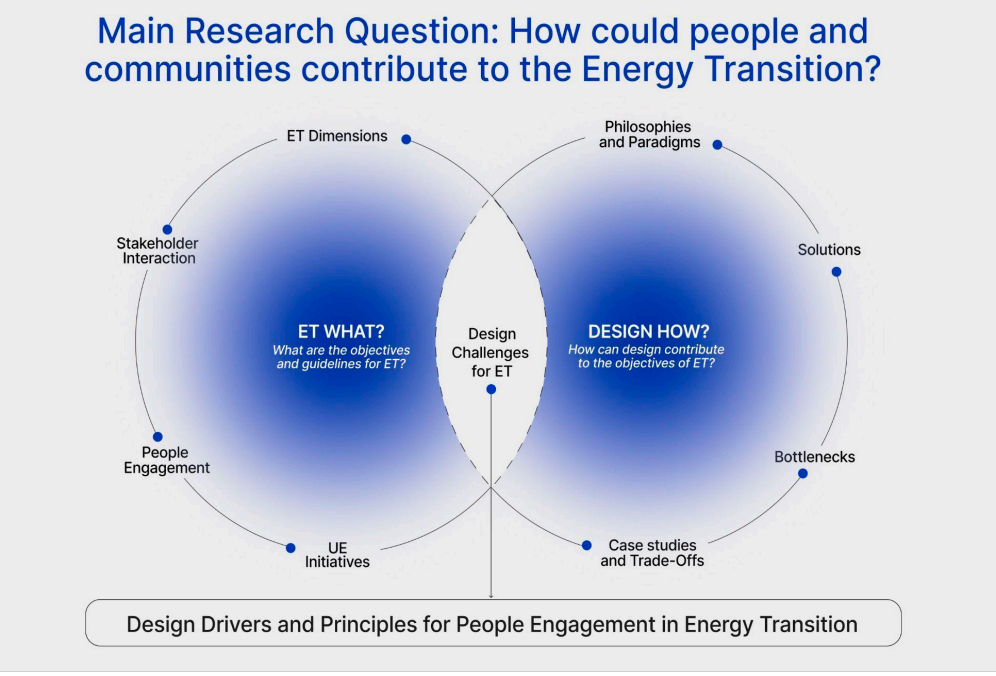

Figure 1. Visual abstract that condenses the article's structure, which encompasses two primary sections: one addressing the objectives and guidelines of the EU for ET, and the other exploring the design's potential contributions and opportunities.

The analysis of the case studies and academic literature reporting addressing ET goals indicate that the topic has yet to receive extensive investigation despite the considerable interest from design communities and educators for sustainability. This paper aims to offer a contribution to fill the knowledge gap on ET objectives and guidelines by providing a conceptual framework for design initiatives for ET. The framework includes design-

oriented reference knowledge and design principles summarizing the analysis and findings in a set of conceptual maps. The document includes a set of visual representations of the results. The visual maps aim to summarise the primary outcomes of the research and provide an atlas to be used by designers and design educators. The conceptual framework generated as an answer to the two main research questions was recently mapped in a grid to be used as a design tool in the analysis of case studies and in the preliminary design research for ET-oriented projects. The final part of the document reports the results obtained by applying the grid to three meaningful case studies.

2. Objectives and Guidelines for ET

The analysis of objectives and guidelines for ET throughout European Union official documents and academic literature is the grounding step to address the first research question, namely "How can individuals and communities contribute to ET?"

For this purpose, the analysis draws from the macro policy level to the micro individual level, highlighting the respective intervention dimensions and challenges. After recognizing the complexity of action levels and the interaction between the actors involved in ET, specific attention is given to the role of citizens and communities.

2.1. ET Who and What: Actors and Dimensions of the Transition

ET is a complex goal encompassing numerous and intricate dimensions: macroeconomic, political, and infrastructural levels, as well as citizen engagement.

Within the states of the European Union, the initiatives about the ET depend on several factors such as the availability of local resources, the private and public stakeholders in charge of the production and distribution of electric energy, and the attitude of governments in acting as the active subject in the market and as the controller and mitigator of its trends. Furthermore, the initiatives for ET are significantly impacted by contingent situations, such as conflicts and strategies for international relationships and alliances. Comprehensive modelling of the dynamics involving political and social actors goes beyond the scope of the research reported in this document, which instead focuses on models derived from the ET directives and principles.

A systematic analysis of scholarly publications on ET conducted by Harichandan et al. [2] shows the increasing importance of climate change mitigation, renewable energy, governance approach, and emission reduction, as well as the need for research to further develop policy frameworks, energy infrastructures, renewable energy ecosystems, clean energy economic analysis, and impact assessment.

Focusing on citizens, the literature portrays factors such as individuals' attitudes, beliefs, and behavioural factors towards adopting sustainable energy, along with examples that highlight the role of personal motivation, awareness, and behaviour change [2,3]. The diagram in Figure 2 systematizes the main ET actors and interventions in a multilevel perspective representation, highlighting that the European's efforts primarily focus on the macro socio-economic and political dimension in terms of policy regulation [4,5], technology innovation [6], infrastructure development [7–9], investments [10,11], and market transformation [12,13]. The individual and household levels highlighted in yellow and deeper are analyzed in Section 2.4 and encompass the concepts of awareness and agency [14,15].

Figure 2 represents various dimensions of the ET, categorized into three levels according to the engaged actors: (i) individual commitment and agency; (ii) local communities; and (iii) companies and institutions, economic actors, policymakers, and institutions. The figure captures the multifaceted nature of the ET by showcasing various elements within each level and their relationships.

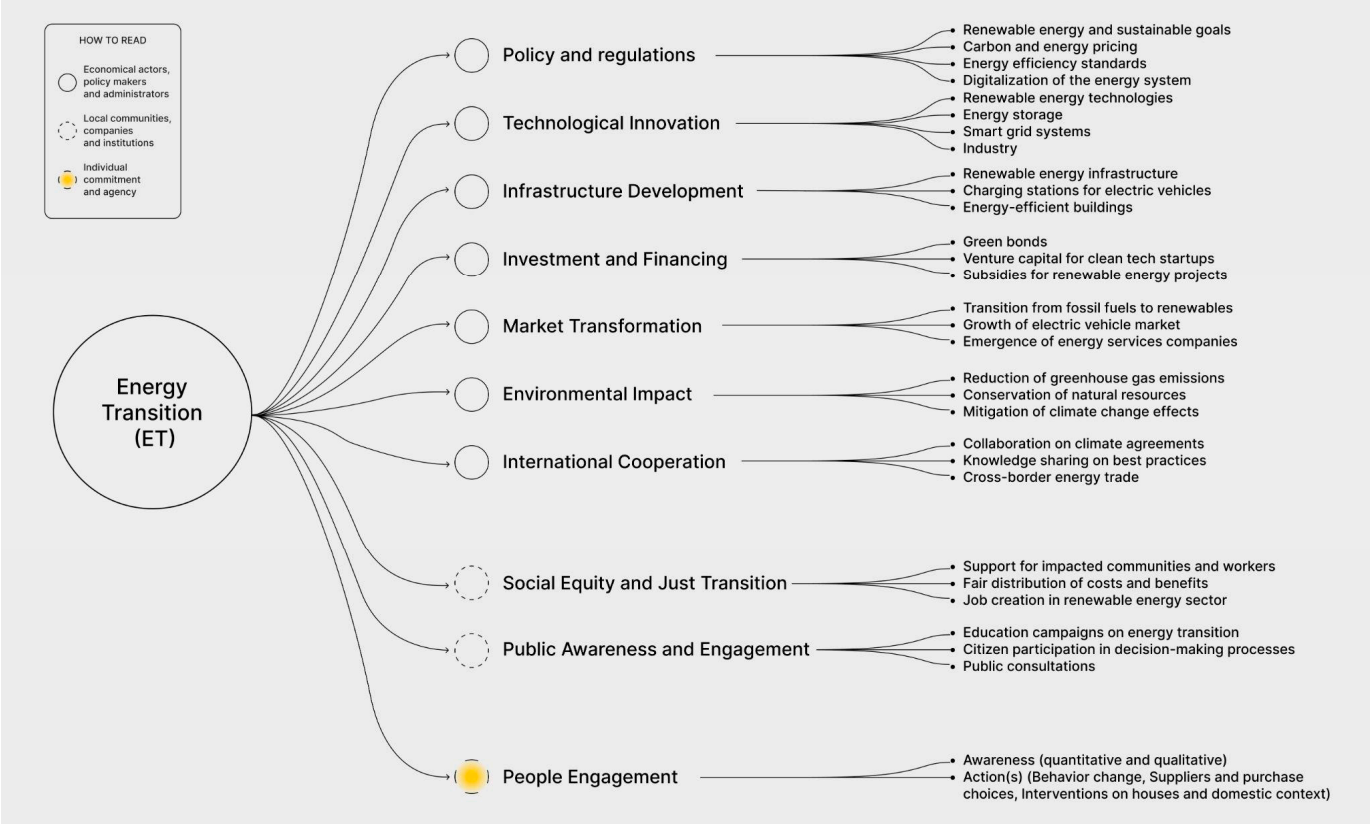

Figure 2. Visualization of ET actions. A three-level representation unveiling the multi-dimensionality of decarbonization strategies.

At the economic, policy, and institutional levels, it represents the broader socioeconomic and political factors influencing the ET. At this level, it incorporates policy interventions [5,6], technological innovation [7], urban infrastructure development [8–10], and market dynamics [11–14] that can enhance user experiences and promote sustainable practices. Several key aspects encompass smart grids, industry, energy-efficient buildings, demand response programs, and digitalization. Each mutually benefits the others and contributes to a more human-centred and environmentally conscious urban living experience. Citizen participation in demand response programs, achieved via adjusting their electricity consumption in response to signals from utilities or grid operators, impacts the reduction of the congestion in power grids, delays network upgrades, and enhances grid flexibility [14]. At the community level, companies and institutions level, awareness and engagement become public [15,16], and possible impacts of social equity and just transition [17] on the local working context are illustrated. Finally, Figure 2 extends to the individual level, where it portrays factors such as individuals' awareness, behaviour change, suppliers, purchase choices, and interventions on houses and domestic context. The map is enriched by incorporating specific and non-exhaustive examples that highlight environmental impact assessment [18] and international cooperation [19], shaping the landscape of sustainable energy adoption. Understanding this complex multilevel structure is essential for researchers, designers, and educators, as it provides insights into the broader systemic context within which user experiences are situated. The visual organization of the dimensions of the ET into levels facilitates a holistic and comprehensive understanding of the ET from a user experience perspective by guiding designers in creating meaningful, feasible, and human-centred solutions.

2.2. European Union-Driven Initiatives for ET

In the context of ET, the European Union is a global leader that promotes a complex system of plans, directives, regulations, and funding to direct the efforts of all stakeholders towards a common direction. For this investigation, it is fundamental to delve into this complex system of EU interventions to understand the main actors (their level of interest vs. engagement) and the main objectives (the dimensions of ET focused on in European plans), but above all, the opportunities and gaps for action in the discipline of design.

The first-level initiative is the Green Deal, a long-term strategy for the ecological transformation of the European economy. The Green Deal revolves around three fundamental principles: (i) ensuring a secure and affordable energy supply for the EU; (ii) developing a fully integrated, interconnected, and digitized energy market; and (iii) prioritizing energy efficiency, improving the energy performance of buildings, and developing an energy sector based mainly on renewable sources. The plan includes a series of actions to reduce greenhouse gas emissions, increase energy efficiency, promote the use of renewable energy, and protect biodiversity and citizens' health [20]. A series of packages are articulated to achieve the objectives identified by the EU, which in turn are divided into corresponding sub-initiatives. The connection lies in aligning funding and resources with the strategic direction established by the Green Deal. The Framework Programmes [21] provide the means to finance and implement projects and actions that support and achieve the goals of the Green Deal. Finally, the National Energy and Climate Plans (NECPs) [22] represent one of the main tools for implementing EU climate and energy policy and achieving the Green Deal objectives. Specifically, the NECPs are individual assessments from each Member State published by the European Commission, providing personalized instructions on implementing guidelines [23]. As part of the EU requirements, each Member State must submit a progress report every two years, «to better develop and implement the plans, the Member States are required to consult citizens, businesses, and regional authorities in the drafting and finalization process» [22].

Understanding the structure and content of UE initiatives is a determinant reference for designers and researchers supporting individuals and communities in the search for ET solutions that fit UE values and objectives, as well as the different Member States' guidelines.

Figure 3 visually represents the hierarchical structure and relationships between EU initiatives for sustainable transition, facilitating an understanding of their interconnections. It provides a concise overview of the main initiatives, policies, plans, frameworks, and funding released by the European Union for its Member States, all aimed at achieving the overarching goal of sustainable transition promoted via the Green Deal. The scheme is organized into three main sections: Recognized Focus of the Green Deal initiative, the Green Deal Policy Framework, and the Founding Mechanisms.

The first section (Focus) aims to establish a link between the sustainable transition goals and the main EU initiative. The Policy Framework section breaks down the main plan of the European Green Deal into priorities that directly or indirectly address one or more focuses of the ET. Focus areas and packages specifically directed to ET are highlighted in dark blue. Priorities directly addressing citizens are highlighted in yellow. Lastly, the third section (Foundings) is a collection of financing mechanisms that emerged parallel to the Green Deal initiatives.

Regarding design research, the figure holds value, as it strives to reorganize and prioritize ongoing interventions within the EU. Providing an overview of the current priorities enables researchers to identify areas that may have received less attention or require further intervention. This insightful perspective aims to aid researchers and designers in developing solutions aligned with the EU's ET goals, addressing gaps and maximizing impact in areas that may have been previously overlooked.

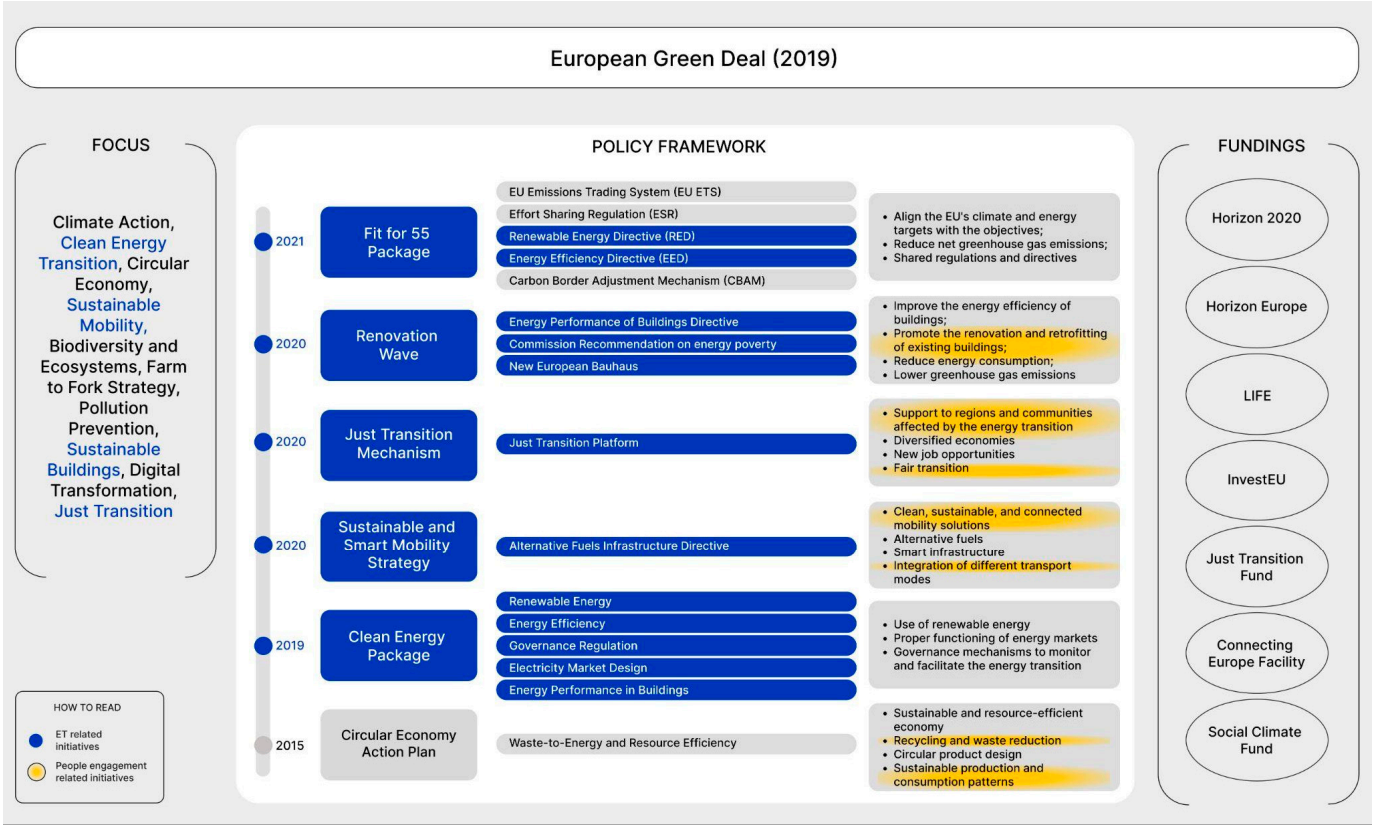

Figure 3. Visualization of the EU's commitment to sustainable transition. An overview of main initiatives targeting ET and People Engagement.

2.3. The Network of Actors for ET

The actors interacting in UE interventions addressing ET build a complex network spanning from the European Commission to individuals and comprehending public institutions, independent organizations, private companies, and citizens.

The legislative and executive power of the EU is exerted by the European Commission, the European Parliament, and the Council of the European Union. The members of the European Parliament are directly elected by voters in all Member States and represent the European people's interests with regard to EU lawmaking. The Council of the European Union is made up of the Member States' government Ministers, depending on the legislation being discussed, who defend their national interests in the Council. Each Member State nominates one Commissioner to the European Commission, where the interests of the EU as a whole are promoted. The Commission proposes UE legislations, while the Parliament and Council jointly adopt them. The member states then implement them by interacting with local actors, and the Commission ensures that the laws are properly applied [24].

The group of Chief Scientific Advisors provides independent scientific advice directly to the Commission on topics of high political and strategic importance. The group is composed of seven Chief Scientific Advisors, appointed in their personal capacity and who act independently and in the public interest. The advisors interact with all relevant actors and work closely with the Scientific Advice for Policy by European Academies (SAPEA) consortium, which gathers expertise in engineering, humanities, medicine, and natural and social sciences from over 100 academies and societies across Europe [25].

Figure 4 illustrates the principal actors engaged in the ET according to EU guidelines, wherein core actors predominantly affiliated with EU organizations are distinguished by a white background. Additionally, the interactions between these actors are elaborately detailed, showcasing the inputs and outputs associated with each interaction. Notably, individuals and communities are highlighted in yellow to explicitly demonstrate their

involvement at various policy formulation stages and clarify their roles. This figure constitutes an instrument for design research, providing researchers and designers with profound insights into the diverse landscape of actors participating in the ET. Its primary objective is to enrich research and design processes by facilitating the identification of key actors, their interactions, and their degrees of engagement. By offering a holistic view of the actors' landscape, this visual representation enables the exploration of strategic partnerships and the establishment of effective communication channels to engage with diverse actors.

Ultimately, the figure aims to support the development of tailor-made solutions that align with the distinct needs, interests, and requirements of actors within the dynamic realm of ET. It serves as a crucial resource in fostering collaboration and cooperation among stakeholders, thereby contributing to the advancement of sustainable practices and innovations in the field of ET.

These patterns reflect the complexity and multi-stakeholder nature of the ET and sustainability initiatives. While institutions, businesses, and industry players play crucial roles, there is room for improving people and community engagement to ensure a just and inclusive transition for all. People participation is a determinant for the success of ET initiatives, both as political actors in tight correlation with cultural changes, as well as last mile actuators via behavioural change.

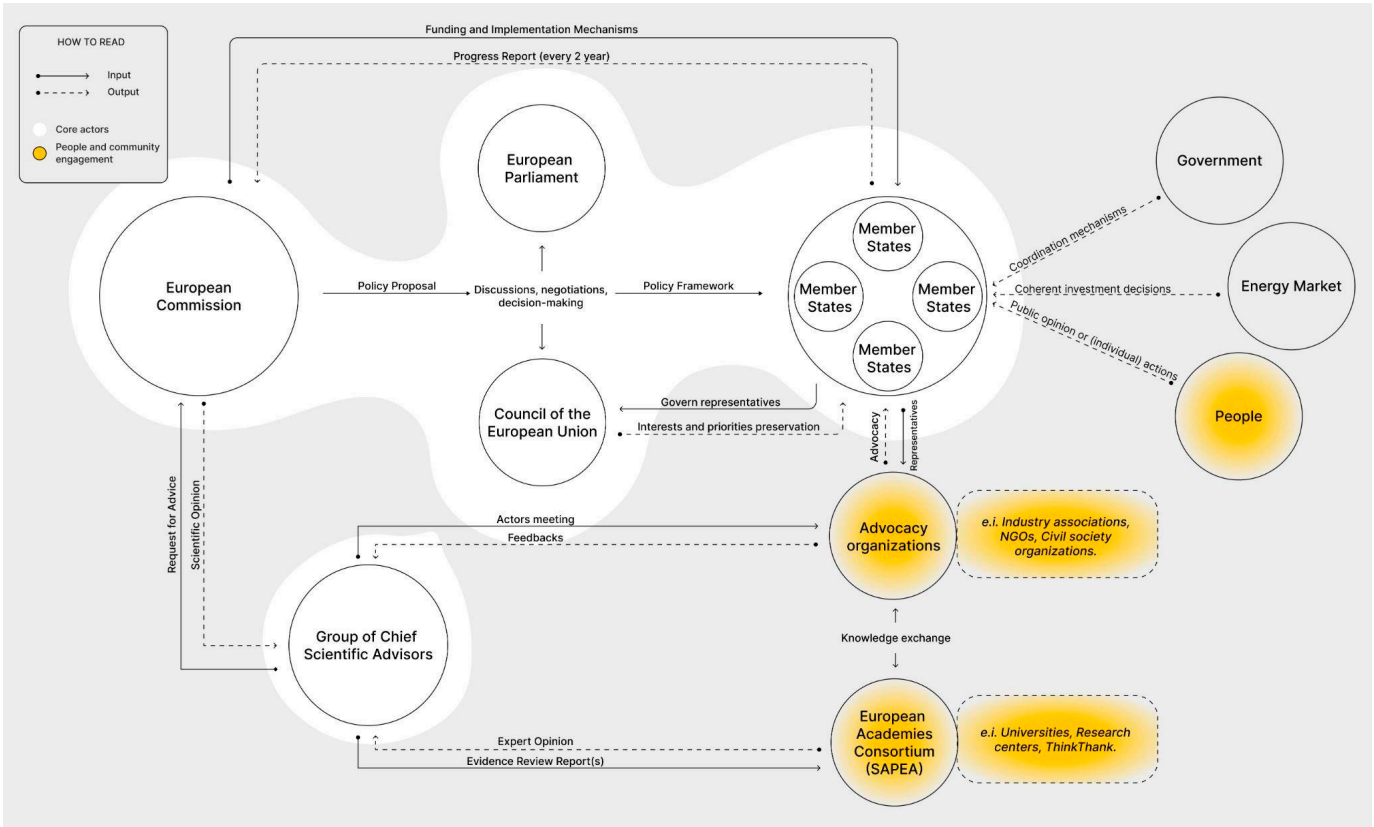

Figure 4. A Visual mapping of key actors and their interactions in ET from EU guideline perspectives.

2.4. The Role of People in ET

In the European Green Deal, the EU emphasizes that the transition towards sustainability must be fair and inclusive, prioritizing people and bringing citizens together in all their diversity. This requires ambitious and cross-cutting actions to engage and empower people and communities, supporting behavioural, social, and cultural changes where they are most needed for a just and inclusive transition [20]. For this to be possible, it is necessary to examine the implications of EU energy policies by explicitly shedding light on the

accessibility of decarbonization measures, funds, and information and to force a paradigm shift [26].

The European Union recognizes that adopting a people-centred approach integrated with technological innovation [27] is necessary to inclusively involve all stakeholders in the ET process. In this context, among the groups that play a fundamental role, the Group of Scientific Advisors (SAM) and the Green Deal Support Office are mentioned. The SAM is a mechanism established by the European Commission to provide scientific and independent advice [25]. The group explores ways to engage local communities and citizens in the ET, emphasizing the crucial role of active citizen participation in the success of energy policies [28].

Another comprehensive approach is the Green Deal Support Office [29], which provides support and coordination in implementing the Green Deal. The office serves as a bridge between the EU and the Member States to facilitate collaboration and engagement of all stakeholders in the ecological transformation process. The office promotes coherence among the various initiatives (currently 73) and ensures effective information sharing and best practices [29]. The underlying theoretical framework for all office activities recognizes citizens and communities as stakeholders and inclusion as an action pillar. As mentioned in Section 2.1, people's engagement in ET is based on people's awareness and agency. The initiatives undertaken by the European Union and other entities have heavily invested in engaging individuals and communities at various levels. Specifically, these efforts encompass promoting energy literacy and awareness [30,31], providing access to information and tools [32], and encouraging citizen advocacy and awareness-raising [33–35]. Furthermore, additional initiatives focus on advocating for sustainable lifestyle choices [36–39], encouraging the adoption of energy-saving practices [40–42], and subsequently acknowledging and rewarding the contributions made by citizens [43]. At a higher level of engagement, some programs involve people's participation in energy efficiency programs [44] by cultivating collaborative partnerships, dialogue, and cooperation to discover innovative solutions and address energy challenges specific to different communities [45]. Moreover, specific programs encourage and empower citizens to initiate and actively participate in local renewable energy projects, energy cooperatives, and community-based initiatives [46–48] and establish mechanisms for citizen feedback [49–52]. These efforts aim to foster a more comprehensive and inclusive approach to ET, ensuring people and communities' active involvement and ownership in shaping a sustainable energy future.

Figure 5 is dedicated to delving into the role of citizens and communities in the context of ET, mainly focusing on awareness features and typologies of actions. It serves the purpose of systematizing the tasks individuals undertake to engage in sustainable actions, as recommended by the EU and parallel initiatives addressing ET. These tasks are organized within a complex and multilevel structure, emanating from two primary criteria: (i) awareness and (ii) action.

The first criterion (awareness) encompasses a qualitative understanding of one's impact and energy information and a quantitative evaluation of energy usage in daily activities via metrification and monitoring tools. On the other hand, the second criterion (action) is based on the concept that individual actions can manifest via various dimensions, including changes in consumption behaviours, transitions towards more sustainable energy suppliers, the purchase of energy-efficient appliances, interventions in houses and domestic contexts such as smart energy management, and improvements in insulation and renewable energy generation.

The circular arrangement of these tasks is a deliberate choice, influenced by the realization that awareness and action, along with their respective subtasks, do not represent sequential stages of people engagement but serve as potential entry points for individual involvement. The primary objective of this representation is to gather and systematize the diverse tasks rather than suggesting a specific design strategy. Organizing these tasks into a coherent structure aims to provide a comprehensive overview of the multifaceted aspects

of citizen engagement in ET, facilitating a better understanding of the potential avenues for fostering sustainable actions at the individual and community levels.

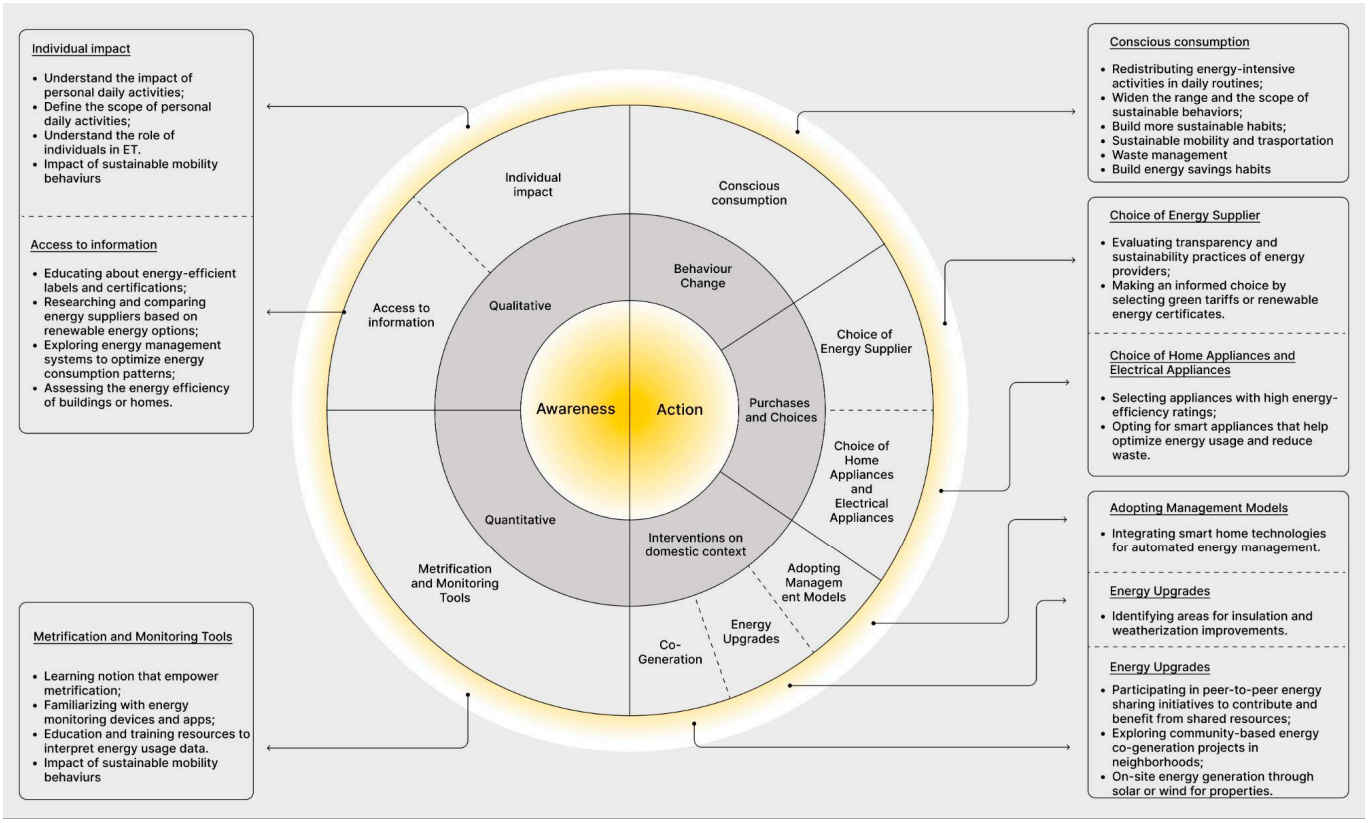

Figure 5. Visual systematization of main tasks and subtasks for People and Communities' engagement in ET.

For many individuals, awareness is not enough to change towards pro-environmental behaviours because they are hindered by several psychological barriers, such as ideological worldviews that tend to preclude alternatives, sunk costs and behavioural momentum, low confidence toward experts and authorities, and perceived risks of change [53]. Angheloiu, Sheldrick, and Tennant [54] identify the key feature to bridge awareness to action in the development of enabling images of the future. So far, design can support the development of alternative narratives, products, and services. Also, the agency can affect awareness via material participation, defined as a specific mode of engagement distinguished by the fact that it employs objects such as energy-efficient lightbulbs, photovoltaic panels, electric cars, and smart meters to involve people in environmental campaigns [55].

3. Design Contribution to the Objectives of ET

The second research question driving the reported research focuses on the contributions that design as a discipline and community of academics and practitioners can offer to the ET challenges. The review focused on design theories—including design approaches, methods, principles, and values—and case studies reporting solutions for specific ET-related project briefs. The result points out the main competencies that design can put at stake in facing the ET challenges and report the evolution of thinking and sensibility toward sustainability issues. The investigation was extended out of the boundaries of the design discipline to include theories and valuable knowledge in designing solutions for behaviour change. Identifying the bottlenecks impeding changes and the awareness of the complexity of enabling new behaviours are crucial to avoid naive approaches in the design of solutions for ET.

3.1. Philosophies and Paradigms

In this section, a specific reference is made to anthropocentric, humanistic, and post-Humanistic design philosophies [56] and design paradigms focusing on sustainability and ET (see Figure 6).

User-Centred Design (UCD) focuses on user needs [57], enhances usability [58], and incorporates user feedback throughout the design process [59]. A positive user experience is created by understanding users' preferences, behaviours, and requirements [57] to develop user-friendly products and systems [58]. The UCD process involves iterative design cycles and user feedback to refine and improve the design [59]. Limitations of this approach include focusing mainly on the needs of individual users and ignoring broader social and environmental factors [60]. Moreover, the prediction of user behaviour and the anticipation of all possible scenarios can take time, effort, and resources [60,61].

Among the identified approaches in the context of UCD, the focus primarily revolves around themes of energy efficiency and energy management in the workplaces [62,63], context-aware systems [64], smart houses [65], commercial buildings [66,67], and residential buildings [68]. Particular emphasis is placed on the domestic environment via solutions such as apps [69,70], smart meters [71], eco-feedback systems [72,73], gamification devices/solutions [74], and more general investigation on the interaction with the domestic environment [75]. In the context of UCD philosophies, some of the theoretical frameworks identified [70] follow standard phases, i.e., user research, ideation, prototyping, and testing. At the same time, others are tailored [76], i.e., for the developing strategies towards sustainable energy use via three steps: level, type, and impact domain, and three corresponding actions for designers: (1) Distinguishing between three elements: individual behaviours, social actions, and technologies. (2) Distinguishing between energy efficiency pathways and reduction pathways. (3) Distinguishing between the five potential impact domains of an ET pathway: economy, community, human health, nature, and quality of life.

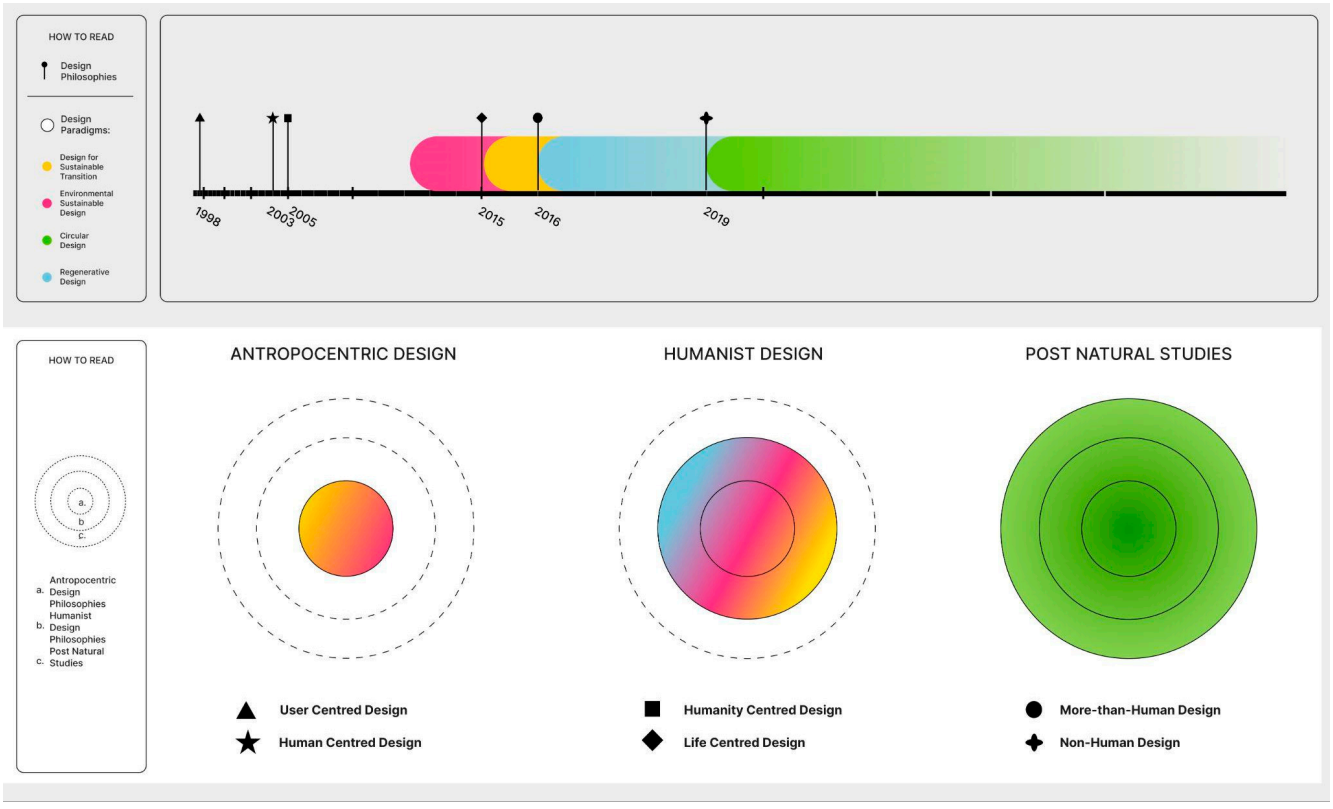

Figure 6. Visualization of the evolution of sustainability-related design philosophies and paradigms: intersecting design values across key moments.

However, some positions question users' priorities and desires concerning global well-being within the design process [77]. This opinion is based on the notion that the interaction design community needs to shift towards a new design paradigm, explicitly considering global well-being in a Human-Centered Design (HCD) process [78]. HCD seeks to create solutions that are not only user-friendly but also ethically and socially responsible, promoting the well-being of individuals and communities [79]. In the HCD process, users and stakeholders actively participate in co-creation, promoting empathy and collaboration [80]. On the other hand, user groups' diverse perspectives could be excluded, marginalized, or underrepresented [81]. It can also be difficult to anticipate future needs, as designing solely for current needs can overlook new or evolving needs as contexts change [82]. In the literature of HCD, there is a tendency to address the topic of social justice [83–86] via community engagement [83,84,87] and co-designed solutions [88–90]. The outcomes of these interventions focus more on the systemic level, such as the food system [91], the building system [92,93] and the industry working environment [94].

Among the proposed solutions, it is noteworthy to mention intelligent tutoring systems integrated with augmented reality technology [94]. From a methodology point of view, an interesting framework was identified that integrates Design Thinking with the Framework for Strategic Sustainable Development [95] to create a process of Sustainable Design Thinking as a possible approach to achieving strategic and sustainable outcomes [96].

Regarding sustainability, it is argued [97] that HCD has limitations, while Humanist Design Philosophies could offer a more comprehensive approach. HCD tends to focus solely on buyers or users, neglecting other actors in the value chain, such as non-human entities, including animals and natural elements, and overlooking essential stages such as sourcing and end-of-life [98]. Its methods struggle to address abstract sustainability needs. Ecological and social issues are often low priorities for customers in user research [99].

Humanity-Centered Design considers the interconnectedness of individuals, society, and the environment. It embraces a systemic approach and integrates ethical, social, and environmental considerations into the design process. The Humanity-Centred Design addresses complex societal challenges, embraces inclusivity and diversity [80] and integrates human values and ethics [100]. It strives to create solutions that benefit humanity as a whole. It, however, faces challenges, including balancing conflicting interests, navigating complex ethical issues [100] and integrating systemic changes [101].

Among the solutions identified are gamification for system management [102], interactive narratives for social interventions [103] that extract theories and practices related to human activity embodied cognition and media studies, and develop tools for navigability, identification, co-creation, immersion, and transformation.

Life-Centred Design (LCD) emphasizes valuing and preserving ecological systems [104], integrating living beings' needs [105], and promoting regenerative and sustainable practices [106]. With a focus on ecosystem health and the well-being of all living beings, LCD supports harmonious coexistence between humans, animals, and the environment [107]. However, it faces challenges in managing complex interconnectedness [105], addressing implementation and scalability issues [106], and navigating ethical considerations [104]. When compared with anthropocentric philosophies, a limited number of contributions are identified. Among the most relevant contributions is identified in the 2023 issue of the "Disegno Industriale Industrial Design" Journal [108]. This contribution explores circularity and sustainability in the design process by examining the Packaging System as a paradigm for contemporary commodities and showcasing research at different scales with the collaboration of prestigious universities. Moreover, a comprehensive framework for LCD is proposed by Borthwick et al. [107]. It includes principles, actionable methods, and a responsible innovation model, highlighting how interaction designers can utilize this framework to integrate environmental and ethical considerations during the design of interactive products.

Post natural studies allow designers to explore innovative and sustainable design solutions by considering the complex interplay between nature and technology [109]. This expansion allows designers to tackle ecological and social challenges, promoting a holistic

approach that integrates environmental sustainability and social equity [110]. Post-natural studies foster critical reflection among designers, encouraging ethical considerations and a deeper understanding of the consequences of manipulating natural systems. However, post-natural studies also face limitations that need to be acknowledged. Ethical and moral complexities arise due to deliberate alterations of natural systems, requiring designers to navigate these challenges responsibly [109]. Implementing post-natural theories into practical design solutions can be challenging. This could result in a lack of concrete guidelines or frameworks for designers to follow [104]. Additionally, limited awareness and adoption of post-natural concepts within the design community hinder the widespread application.

Evidence shows that in design philosophies, considerable attention is directed towards sustainability as an overarching theme [32], but way less effort is directed towards the topic of ET. Based on this ground knowledge, a more focused inquiry was conducted, focusing on more specific keywords. The outcome of this second research phase entails an overview of design methodologies explicitly tailored for sustainability.

Results show that notable approaches encompass Environmentally Sustainable Design [35], Regenerative Design [34], and Circular Design [35,36]. Refer to [37] for a more comprehensive compilation of pivotal publications on Design for Sustainability (DfS). Notably, within the ET domain, only recent developments have witnessed the emergence of research subgroups that acknowledge the role of design. Among the most cited approaches, there is Design for Sustainability Transitions (DfST) [37], also known as Transition Design [38].

Design for Sustainability encompasses various design approaches that address environmental, social, and economic challenges [111]. It is influenced by human-centric, humanistic, and LCD philosophies by considering design's social and ecological aspects, promoting responsible consumption, and aiming for long-term sustainable outcomes. Environmentally Sustainable Design focuses on minimizing the negative environmental impact of products, systems, or processes throughout their life cycle [111]. It aligns with the human-centric and humanistic philosophies, as it aims to create designs that consider the well-being of humans while also considering the broader ecological context and the need for environmental stewardship. Regenerative Design goes beyond Sustainability by aiming to restore and regenerate ecological systems rather than merely minimizing harm [112]. It draws inspiration from more-than-human and non-human design philosophies, recognizing the interdependence of human and non-human elements and seeking to create designs that contribute positively to the flourishing of all life forms.

Circular Design approaches aim to create products, systems, and processes within closed-loop systems, where resources are circulated, and waste is minimized [113]. It aligns with human-centric, humanistic, and LCD philosophies by prioritizing the well-being of humans and the environment, emphasizing resource efficiency, and reducing the negative impact of design on natural systems. Design for Sustainability Transitions or Transition design [114] focuses on enabling societal shifts towards more sustainable and resilient futures [115]. It draws inspiration from humanistic and LCD philosophies by recognizing the need for systemic change, engaging multiple stakeholders, and envisioning new ways of living and organizing society. This field encompasses a diverse range of topics and approaches. The first cluster of studies [116,117] focuses on theoretical foundations and frameworks for understanding and advancing sustainability transitions via design. Others [118] provide an educational perspective on transition design as a framework for addressing complex sustainability challenges.

Among the methodological approaches identified, Ref. [54] explored the use of alternative futures as a design approach, while Ref. [119] highlighted the importance of modelling complex systems to inform policy-making. Ref. [120] examined the role of participatory design visioning in driving sustainability transitions, and Ref. [121] provided insights into methodological expansion in studying sustainability transitions. Stakeholder engagement and participation consist of a significant topic within the literature. The case study [122] investigated the role of design in specific sustainability transition projects, while Ref. [123]

examined the importance of citizen engagement. Ref. [124] explored design practices that envision sustainable futures, and Ref. [118] emphasized the significance of everyday life and lifestyles in driving sustainability transitions.

Finally, a cluster focusing on social and behavioural aspects of sustainability transitions emerges. Ref. [125] offered insights into the role of behaviour change in sustainability transitions, while Ref. [126] explored the potential of citizen science in advancing sustainability transitions. Figure 6 consists of a visual synthesis of this section, highlighting how philosophies and methodologies progressively align in terms of design principles. A transition towards a more holistic and transdisciplinary approach is highlighted via a shift from user-centred to community-centred design, a shift from the designer as an expert to the designer as a facilitator [127], and a shift from user consultation to co-design [128]. As different design approaches evolve, there is an increasing emphasis on understanding and addressing the needs and aspirations of not just individual users but also broader human communities and ecological systems.

This shift recognizes the interconnectedness and interdependence of various stakeholders and the importance of considering their perspectives and interests in the design process [129]. There is a growing recognition that designers should act as facilitators rather than sole experts. This approach involves promoting collaboration, active participation, and engagement among stakeholders. By adopting a facilitator role, designers can harness diverse stakeholders' collective intelligence and expertise, enabling more inclusive and effective design outcomes [130]. The role of design as a strategic factor for innovation in both production and social contexts is emphasized. Methods that promote participatory [131] design and co-production gain prominence [128,131–135]. Co-design approaches involve actively involving end-users, stakeholders, and communities in the design process, fostering a sense of ownership, empowerment, and shared responsibility. These participatory methods could enhance the quality and legitimacy of proposed solutions, such as socially acceptable and sustainable energy systems [136].

As shown in Figure 6, philosophies intersect and converge with design methodologies. Specifically, the subsequent design methodologies operationalize and expand upon the foundational principles and perspectives of the previously mentioned philosophies, employing them pragmatically to tackle sustainability issues and cultivate beneficial social and environmental outcomes.

3.2. Solutions

Starting from the literature collected in the previous section, this paragraph aims at reorganizing solutions developed in the context of product, service and interaction design that targets the broader topic of sustainability and ET. The solutions identified were clustered into categories in order to provide a wider overview of the possible interventions that could be developed.

In the broad literature of Design for Sustainability and Design for Sustainable Transition, which has emerged as the most comprehensive terms, multiple solutions were identified as the product of designers' efforts. These solutions include Design for Behaviour Change, Communities Engagement, Design for Accessibility, Participatory Design Approaches (User Generated Content and Bottom-Up solutions), Gamification, Educational Tools, and (social media) Campaigns. The following paragraphs aim at systematizing solutions collected online.

Design for Behavior Change theories typically derive from behavioral studies and draw insights from theories such as behavioural economics [137], social norms [138], and motivational design. They aim to understand and influence the psychological factors that drive behaviour change by considering human motivations, attitudes, and values.

The main objectives of the ET are increased energy savings and reduced climate emissions. In addition to developing technological opportunities, attention has long been focused on the importance of behavioural change solutions. This approach emphasizes

environmental and psychological approaches to understanding behaviour, contrasting the previously employed one-dimensional strategies.

The term behavior change encompasses various actions, attitudes, and roles, from interacting with a touchpoint to fundamentally changing one's lifestyle. It is essential to consider the levels at which behavioural change is addressed for sustainability [139], whether at the human, consumer, customer, or user level. These levels involve changes in lifestyle, habits, and actions related to a specific context, service, or scenario. Some solutions focus on defining change dimensions, leveraging the notion that people change their attitudes only when ready [140]. It is crucial to recognize the key moments to prompt action based on the different levels of readiness individuals undergo before implementing change, known as pre-contemplation, contemplation, preparation, action, and maintenance.

In Design for Behaviour Change (DfBC), the architecture of choices is recognized as a highly influential element. Similarly, the effectiveness of a nudge is preferred over imposing an obligation [141], and the opportunity to incentivize people via immediate rewards rather than long-term paybacks is emphasized. The research area of Design for Sustainable Behavior has emerged to explore measures for reducing environmental impact by moderating how people use products, services, and systems [142]. However, the type of change that can be created is complex and multi-layered. For example, it encompasses (i) raising awareness and engagement, (ii) changing energy consumption habits, (iii) transforming work and daily life practices, (iv) making choices regarding energy providers and electric appliances, and (v) actively participating in the smart grid system. Specifically, it is possible to design interventions that promote awareness, sensitization, and engagement to drive behaviour change towards electrification.

The literature discusses strategies to communicate and facilitate social change [143] and the power of social norms in promoting sustainable actions [144]. In addition, consumers' energy consumption habits are crucial in achieving sustainability goals. Studies have examined interventions aimed at home energy conservation [145] and the dynamic interaction between personal norms and environmentally friendly purchasing behaviour [146]. Transforming work and daily living practices is critical to achieving sustainable lifestyles. Research has examined how homeowners interact with smart energy monitor feedback over the long term and the adoption of a practical perspective on energy use [147]. In addition, consumers' choices of energy suppliers and appliances significantly influence their environmental impact. Several studies have examined the effect of green electricity tariffs on low-carbon consumption behaviour [148] and the role of energy labelling in consumers' appliance choices [149,150]. Finally, consumer involvement in the smart grid enables a more efficient and sustainable energy system. Studies have explored feedback, reinforcement, and information to reduce household energy consumption and a contemporary approach to understanding consumer behaviour in household energy use [151].

From a systematic review of theories, methods, and toolkits used in DfBC, it is evident that the trend is to focus more on the individual rather than the community. Among the identified solutions that connect sustainable transition goals with everyday life, persuasive messaging, challenges, and cues are used to guide users towards sustainable choices [152], such as the One-minute shower challenge [153]. Systems for real-time feedback and energy consumption monitoring [154–156] are also employed, as well as educational tools, such as quiz apps about electrification [157], web apps with a real-time map of CO_2 emissions [156], and apps that support the understanding of energy labels [158]. Generally, gamification apps are used to develop and support sustainable habits [159–164]. The interaction provided by these tools allows users to engage with electrification playfully, without the need to discuss responsibility, the urgency of action, the complexity of new technologies, or the need to change consumption habits. Users can gain a deeper understanding of this subject and actively participate in and identify with a community while being able to divide tasks into levels/dimensions/areas to initiate gradual change [165].

Solutions such as Climate Change Campaigns [166–169] bridge the gap between citizens and communities and integrate multiple solutions. Specifically, ActNow [170] promotes tips to be implemented in daily life, proposes challenges to engage communities, offers impact tracker systems for detailed measurement of every action (CO_2, water, energy, waste), and designs storytelling and educational stories. Moreover, the campaign provides materials for sustainable transition communication [171].

As a reference for community-oriented solutions, Ref. [172] extracted success factors from various Community-based behaviour change initiatives. The investigation identifies several solutions targeted at communities, including community-based interventions promoting energy efficiency that adopt a multilevel perspective [173]. Information and awareness-based interventions start with a socio-psychological factor analysis [174] and include eco-district design [175,176], energy-switching programs such as interventions to convert coal-dependent communities [177], and smart technology-focused interventions involving eco-feedback interfaces [178,179], IoT, and AI technologies [180].

3.3. Bottlenecks for Citizens' Engagement

Previous paragraphs emphasize how, in the ET, people and citizens must be actively engaged to leverage the potential for innovative products, strategies and participatory processes [181]. In order to address the diverse sensitivities and priorities of individuals, it is important to relate electrification to processes on three different scales: the individual level, the local context, and the economic, political, and administrative levels.

The call to action for customers towards the sustainable transition is based on two forms of engagement: a pragmatic one and an idealistic one [182]. Pragmatic engagement consists of customers' participation in the electrification process via concrete actions, i.e., the installation, the purchase, or the upgrade of energy devices. The ideal form of engagement is linked to the macro values of sustainable transition, and it engages people via knowledge-building and opinions, ultimately leading to advocacy. ET impacts people's habits and entails a paradigm shift in the system [183,184]. This implies the existence of potential barriers to the adoption of the solutions developed and explored in the previous paragraph. These barriers could influence people's engagement and decision-making processes in daily behaviours towards pro-environmental behaviour, also known as environmentally significant behaviour [185,186].

The literature identifies various barriers linked to the three dimensions: individual, local, and macro-systemic [187]. Specifically, at the individual level, forces such as attitudinal factors, personal needs, and capabilities come into play [188]. At the local level, habits and situational factors act as immediate and specific influences in a given moment and place, such as the surrounding physical environment, the presence of individuals, and perceptual stimuli [189]. Meanwhile, at the macro-systemic level, contextual forces operate, constituting a broader set of influences and conditions that extend beyond the immediate situation, such as social norms, governmental policies, and infrastructures.

Environmental behaviour depends on personal and situational variables in an interactive manner. When a high level of conflict arises between personal and situational variables, the predictive power of attitudes tends to be minimal. In contrast, it tends to be maximal in cases of coherence between them. The influence of situational variables depends on the specific environmental action being considered. In some instances, situational variables were found to be the most significant, while in others, commitment or moral obligation played an essential role [187]. This knowledge is essential for developing a comprehensive framework to guide design research and education for ET. Figure 7 provides an overview of the recognized bottlenecks in the design field.

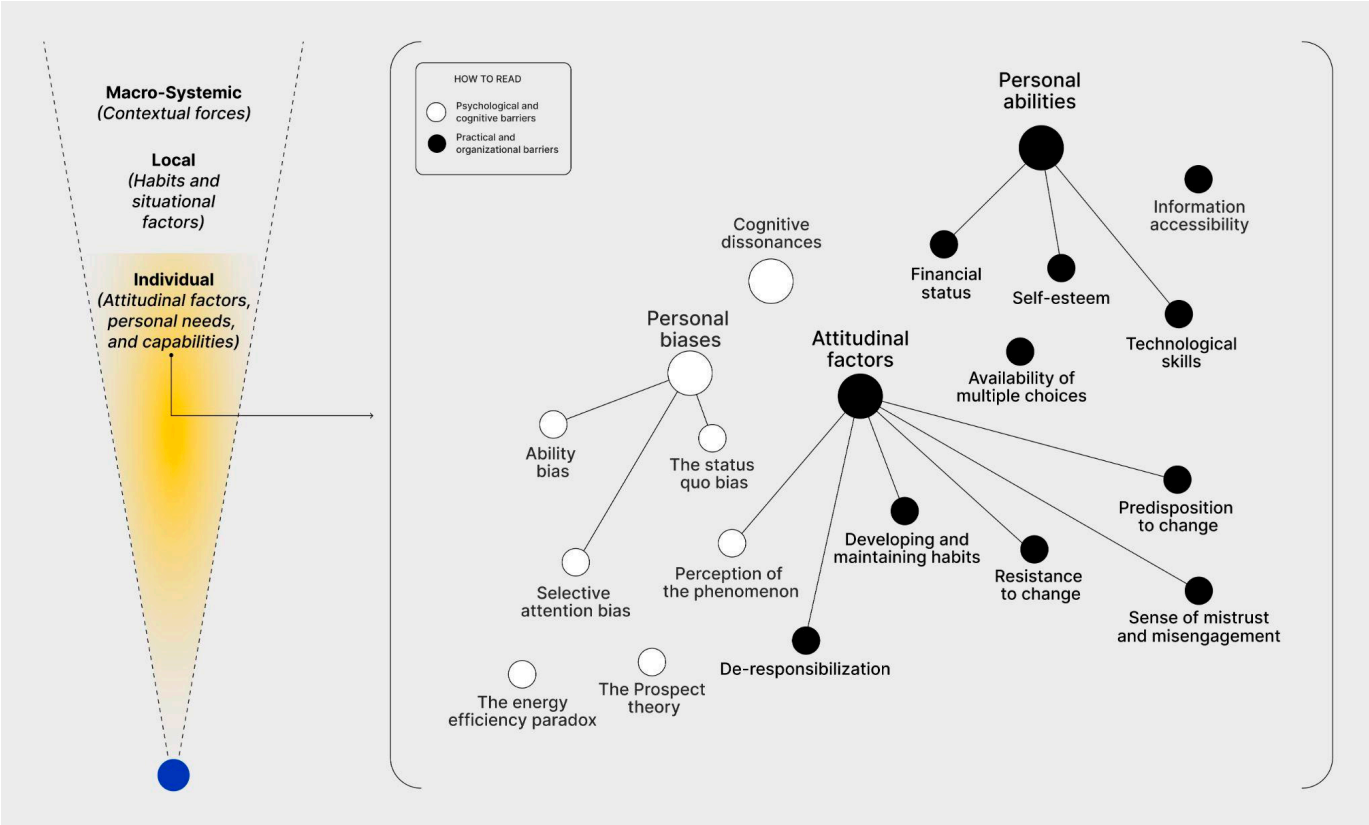

Figure 7. A Systematic visualization of potential bottlenecks in People's Engagement in ET.

Figure 7 endeavours to gather and systematize the primary bottlenecks concerning People's engagement in ET identified by design research. Specifically, it offers a comprehensive overview of factors that have the potential to hinder the generation of effective solutions and hinder the adoption of good practices supporting ET. The visualization predominantly focuses on the principal challenges people may encounter individually. These barriers were categorized into two distinct groups: (i) psychological and cognitive barriers and (ii) practical and organizational barriers.

The primary objective of Figure 7 is to equip designers with invaluable insights into the prospective obstacles they may face while devising effective solutions. As a proactive tool, it empowers designers to anticipate challenges and adapt their design approaches accordingly. This enhanced understanding enables them to allocate their attention and resources more efficiently, especially during the preliminary stages of a project or in subsequent co-design and solution validation activities. By pre-emptively addressing these bottlenecks, designers can enhance the efficacy and feasibility of their solutions, ultimately contributing to a more seamless and successful ET process.

As discussed in the previous paragraphs, the factors that can influence the individual dimension encompass personal capabilities and attitudinal factors. Personal capabilities refer to aspects such as self-esteem, financial availability, and technological skills [190]. These factors significantly shape individuals' attitudes and behaviours towards adopting sustainable practices and technologies. As far as attitudinal factors, bottlenecks tend to refer to a possible resistance to change [191], the difficulty in developing and maintaining new habits [192], a sense of mistrust or disengagement and an individual or altered perception of sustainability topics [192,193].

More specifically, people tend to exhibit innate resistance when faced with the prospect of changing established behaviours and routines, particularly regarding energy consumption patterns; it is almost impossible for the end consumer to break out of this cycle

alone [194]. Overcoming this resistance requires targeted efforts in education and communication to clarify the complex benefits of sustainable energy practices.

The perception of ET itself poses a significant barrier to citizen engagement. Often, the topic is perceived as intricate, technical, and distant in time and space from people's daily lives [195,196]. This perception fuels a sense of detachment and disinterest among citizens, limiting their motivation to participate actively in energy-related discussions and initiatives. A prevalent attitude among citizens is the tendency to shift the responsibility for ET exclusively onto governmental entities, businesses, or other actors, often linked to the belief that an individual's actions can have only a limited impact.

Sustainability as a normative framework is in constant cognitive friction with individual behaviour, reflecting the relationship between personal experience and culture and external factors [192]. This friction creates conflict or incongruence between an individual's cognitions, beliefs, or values and their actual behaviour or choices regarding sustainability. This phenomenon is known as cognitive dissonance [192,197,198] and is the subject of research in the field of Design for Sustainable Behavior, which seeks to address it via solutions such as nudges, public commitment [199], induced hypocrisy [200], or the development of a sustainable consumption pattern [201]. Weder et al. [192] offered interesting findings, which proposed a new version of narrative inquiry to explain sustainability-related cognitive dissonance. The results of conducted tests show that there is often a limited relationship between sustainability and personal experiences. Instead, sustainability is represented by others, such as family members, friends, or culture. Sustainable actions are conceptually linked to a way of life and are followed as part of daily routines. There is a tendency to resort to moral corruption to justify the non-adoption of sustainable behaviours.

Dissonances are not the only possible obstacle to citizen engagement in ET that acts on a psychological-cognitive level. Further cognitive phenomena that can influence the way people process information and make decisions are personal biases [202–204].

Selective attention bias [205] refers to the human tendency to focus only on specific aspects of available information while ignoring or undervaluing other relevant elements. In the context of citizen and designer engagement in ET, attention selectivity can lead to insufficient consideration of important energy-related issues or innovative solutions, thereby limiting citizen participation and interest. The status quo bias [206] refers to people's tendency to prefer the current situation over a change, even if the change could be advantageous or necessary. In the context of ET, this bias can hinder the adoption of new technologies or more sustainable energy practices. The energy efficiency paradox [207] occurs when efficient energy solutions are available, but consumers or organizations do not adopt or fully utilize them. This can be due to factors such as lack of awareness, high initial costs, lack of incentives or motivation, or the illusion that small changes do not significantly impact overall energy consumption.

3.4. ET Complexity and Design Trade-Offs

The analysis of design theories and studies makes evident the complexity of pursuing the goals of ET with respect to solutions for people engagement. The criticalities can be summarized in a list of trade-offs each design initiative could face, including the following:

- Convenience vs. Behavior Change: ET often involves encouraging citizens to adopt new behaviours and practices, such as reducing energy consumption or using renewable energy sources. The trade-off here is between designing solutions that are convenient and easy to use versus requiring significant behaviour changes. Striking a balance between promoting sustainable behaviours and minimizing disruption to citizens' daily lives is crucial;
- Technology vs. User-Friendliness: Introducing new technologies and systems for ET may offer numerous benefits, but they can also present challenges regarding user-friendliness and ease of adoption. The trade-off lies in designing user-friendly interfaces, intuitive controls, and clear instructions to ensure that citizens can easily understand and interact with the technology;

- Cost vs. Affordability: One trade-off is between the cost of implementing ET measures and the affordability for citizens. While certain renewable energy technologies or energy-efficient solutions may have higher upfront costs, they can lead to long-term savings. However, ensuring that these solutions are affordable and accessible to a wide range of citizens can be a challenge;
- Privacy vs. Data Collection: ET initiatives often involve collecting data on citizens' energy consumption patterns to optimize energy efficiency and tailor solutions. However, there is a trade-off between utilizing personal data to improve energy systems and ensuring privacy protection. Balancing data collection and privacy concerns is crucial to building trust and maintaining ethical practices;
- Autonomy vs. System Integration: ET initiatives may require citizens to participate in demand response programs or grid management systems. The trade-off here is between allowing individual autonomy and preferences in energy usage versus integrating citizens' energy consumption into a larger system for better efficiency. Striking a balance between individual control and system optimization is necessary;
- Short-Term vs. Long-Term Impact: Trade-offs can also arise when considering short-term benefits versus long-term sustainability. Some solutions may have immediate positive impacts on energy consumption or emissions reduction, but they might not be sustainable or scalable in the long run. Evaluating trade-offs between immediate benefits and long-term viability is important in designing effective ET solutions.

Depending on the constraints and opportunities characterizing the context, the designers will cope with the specific challenges of the project, finding suitable solutions apt to the local circumstances.

4. ET-Oriented Operational Grid for Design Practice and Education

The vast bibliographic review collected in the research reported in this document constitutes a large basin to which it is possible to refer in the analysis of case studies aimed at producing useful knowledge for ET-oriented design practice and education.

In order to identify the most useful bibliographic resources for each specific intervention context, as a final product of the research, a grid was constructed, which correlates the case studies' characteristics to the most useful contents. The use of the grid requires the identification of the main assets of the case study, namely the following:

- Context (domestic energy management, community engagement, education, . . .);
- Target and involved actors (domestic residents, other actors);
- Type of expected solutions (i.e., a monitoring tool for energy consumption information and metrification; bottom-up solutions via participatory design; educational design tools; systems for circular design, etc.);
- Citizen engagement tasks (i.e., consumption monitoring actions, informed choices about service providers and the purchase of home appliances, efficient use of energy, etc.).

Table 1 summarizes the content of the previous paragraphs in four steps: (i) proposition and pre-requisites, (ii) actors and context research, (iii) benchmarking, and (iv) solution development. The criteria are presented in the form of questions and are accompanied by examples to facilitate understanding, as well as the reference to corresponding paragraphs within the article.

In the following paragraph, some examples show the results that can be obtained by applying the grid to case studies reported in the literature. The application of the grid produces meaningful takeaways of solutions for the critical issues involved in ET-oriented projects. The case studies were chosen to represent different phases of the development of solutions. Specifically, the first case consists of evaluating an existing solution, the second case corresponds to the redesign of a solution that is no longer valid, and the third analyzes some tools and frameworks made available to plan the development of new solutions.

Table 1. ET-oriented operational grid for design practice and education.

Proposition(s) and Prerequisite(s)	Actor(s) and Context(s) Research	Benchmarking	Solution(s) Development
What philosophy guides the approach? (Anthropocentric, Humanist, Post Natural, etc.) [Section 3.1]	**What is the context for which the intervention is designed?** (Current or practices? How would they are modified?) [Section 2.2]	**What key takeaways can be extracted from existing solutions?** Acceptance of the solutions, specific conditions, preferences, etc.)	**Which design action is intended to be developed?** (Product, service, experience, innovation, communication) [Section 3]
Which design paradigm is most appropriate? (Design for Sustainable Transition, Environmental Sustainable Design, Regenerative Design, etc.) [Section 3.1]	**Who is the intervention designed for?** (Any clients, intermediaries, funders, etc.) [Section 2.2]	**What are the obstacles that emerge from existing solutions?** (Psychological, cognitive, practical and organizational barriers) [Section 3.3]	**Which solution is intended to be designed?** (Design for Behaviour Change, Communities Engagement, Gamification, Educational Tools, etc.) [Section 3.2]
What level of involvement is envisioned with the target of the solution? (Top-down design, Consultation, Co-design, etc.) [Section 3.1]	**Who are the main actors, and what is their model of interaction?** (Identifying needs, design gaps, and collaboration opportunities) [Section 2.3]		**How should the proposed solution be validated?** (User testing, workshops, interviews, trial periods, etc.)
What is the primary objective? (To inform, to engage, to empower, to support, etc.) [Section 3]	**What tasks for people engagement are intended to be promoted?** (Awareness, Action, or their respective sub-tasks)		

4.1. ApplianceNet: A Domestic Energy Management Solution

The first case study analyzed via the grid is reported in the paper "ApplianceNet: a neural network based framework to recognize dailylife activities and behavior in smart home using smart plugs" [154]. It was published in 2022, and it is a study conducted in collaboration with Queens University Belfast (Belfast, UK), the University of West of England (Bristol, UK), and the College of Technological Innovation, Zayed University (Dubai, United Arab Emirates). It focuses on energy management in domestic environments and aims at empowering and supporting citizens. This academic research introduces a novel framework, ApplianceNet, leveraging smart plugs to analyze the energy consumption patterns of home appliances. The framework employs a multi-layer, feed-forward neural network to intelligently process the collected time-series data and classify activities and behaviour. The performance of ApplianceNet is evaluated using a publicly available real homes dataset, demonstrating its effectiveness in recognizing daily life activities. The results indicate a significant improvement over existing methods. Moreover, the proposed framework is simple to implement and compatible with existing home infrastructure.

This specific solution requires that the citizens are involved in tasks such as developing capacity and awareness about monitoring electrical consumption and making informed energy choices about suppliers and domestic appliances. The case study promotes the following solutions to involve behaviour change and design for accessibility:

- Data-driven approach. The study emphasizes the importance of utilizing data-driven approaches to identify various energy usage applications from a customer's perspective. These applications include reducing utility bills, contributing to global warming reduction, non-intrusive monitoring of daily activities, and monitoring behaviours;
- Tailored solutions based on customers' existing appliances. The study focuses on recognizing the status and technological opportunities of home appliances owned by customers to develop a customized solution. The final solution is derived from a framework designed for energy monitoring devices, ensuring reproducibility;

- Non-intrusiveness and integration with existing infrastructure. After considering a wide range of possibilities, the project reflects on the intrusiveness acceptable to customers and selects the most suitable solution (unobtrusive). The proposed solution seamlessly integrates with the existing home infrastructure without compromising residents' privacy or requiring additional sensors that may affect aesthetics or complicate interaction;
- Consideration of effort and personalization. The study delves into the effort customers require during different phases, including installation and actual product usage. The effort is evaluated based on the information and personal capacity needed to use the device and the economic investment necessary for its functionality;
- Customizability and freedom of device usage. Once adopted by the customer, the study emphasizes the importance of allowing space for personalization;
- Accessible presentation of results. The study highlights the need to present results in an accessible format to facilitate identifying and recognizing patterns for behaviour change. For example, time intervals can organize results, such as distinguishing electricity consumption during meals.

The critical limitations of the experiment can be summarized as follows:

- Lack of Prompts or Next Steps Guidance. Visualizing and presenting usage patterns alone may not be sufficient to activate sustainable actions and induce changes in consumer routines. Additionally, consumers may become habituated to the device over time, potentially leading to disregard or ignorance of its recommendations;
- User Acceptance and Adoption. The study assumes that consumers will readily accept and adopt the proposed solution. However, there may be challenges related to consumer acceptance, willingness to invest in the required devices, and the learning curve associated with utilizing the system effectively. These factors could limit the widespread adoption of the framework;
- Privacy Concerns. Although the study emphasizes the non-intrusive nature of the proposed solution and its integration with existing home infrastructure, privacy concerns may still exist. Some consumers may be hesitant to have their daily activities and behaviours monitored, even if it is for energy optimization purposes. Addressing privacy concerns and ensuring data security are important considerations in implementing such frameworks.

4.2. Best Practices in Sustainable Transition for Coal-Dependent Communities

The second case study was chosen as an example of community-driven practice. It is described by Tarekegne et al. in the document "Coal-dependent Communities in Transition: Identifying Best Practices to Ensure Equitable Outcomes" [177] and was published in 2021. The research was developed for the U.S. Department of Energy under Contract by the Pacific Northwest National Laboratory and aimed at the sustainable transition of coal-dependent communities.

According to Tarekegne et al., the U.S. coal industry is witnessing a significant increase in the retirement and decommissioning of coal-fired power plants. This shift in the energy production landscape has profound social, environmental, and economic implications for communities reliant on coal. To explore the decommissioning process and ensure fairness, the authors examine the role of communities and present best practices identified by them. In the resulting report, four case studies were analyzed: Wise County, VA; Anderson County, TN; Muskegon, MI; and Becker, MN. These case studies provide insights into the impacts of decommissioning and highlight community-driven best practices. They include solutions based on participatory design and community engagement. The document claims: «The need to acknowledge community members as stakeholders in the ET process is critical, not only because there is no existing framework that identifies a public participation role for affected communities, but also because these communities were historically denied the right to oversee how energy decisions affect them» [177].

The citizens were engaged in tasks such as identifying the components of an equitable ET, making informed energy choices regarding management models, and co-generation. The case study analysis produced the following takeaways:

- Community-based decision making. It is crucial for equitable decommissioning processes, recognize no universal development plan for transitioning from coal power;
- Tailoring strategies to individual communities and extracting tailored best practices. Each community's trajectory via decommissioning is unique, and considering their specific needs and preferences in ET is of paramount importance. The overall impact consideration: community impacts of power plant decommissioning extend beyond job and revenue losses, encompassing cultural, social, environmental, and long-term health-related effects that should be acknowledged and addressed;
- Commonly identified decommissioning best practices. They include early and continued community engagement via various communication channels, early planning of post-decommissioning projects, recognition and mitigation of social impacts, transparency throughout the process, identification of funding sources and technical expertise, and acknowledging communities as stakeholders with decision making rights;
- Assistance for coal-dependent communities in ET. To facilitate knowledge sharing and decision making, assistance can be provided via technical assessments for alternative site uses or new technologies, cross-partnership engagement and collaboration, financial support via grants and loans for redevelopment surveys, job creation, and environmental cleanup costs;
- Importance of long-term interventions. It requires equal consideration of the pre-, during and post-intervention phases.

The solutions are tailored specifically to each context, which is a key factor for the success of the initiatives. Reducing the scale of intervention and targeting specific groups or areas is often recommended. However, at the same time, having overly specific solutions may risk placing essential decisions in the hands of the community itself, which may not have the necessary tools to comprehend the consequences or explore alternative possibilities fully.

4.3. Circular Design Guide for Solutions Development

The third and last case study is the work-in-progress project The Circular Design Guide [208]. The reported Circular Design Guide is a collaboration between the Ellen MacArthur Foundation and IDEO, made for designers and innovators. The current paradigm shift in public and private management practices revolves around transitioning from linear to circular models. This resource aims to guide innovators seeking to develop advanced, efficient solutions within the circular economy framework. This resource empowers users to explore novel approaches to generate sustainable, resilient, and enduring value within the circular economy. Although primarily oriented towards the manufacturing and product domains of the private sector, it also offers insights for public sector organizations seeking to embrace circular models, either in external support or internal operations. This resource provides comprehensive, step-by-step instructions on adopting circular methodologies and mindsets. Distinct phases represent a structured approach to design for innovation, enabling practitioners to navigate the complexities of the circular design process and maximize its potential for creating sustainable and impactful solutions. Rich multimedia content such as videos, case studies, and supplementary resources accompany the guidance provided. Additionally, the resource encompasses practical tools for implementing circular strategies, including worksheets and pre-packaged workshops complete with facilitator guides, video lectures, and presentations. The key takeaways include many activities lined up for designers to release innovative solutions:

- Understand. Acquiring information about circular design solutions and developing a deeper understanding of transitioning from linear to circular thinking. This phase involves gaining insights into the principles and practices of circular design;

- Define. Articulate the challenge you aim to explore and establish specific project objectives. It entails identifying ongoing opportunities for circularity, whether you are just starting out or re-evaluating an existing solution. This phase focuses on defining the scope and direction of the project;
- Make. Understanding the needs of all users in your value chain, identifying opportunities to generate ideas, and developing and selecting concepts. This phase emphasizes the tangible design aspect, involving creating prototypes and iterative testing to refine the solutions;
- Release. Launching the developed concept into the market to continuously gather feedback to enhance the product, service, and overall business. This phase encompasses understanding how to foster new partnerships and drive organizational change to support circularity.

The main opportunities derived from the circular design approach are as follows:

- Empowerment and Ownership. Engaging citizens in the circular design process allows them to actively participate and take ownership of ET. By involving citizens in decision making, their perspectives, needs, and preferences can be considered, fostering a sense of empowerment, and creating a more inclusive and equitable transition;
- Collaborative Ecosystems. The circular design encourages collaboration and partnerships among stakeholders, including businesses, consumers, and waste management organizations. These collaborations can lead to innovative solutions that address systemic challenges and create shared value across the value chain.

The analysis evidences the following criticalities:

- Technological Barriers. Implementing circular design principles in the energy sector may require advanced technologies and infrastructure that are not readily available or cost-effective;
- Limited Awareness and Knowledge. Citizen awareness and understanding of circular design concepts and their implications for ET may be limited;
- Behavior Change and Adoption. Transitioning to a circular design approach requires changes in consumer behaviour and the adoption of new practices;
- Scalability and Systemic Change: Scaling up circular solutions requires coordinated efforts, investment, and collaboration among multiple actors, which may face resistance and inertia from existing linear models.

5. Conclusions

This research document emphasizes the crucial role of design practice and education in contributing to ET's goals and values. The authors stress the need for increased attention and commitment from all social actors to achieve a clean, sustainable, and accessible energy future. Recognizing the complexity of ET, the research calls for a cultural effort to foster dialogue and collaboration among diverse disciplines to effectively manage the inevitable friction associated with this profound change. While ET initiatives concentrate on infrastructures and systems, the document highlights the significance of engaging citizens and stakeholders in social dialogues. By promoting awareness and actions, the involvement of all actors becomes instrumental in facilitating lasting behaviour change and adopting sustainable practices. With its unique theoretical frameworks and project expertise, design can contribute meaningfully to ET. In the face of partially predictable long-term impacts of ET, designers can play a crucial role in constructing multi-disciplinary project environments and managing complex system descriptions. Ultimately, the document seeks to inspire greater engagement of designers in ET, fostering collaborative efforts, innovation, and solutions for a sustainable and prosperous future.

The research summarized in this document aims to collect relevant insights for design and design education addressed to the goals and values of ET. The knowledge gap we intend to cover is the availability of synthetic yet not superficial knowledge supporting the understanding of the ET objectives and guidelines. The preliminary studies of the research

presented in this paper revealed the scarce engagement of designers in the field of ET and the lack of roadmaps apt to orient the commitment of designers acting as researchers, practitioners, or teachers willing to contribute to the ET goals. Furthermore, during the work performed on the UE documents, the paper authors developed an awareness of the possible contributions that the disciplines of design—including service and communication design and design for experience—could offer to the achievement of the ET objectives. The research efforts were then oriented toward the production of maps to facilitate the understanding of ET.

According to the EU guidelines, the most impacting initiatives in ET concern infrastructures and systems; on the other hand, we point out the importance of focusing on the engagement of all citizens and social actors in the social dialogue about this topic, so to favour awareness, sense of responsibility, and the generation of bottom-up solutions. Fostering participation and facilitating durable behaviour change, enabling the adoption of sustainable behaviours, understanding the needs and potentials of local contexts, and inventing products, services, and socio-technical systems are activities that can bring a meaningful contribution to ET. To these purposes, design theories and project skills can play an important part, exploiting specific competencies and expertise.

The principles of Value Sensitive Design and the design approaches focused on experience can be crucial in providing a holistic description of possible scenarios and alternatives, favouring co-design and participating initiatives to devise solutions apt to encounter users' needs and constraints.

The techniques for design research, including design ethnography, digital ethnography, and contextual design, provide tools and methodologies for investigating behaviours and activities and revealing mental models, attitudes, and preferences. The expertise in human-centred design provides the means for user profiling and service personalization; experience design allows the development of solutions capable of encountering material and non-tangible needs.

ET will enact transformations that will produce impacts only partially predictable in advance. In long-term transformation processes, designers can also play a role in constructing multi-disciplinary project environments and managing complex descriptions of systems and scenarios.

Design can also play a role on a higher level to address economic aspects. Considering an anthropological definition, Fry states the ability of design to prefigure what we create before the act of creating, arguing for an economic paradigm shift led by design [209].

In the context of ET, this ability of design to prefigure alternative futures and, in particular, pluralistic alternative futures [210] can be applied to solve (i) the divide on priorities in ET between EU member states with lower levels of economic development and leading countries; and (ii) the lack of consensus on how fast the transition should and can take place.

Further development of this study can encompass both the strategic application of design as a primary agent of economic change and the use of the proposed conceptual maps as enable for designers and other subjects in the development of ET solutions.

Author Contributions: Conceptualization, M.P., F.C. and V.C.; methodology, M.P. and F.C.; software, V.C.; validation, V.C.; formal analysis, M.P. and F.C.; investigation, V.C.; resources, M.P., F.C. and V.C.; data curation, M.P. and F.C.; writing—original draft preparation, V.C.; writing—review and editing, M.P. and F.C.; visualization, V.C.; supervision, M.P. and F.C.; project administration, M.P.; funding acquisition, M.P. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. 2050 Long-Term Strategy. Available online: https://climate.ec.europa.eu/eu-action/climate-strategies-targets/2050-long-term-strategy_en (accessed on 27 July 2023).
2. Harichandan, S.; Kar, S.K.; Bansal, R.; Mishra, S.K.; Balathanigaimani, M.S.; Dash, M. Energy Transition Research: A Bibliometric Mapping of Current Findings and Direction for Future Research. *Clean. Prod. Lett.* **2022**, *3*, 100026. [CrossRef]
3. Qiao, W.; Yin, X. Understanding the Impact on Energy Transition of Consumer Behavior and Enterprise Decisions through Evolutionary Game Analysis. *Sustain. Prod. Consum.* **2021**, *28*, 231–240. [CrossRef]
4. Mundaca, L.; Samahita, M.; Sonnenschein, J.; Seidl, R. Behavioural Economics for Energy and Climate Change Policies and the Transition to a Sustainable Energy Use—A Scandinavian Perspective. In *Energy and Behaviour*; Elsevier: Amsterdam, The Netherlands, 2020; pp. 45–87. ISBN 978-0-12-818567-4.
5. del Guayo, Í.; Cuesta, Á. Towards a Just Energy Transition: A Critical Analysis of the Existing Policies and Regulations in Europe. *J. World Energy Law Bus.* **2022**, *15*, 212–222. [CrossRef]
6. Faure-Schuyer, A.; Welsch, M.; Pye, S. European Energy Policy Objectives. In *Europe's Energy Transition—Insights for Policy Making*; Elsevier: Amsterdam, The Netherlands, 2017; pp. 31–39, ISBN 978-0-12-809806-6.
7. Khan, K.; Su, C.W. Does Technology Innovation Complement the Renewable Energy Transition? *Environ. Sci. Pollut. Res.* **2022**, *30*, 30144–30154. [CrossRef]
8. The EU Needs More Public Investment in Energy Infrastructure to Fight Climate Change. Available online: https://www.eesc.europa.eu/en/news-media/news/eu-needs-more-public-investment-energy-infrastructure-fight-climate-change (accessed on 14 June 2023).
9. McKinsey and Company. *Preparing for Energy Transition in Infrastructure*; McKinsey and Company: New York, NY, USA, 2021.
10. Kotek, P.; Granado, P.C.D.; Egging, R.; Toth, B.T. European Natural Gas Infrastructure in the Energy Transition. In Proceedings of the 2019 16th International Conference on the European Energy Market (EEM), Ljubljana, Slovenia, 18–20 September 2019; pp. 1–6.
11. Polzin, F.; Sanders, M. How to Finance the Transition to Low-Carbon Energy in Europe? *Energy Policy* **2020**, *147*, 111863. [CrossRef]
12. IEA. *Financing Clean Energy Transitions in Emerging and Developing Economies*; IEA: Paris, France, 2021.
13. Faure-Schuyer, A.; Welsch, M.; Pye, S. A Market-Based European Energy Policy. In *Europe's Energy Transition—Insights for Policy Making*; Elsevier: Amsterdam, The Netherlands, 2017; pp. 41–48, ISBN 978-0-12-809806-6.
14. Deane, P.; Collins, S.; Gallachóir, B.Ó.; Eid, C.; Hartel, R.; Keles, D.; Fichtner, W. Impact on Electricity Markets. In *Europe's Energy Transition—Insights for Policy Making*; Elsevier: Amsterdam, The Netherlands, 2017; pp. 105–118, ISBN 978-0-12-809806-6.
15. Dehler, J.; Keles, D.; Telsnig, T.; Fleischer, B.; Baumann, M.; Fraboulet, D.; Faure-Schuyer, A.; Fichtner, W. Self-Consumption of Electricity from Renewable Sources. In *Europe's Energy Transition—Insights for Policy Making*; Elsevier: Amsterdam, The Netherlands, 2017; pp. 225–236, ISBN 978-0-12-809806-6.
16. Pye, S.; Dobbins, A.; Baffert, C.; Brajković, J.; Deane, P.; De Miglio, R. Energy Poverty Across the EU. In *Europe's Energy Transition—Insights for Policy Making*; Elsevier: Amsterdam, The Netherlands, 2017; pp. 261–280, ISBN 978-0-12-809806-6.
17. Morena, E.; Krause, D.; Stevis, D. (Eds.) . *Just Transitions: Social Justice in the Shift Towards a Low-Carbon World*; Pluto Press: London, UK, 2019; ISBN 978-1-78680-532-4.
18. Ge, T. A Conceptual Framework for Assessing Social and Environmental Impacts of Belt and Road Initiative and Just Energy Transition. *Front. Sustain. Food Syst.* **2022**, *6*, 982086. [CrossRef]
19. International Cooperation in Clean Energy. Available online: https://research-and-innovation.ec.europa.eu/research-area/energy/international-cooperation-clean-energy_en (accessed on 14 June 2023).
20. Un Green Deal Europeo. Available online: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_it (accessed on 1 June 2023).
21. European Parliament, Directorate General for Parliamentary Research Services. EU Framework Programmes for Research and Innovation: Evolution and Key Data from FP1 to Horizon 2020 in View of FP9: In Depth Analysis. Available online: https://www.europarl.europa.eu/thinktank/en/document/EPRS_IDA(2017)608697 (accessed on 19 July 2023).
22. National Energy and Climate Plans. Available online: https://commission.europa.eu/energy-climate-change-environment/implementation-eu-countries/energy-and-climate-governance-and-reporting/national-energy-and-climate-plans_en (accessed on 1 June 2023).
23. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions United in Delivering the Energy Union and Climate Action—Setting the Foundations for a Successful Clean Energy Transition. Available online: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52019DC0285 (accessed on 19 July 2023).
24. European Union. *Types of Institutions, Bodies and Agencies*. Available online: https://european-union.europa.eu/institutions-law-budget/institutions-and-bodies/types-institutions-and-bodies_en (accessed on 19 July 2023).
25. Group of Chief Scientific Advisors. Available online: https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/scientific-support-eu-policies/group-chief-scientific-advisors_en (accessed on 1 June 2023).
26. Designing Building Decarbonisation Policies for a Socially Just Energy Transition > BPIE—Buildings Performance Institute Europe. Available online: https://www.bpie.eu/publication/designing-building-decarbonisation-policies-for-a-socially-just-energy-transition/ (accessed on 1 June 2023).

27. Put People at the Heart of Energy Transition Policies, EU Chief Scientific Advisors Recommend. Available online: https://research-and-innovation.ec.europa.eu/news/all-research-and-innovation-news/put-people-heart-energy-transition-policies-eu-chief-scientific-advisors-recommend-2021-06-29_en (accessed on 1 June 2023).
28. Research and Innovation. Q&A: "People Have to Be at the Centre of the Energy Transformation". Available online: https://ec.europa.eu/research-and-innovation/en/horizon-magazine/qa-people-have-be-centre-energy-transformation (accessed on 1 June 2023).
29. Research and Innovation. Green Deal Projects Support Office. Available online: https://ec.europa.eu/research-and-innovation/en/strategy/strategy-2020-2024/environment-and-climate/european-green-deal/green-deal-projects-support (accessed on 1 June 2023).
30. IEA. Empowering People to Act: How Awareness and Behaviour Campaigns Can Enable Citizens to Save Energy during and beyond Today's Energy Crisis. Available online: https://www.iea.org/commentaries/empowering-people-to-act-how-awareness-and-behaviour-campaigns-can-enable-citizens-to-save-energy-during-and-beyond-today-s-energy-crisis (accessed on 1 June 2023).
31. EU4Energy-Promoting the Clean Energy Transition-Empowering Consumers through Better Regulation. Available online: https://euneighbourseast.eu/projects/eu-project-page/ (accessed on 1 June 2023).
32. BUILD UP: The European Portal for Energy Efficiency in Buildings. Phoenix H2020. Available online: https://build-up.ec.europa.eu/en/home (accessed on 19 July 2023).
33. The European Learning Community for Future-Proof Cities. Energy Cities. Available online: https://energy-cities.eu/community-energy-for-future-proof-cities/ (accessed on 19 July 2023).
34. EEAS. Awareness and Action for Environment Protection. Available online: https://www.eeas.europa.eu/node/63659_en (accessed on 19 July 2023).
35. Awareness Raising Campaigns for Stakeholders' Behavioural Change. Available online: https://climate-adapt.eea.europa.eu/en/metadata/adaptation-options/awareness-campaigns-for-behavioural-change (accessed on 19 July 2023).
36. Make It Green. Available online: https://next-generation-eu.europa.eu/make-it-green_en (accessed on 19 July 2023).
37. EEAS. Campaigns. Available online: https://www.eeas.europa.eu/eeas/campaigns_en (accessed on 19 July 2023).
38. Mobility Strategy. Available online: https://transport.ec.europa.eu/transport-themes/mobility-strategy_en (accessed on 19 July 2023).
39. Efficient and Green Mobility. Available online: https://transport.ec.europa.eu/news-events/news/efficient-and-green-mobility-2021-12-14_en (accessed on 19 July 2023).
40. Saving Energy. Available online: https://www.iea.org/topics/saving-energy (accessed on 19 July 2023).
41. ENEA. Energy: 20 Tips to Save on Your Bills. Available online: https://www.enea.it/en/news-enea/news/energy-20-tips-to-save-on-your-electric-bill (accessed on 19 July 2023).
42. Energy Efficiency Directive. Available online: https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficiency-targets-directive-and-rules/energy-efficiency-directive_en (accessed on 19 July 2023).
43. EUSEW Awards 2023. Available online: https://sustainable-energy-week.ec.europa.eu/awards_en (accessed on 19 July 2023).
44. Advancing Sustainable Energy for Europe. Available online: https://www.eeef.lu/home.html (accessed on 19 July 2023).
45. European Partnerships in Climate, Energy and Mobilit. Available online: https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/european-partnerships-horizon-europe/climate-energy-and-mobility_en (accessed on 19 July 2023).
46. Community Energy Programs. Available online: https://www.energy.gov/scep/community-energy-programs (accessed on 19 July 2023).
47. SEAI. Do Stage | SEC. Available online: https://www.seai.ie/community-energy/sustainable-energy-communities/energy-community-programm/ (accessed on 19 July 2023).
48. EEA Grants. Renewable Energy. Available online: https://eeagrants.org/topics-programmes/climate-change-and-renewable-energy/renewable-energy (accessed on 19 July 2023).
49. Public Consultations and Other Consultation Activities—Employment, Social Affairs & Inclusion—European Commission. Available online: https://ec.europa.eu/social/main.jsp?catId=333&langId=en (accessed on 19 July 2023).
50. Contributing to Law-Making through Public Consultations and Giving Feedback. Available online: https://commission.europa.eu/about-european-commission/service-standards-and-principles/transparency/consultations_en (accessed on 19 July 2023).
51. CIVICITI: THE CITIZEN PARTICIPATION PLATFORM | Civiciti Project | Fact Sheet | H2020. Available online: https://cordis.europa.eu/project/id/828439 (accessed on 19 July 2023).
52. Infrastructure for Civil Society. Available online: https://www.europeanhub.org/ (accessed on 19 July 2023).
53. Gifford, R. The Dragons of Inaction: Psychological Barriers That Limit Climate Change Mitigation and Adaptation. *Am. Psychol.* **2011**, *66*, 290–302. [CrossRef]
54. Angheloiu, C.; Sheldrick, L.; Tennant, M. Future Tense: Exploring Dissonance in Young People's Images of the Future through Design Futures Methods. *Futures* **2020**, *117*, 102527. [CrossRef]
55. Marres, N. *Material Participation: Technology, the Environment and Everyday Publics*; Palgrave Macmillan: Basingstoke, UK, 2012; ISBN 978-1-137-02966-9.

56. Kopnina, H. Anthropocentrism and Post-Humanism. In *The International Encyclopedia of Anthropology*; Wiley: Hoboken, NJ, USA, 2019; ISBN 978-1-118-92439-6.
57. Pea, R. User Centred System Design-New Perspectives on Human/Computer Interaction. *J. Educ. Comput. Res.* **1987**, *3*, 129–134.
58. Schwabbauer, M.L. Use of the Latent Image Technique to Develop and Evaluate Problem-Solving Skills. *Am. J. Med. Technol.* **1975**, *41*, 457–462.
59. Nielsen, J.; Molich, R. Heuristic Evaluation of User Interfaces. In Proceedings of the International Conference on Human Factors in Computing Systems, Seattle, WA, USA, 1–5 April 1990.
60. Gaver, B.; Dunne, T.; Pacenti, E. Design: Cultural Probes. *Interactions* **1999**, *6*, 21–29. [CrossRef]
61. *The Persona Lifecycle*; Elsevier: Amsterdam, The Netherlands, 2006; ISBN 978-0-12-566251-2.
62. Lockton, D.; Cain, R.; Harrison, D.; Giudice, S.; Nicholson, L.; Jennings, P. Behaviour Change at Work: Empowering Energy Efficiency in the Workplace through User-Centred Design. UC Berkeley: Behavior, Energy and Climate Change Conference. 2011. Available online: https://escholarship.org/uc/item/6ww5h5jm (accessed on 19 July 2023).
63. Baedeker, C.; Piwowar, J.; Themann, P.; Grinewitschus, V.; Krisemendt, B.; Lepper, K.; Zimmer, C.; Von Geibler, J. Interactive Design to Encourage Energy Efficiency in Offices: Developing and Testing a User-Centered Building Management System Based on a Living Lab Approach. *Sustainability* **2020**, *12*, 6956. [CrossRef]
64. Kotsopoulos, D.; Bardaki, C.; Papaioannou, T.G.; Lounis, S.; Pramatari, K. Agile User-Centered Design of an Iot-Enabled Gamified Intervention for Energy Conservation at the Workplace. *IADIS Int. J. WWWINTERNET* **2018**, *16*, 1–25. [CrossRef]
65. Vilarinho, T.; Farshchian, B.; Wienhofen, L.W.M.; Franang, T.; Gulbrandsen, H. Combining Persuasive Computing and User Centered Design into an Energy Awareness System for Smart Houses. In Proceedings of the 2016 12th International Conference on Intelligent Environments (IE), London, UK, 14–16 September 2016; pp. 32–39.
66. Gulbinas, R.; Jain, R.K.; Taylor, J.E. BizWatts: A Modular Socio-Technical Energy Management System for Empowering Commercial Building Occupants to Conserve Energy. *Appl. Energy* **2014**, *136*, 1076–1084. [CrossRef]
67. Motivating and Quantifying Energy Efficient Behavior among Commercial Building Occupants—ProQuest. Available online: https://www.proquest.com/openview/88de3def56151b2aff7a8b517745e9dd/1?cbl=18750&pq-origsite=gscholar&parentSessionId=MrfxWMbfEpdy1idjzlqOzhEZE%2BdekohHBd2ja7Y%2Fhkg%3D (accessed on 19 July 2023).
68. Gulbinas, R.; Jain, R.K.; Taylor, J.E.; Peschiera, G.; Golparvar-Fard, M. Network Ecoinformatics: Development of a Social Ecofeedback System to Drive Energy Efficiency in Residential Buildings. *J. Comput. Civil Eng.* **2014**, *28*, 89–98. [CrossRef]
69. Fadhlurrohman, F.N.; Winarsih, N.A.S.; Rohman, M.S.; Saraswati, G.W. User Interface Design for Solar Panel Monitoring System on Android Smartphones Using User-Centered Design Method. In Proceedings of the 2020 International Seminar on Application for Technology of Information and Communication (iSemantic), Semarang, Indonesia, 19–20 September 2020; pp. 625–629.
70. Hasan, A.; Ismail, N.A.; Ismail, B.; Hamid, S.; Madni, H.; Ali, J.; Sahar, G. User-Centred Design and Usability Evaluation of Smart Home Energy Management System. *Int. J. Innov. Res. Sci. Eng. Technol.* **2021**, *3*, 1.
71. Dalén, A.; Krämer, J. Towards a User-Centered Feedback Design for Smart Meter Interfaces to Support Efficient Energy-Use Choices: A Design Science Approach. *Bus. Inf. Syst. Eng.* **2017**, *59*, 361–373. [CrossRef]
72. 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]
73. Jain, R.K. Building Eco-Informatics: Examining the Dynamics of Eco-Feedback Design and Peer Networks to Achieve Sustainable Reductions in Energy Consumption. Ph.D. Thesis, Columbia University: New York, NY, USA, 2013. [CrossRef]
74. Paone, A.; Bacher, J.-P. The Impact of Building Occupant Behavior on Energy Efficiency and Methods to Influence It: A Review of the State of the Art. *Energies* **2018**, *11*, 953. [CrossRef]
75. Irizar-Arrieta, A.; Casado-Mansilla, D.; Garaizar, P.; López-de-Ipiña, D.; Retegi, A. User Perspectives in the Design of Interactive Everyday Objects for Sustainable Behaviour. *Int. J. Hum.-Comput. Stud.* **2020**, *137*, 102393. [CrossRef]
76. Böhm, G.; Doran, R.; Rødeseike, A.; Pfister, H.-R. Pathways to Energy Transition: A Faceted Taxonomy. *Int. Stud. Manag. Organ.* **2019**, *49*, 303–319. [CrossRef]
77. Nardi, B. Design in the Age of Climate Change. *She Ji J. Des. Econ. Innov.* **2019**, *5*, 5–14. [CrossRef]
78. Praskievicz, S. How the Environment Became Global. *Anthropocene* **2021**, *35*, 100305. [CrossRef]
79. Buchanan, R. Design Research and the New Learning. *Des. Issues* **2001**, *17*, 3–23. [CrossRef]
80. Sanders, E.B.-N.; Stappers, P.J. Co-Creation and the New Landscapes of Design. *CoDesign* **2008**, *4*, 5–18. [CrossRef]
81. Bardzell, J.; Bardzell, S. What Is "Critical" about Critical Design? In Proceedings of the Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, Paris, France, 27 April 2013; pp. 3297–3306.
82. Zimmerman, J.; Forlizzi, J.; Evenson, S. Research through Design as a Method for Interaction Design Research in HCI. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, San Jose, CA, USA, 29 April 2007; pp. 493–502.
83. Costanza-Chock, S. *Design Justice: Community-Led Practices to Build the Worlds We Need*; Information policy; The MIT Press: Cambridge, MA, USA; London, UK, 2020; ISBN 978-0-262-04345-8.
84. Martusewicz, R.A.; Edmundson, J.; Lupinacci, J. *Ecojustice Education: Toward Diverse, Democratic, and Sustainable Communities*, 3rd ed.; Sociocultural, political, and historical studies in education series; Routledge, Taylor & Francis Group: New York, NY, USA; London, UK, 2021; ISBN 978-0-367-02972-2.
85. Eizenberg, E.; Jabareen, Y. Social Sustainability: A New Conceptual Framework. *Sustainability* **2017**, *9*, 68. [CrossRef]

86. Wu, J. Landscape Sustainability Science: Ecosystem Services and Human Well-Being in Changing Landscapes. *Landsc. Ecol.* **2013**, *28*, 999–1023. [CrossRef]
87. Lippeveld, T. Routine Health Facility and Community Information Systems: Creating an Information Use Culture. *Glob. Health Sci. Pract.* **2017**, *5*, 338–340. [CrossRef]
88. Miller, C.A.; Wyborn, C. Co-Production in Global Sustainability: Histories and Theories. *Environ. Sci. Policy* **2020**, *113*, 88–95. [CrossRef]
89. Kolstad, E.W.; Sofienlund, O.N.; Kvamsås, H.; Stiller-Reeve, M.A.; Neby, S.; Paasche, Ø.; Pontoppidan, M.; Sobolowski, S.P.; Haarstad, H.; Oseland, S.E.; et al. Trials, Errors, and Improvements in Coproduction of Climate Services. *Bull. Am. Meteorol. Soc.* **2019**, *100*, 1419–1428. [CrossRef]
90. Mach, K.J.; Lemos, M.C.; Meadow, A.M.; Wyborn, C.; Klenk, N.; Arnott, J.C.; Ardoin, N.M.; Fieseler, C.; Moss, R.H.; Nichols, L.; et al. Actionable Knowledge and the Art of Engagement. *Curr. Opin. Environ. Sustain.* **2020**, *42*, 30–37. [CrossRef]
91. Hinrichs, C.C. Transitions to Sustainability: A Change in Thinking about Food Systems Change? *Agric. Hum. Values* **2014**, *31*, 143–155. [CrossRef]
92. Kibert, C. *Sustainable Construction: Green Building Design and Delivery*; Wiley: Hoboken, NJ, USA, 2008.
93. D'Oca, S.; Hong, T.; Langevin, J. The Human Dimensions of Energy Use in Buildings: A Review. *Renew. Sustain. Energy Rev.* **2018**, *81*, 731–742. [CrossRef]
94. Longo, F.; Nicoletti, L.; Padovano, A. Smart Operators in Industry 4.0: A Human-Centered Approach to Enhance Operators' Capabilities and Competencies within the New Smart Factory Context. *Comput. Ind. Eng.* **2017**, *113*, 144–159. [CrossRef]
95. Broman, G.I.; Robèrt, K.-H. A Framework for Strategic Sustainable Development. *J. Clean. Prod.* **2017**, *140*, 17–31. [CrossRef]
96. Shapira, H.; Ketchie, A.; Nehe, M. The Integration of Design Thinking and Strategic Sustainable Development. *J. Clean. Prod.* **2017**, *140*, 277–287. [CrossRef]
97. Sustainability Means Shifting from Human-Centred to 'Humanity-Centred' Design. Available online: https://www.dba.org.uk/human-centred-humanity-centred-design/ (accessed on 19 July 2023).
98. Bhamra, T.; Lilley, D.; Tang, T. Design for Sustainable Behaviour: Using Products to Change Consumer Behaviour. *Des. J.* **2011**, *14*, 427–445. [CrossRef]
99. Donelli, F. *It's Time for a Humanity-Centered Design*; Medium: San Francisco, CA, USA, 2017.
100. Österle, H. Ethics or Quality of Life? In *Perspectives on Digital Humanism*; Werthner, H., Prem, E., Lee, E.A., Ghezzi, C., Eds.; Springer International Publishing: Cham, Switzerland, 2022; pp. 263–269, ISBN 978-3-030-86144-5.
101. Björgvinsson, E.; Ehn, P.; Hillgren, P.-A. Participatory Design and "Democratizing Innovation". In Proceedings of the 11th Biennial Participatory Design Conference, Sydney, Australia, 29 November 2010; pp. 41–50.
102. Deterding, S. Gamification in Management: Between Choice Architecture and Humanistic Design. *J. Manag. Inq.* **2019**, *28*, 131–136. [CrossRef]
103. Myers, H. A Humanistic Approach to Designing and Assessing Interactive-Narrative Based Social Interventions. In Proceedings of the 14th National DEFSA Conference, Pretoria, South Africa, 27–29 September 2017.
104. Tewari, S. How to Thrive in the Next Economy: Designing Tomorrow's World Today. *Des. Cult.* **2018**, *10*, 114–116. [CrossRef]
105. Fry, T. *Design as Politics*; Berg: New York, NY, USA, 2011; ISBN 978-1-84788-567-8. (In English)
106. McDonough, W.; Braungart, M. *The Upcycle*, 1st ed.; North Point Press: New York, NY, USA, 2013; ISBN 978-0-86547-748-3.
107. Borthwick, M.; Tomitsch, M.; Gaughwin, M. From Human-Centred to Life-Centred Design: Considering Environmental and Ethical Concerns in the Design of Interactive Products. *J. Responsible Technol.* **2022**, *10*, 100032. [CrossRef]
108. Diid—Disegno Industriale Industrial Design. About the Journal. Available online: https://www.diid.it/diid/index.php/diid/about-the-journal (accessed on 19 July 2023).
109. Sparke, P.; Fisher, F. *The Routledge Companion to Design Studies*; Routledge Art History and Visual Studies Companions Series; Routledge: Abingdon, UK, 2016; ISBN 978-1-315-56208-7.
110. Issuu. Design Activism And Social Change by Xinyuleong. Available online: https://issuu.com/xinyuleong/docs/designactivism (accessed on 19 July 2023).
111. Walker, S. *Sustainable by Design: Explorations in Theory and Practice*; Routledge: Abingdon, UK, 2006.
112. Lyle, J.T. *Regenerative Design for Sustainable Development*; Wiley series in sustainable design; Wiley: New York, NY, USA, 1994; ISBN 978-0-471-17843-9.
113. Bocken, N.M.P.; De Pauw, I.; Bakker, C.; Van Der Grinten, B. Product Design and Business Model Strategies for a Circular Economy. *J. Ind. Prod. Eng.* **2016**, *33*, 308–320. [CrossRef]
114. Irwin, T. Transition Design: A Proposal for a New Area of Design Practice, Study, and Research. *Des. Cult.* **2015**, *7*, 229–246. [CrossRef]
115. Geels, F.W.; McMeekin, A.; Mylan, J.; Southerton, D. A Critical Appraisal of Sustainable Consumption and Production Research: The Reformist, Revolutionary and Reconfiguration Positions. *Glob. Environ. Chang.* **2015**, *34*, 1–12. [CrossRef]
116. Gaziulusoy, İ.; Erdoğan Öztekin, E. Design for Sustainability Transitions: Origins, Attitudes and Future Directions. *Sustainability* **2019**, *11*, 3601. [CrossRef]
117. Gaziulusoy, A.İ.; Öztekin, E.E. Design as a Catalyst for Sustainability Transitions. In Proceedings of the Design as a catalyst for change—DRS International Conference 2018, Limerick, Ireland, 25–28 June 28 2018.
118. Irwin, T.; Tonkinwise, C.; Kossoff, G. Transition Design: An Educational Framework for Advancing the Study and Design of Sustainable Transitions. *Cuad. Cent. Estud. Diseño Comun.* **2020**, *105*, 31–65. [CrossRef]

119. Mercure, J.-F.; Pollitt, H.; Bassi Andrea, M.; Viñuales Jorge, E.; Edwards, N.R. Modelling Complex Systems of Heterogeneous Agents to Better Design Sustainability Transitions Policy. *Glob. Environ. Chang.* **2016**, *37*, 102–115. [CrossRef]
120. Gaziulusoy, A.İ.; Ryan, C. Shifting Conversations for Sustainability Transitions Using Participatory Design Visioning. *Des. J.* **2017**, *20*, S1916–S1926. [CrossRef]
121. GarduñoG Arcía, C.; Gaziulusoy, İ. Designing Future Experiences of the Everyday: Pointers for Methodical Expansion of Sustainability Transitions Research. *Futures* **2021**, *127*, 102702. [CrossRef]
122. Gaziulusoy, A.İ.; Ryan, C. Roles of Design in Sustainability Transitions Projects: A Case Study of Visions and Pathways 2040 Project from Australia. *J. Clean. Prod.* **2017**, *162*, 1297–1307. [CrossRef]
123. Huttunen, S.; Ojanen, M.; Ott, A.; Saarikoski, H. What about Citizens? A Literature Review of Citizen Engagement in Sustainability Transitions Research. *Energy Res. Soc. Sci.* **2022**, *91*, 102714. [CrossRef]
124. Gaziulusoy, A.İ. Postcards from "The Edge": Toward Futures of Design for Sustainability Transitions. *Cuad. Cent. Estud. Diseño Comun.* **2019**, *73*, 66–83. [CrossRef]
125. Kaufman, S.; Saeri, A.; Raven, R.; Malekpour, S.; Smith, L. Behaviour in Sustainability Transitions: A Mixed Methods Literature Review. *Environ. Innov. Soc. Transit.* **2021**, *40*, 586–608. [CrossRef]
126. Sauermann, H.; Vohland, K.; Antoniou, V.; Balázs, B.; Göbel, C.; Karatzas, K.; Mooney, P.; Perelló, J.; Ponti, M.; Samson, R.; et al. Citizen Science and Sustainability Transitions. *Res. Policy* **2020**, *49*, 103978. [CrossRef]
127. Co-Design for Health: From Inclusion to Equity. Available online: https://www.huddleinnovation.com/blog1/2018/5/3/co-design-for-health-from-inclusion-to-equity (accessed on 19 July 2023).
128. Tosi, F. Co-Design and Innovation: Tools, Methods and Opportunities for the Generation of Innovation through User Involvement. In *Design for Ergonomics*; Springer Series in Design and Innovation; Springer International Publishing: Cham, Switzerland, 2020; Volume 2, pp. 129–141, ISBN 978-3-030-33561-8.
129. Tosi, F. Human-Centred Design—User Experience: Tools and Intervention Methods. In *Design for Ergonomics*; Springer Series in Design and Innovation; Springer International Publishing: Cham, Switzerland, 2020; Volume 2, pp. 111–128, ISBN 978-3-030-33561-8.
130. Mok, L.; Hyysalo, S. Designing for Energy Transition through Value Sensitive Design. *Des. Stud.* **2018**, *54*, 162–183. [CrossRef]
131. McLellan, B.C.; Kishita, Y.; Aoki, K. Participatory Design as a Tool for Effective Sustainable Energy Transitions. In *Sustainability Through Innovation in Product Life Cycle Design*; EcoProduction; Matsumoto, M., Masui, K., Fukushige, S., Kondoh, S., Eds.; Springer: Singapore, 2017; pp. 583–599, ISBN 978-981-10-0469-8.
132. Mouter, N.; Koster, P.; Dekker, T. Participatory Value Evaluation for the Evaluation of Flood Protection Schemes. *Water Resour. Econ.* **2021**, *36*, 100188. [CrossRef]
133. Capaccioli, A.; Poderi, G.; Bettega, M.; D'Andrea, V. Participatory Infrastructuring of Community Energy. In *Proceedings of the Proceedings of the 14th Participatory Design Conference: Short Papers, Interactive Exhibitions*; Aarhus, Denmark, 15–19 August 2016, Volume 2, pp. 9–12.
134. Urquiza, A.; Amigo, C.; Billi, M.; Espinosa, P. Participatory Energy Transitions as Boundary Objects: The Case of Chile's Energía2050. *Front. Energy Res.* **2018**, *6*, 134. [CrossRef]
135. Rizzo, A.; Ekelund, B.; Bergström, J.; Ek, K. Participatory Design as a Tool to Create Resourceful Communities in Sweden. In *Culture and Territory*; Centro de Estudos Interdisciplinares em Educação e Desenvolvimento, Smaniotto, C., Mačiulienė, M., Menezes, M., Goličnik Marušić, B., Eds.; Edições Universitárias Lusófonas: Lisbon, Portugal, 2020; Volume 4, pp. 95–107. ISBN 978-989-757-125-1.
136. Heitmann, F.; Halbe, J.; Pahl-Wostl, C. Integrated and Participatory Design of Sustainable Development Strategies on Multiple Governance Levels. *Sustainability* **2019**, *11*, 5931. [CrossRef]
137. Sugden, R. On Nudging: A Review of *Nudge: Improving Decisions About Health, Wealth and Happiness* by Richard H. Thaler and Cass R. Sunstein. *Int. J. Econ. Bus.* **2009**, *16*, 365–373. [CrossRef]
138. Cialdini, R.B.; Goldstein, N.J. Social Influence: Compliance and Conformity. *Annu. Rev. Psychol.* **2004**, *55*, 591–621. [CrossRef]
139. Behaviour Unpacked: Determining the Right Altitude to Address Behavioural Change for Sustainability. Available online: https://www.liveworkstudio.com/articles/behaviour-unpacked-determining-the-right-altitude-to-address-behavioural-change-for-sustainability/ (accessed on 19 July 2023).
140. Chatzopoulou, E. Where Do You Start When Designing for Behaviour Change? Available online: https://uxdesign.cc/how-do-you-design-for-behaviour-change-790b9abefa08 (accessed on 19 July 2023).
141. Thaler, R.H.; Sunstein, C.R. *Nudge: Improving Decisions about Health, Wealth, and Happiness*; Yale University Press: New Haven, CT, USA, 2008; pp. 700–701, ISBN 978-0-300-12223-7.
142. Shin, H.D.; Bull, R. Three Dimensions of Design for Sustainable Behaviour. *Sustainability* **2019**, *11*, 4610. [CrossRef]
143. Van Der Linden, S.; Maibach, E.; Leiserowitz, A. Improving Public Engagement With Climate Change: Five "Best Practice" Insights From Psychological Science. *Perspect. Psychol. Sci.* **2015**, *10*, 758–763. [CrossRef]
144. Yamin, P.; Fei, M.; Lahlou, S.; Levy, S. Using Social Norms to Change Behavior and Increase Sustainability in the Real World: A Systematic Review of the Literature. *Sustainability* **2019**, *11*, 5847. [CrossRef]
145. Heinonen, J.; Säynäjoki, A.; Junnila, S. A Longitudinal Study on the Carbon Emissions of a New Residential Development. *Sustainability* **2011**, *3*, 1170–1189. [CrossRef]
146. Melnyk, V.; Carrillat, F.A.; Melnyk, V. The Influence of Social Norms on Consumer Behavior: A Meta-Analysis. *J. Mark.* **2022**, *86*, 98–120. [CrossRef]

147. Lobaccaro, G.; Carlucci, S.; Löfström, E. A Review of Systems and Technologies for Smart Homes and Smart Grids. *Energies* **2016**, *9*, 348. [CrossRef]
148. Kaiser, M.; Bernauer, M.; Sunstein, C.R.; Reisch, L.A. The Power of Green Defaults: The Impact of Regional Variation of Opt-out Tariffs on Green Energy Demand in Germany. *Ecol. Econ.* **2020**, *174*, 106685. [CrossRef]
149. Si-dai, G.; Cheng-Peng, L.; Hang, L.; Ning, Z. Influence Mechanism of Energy Efficiency Label on Consumers' Purchasing Behavior of Energy-Saving Household Appliances. *Front. Psychol.* **2021**, *12*, 711854. [CrossRef] [PubMed]
150. Stasiuk, K.; Maison, D. The Influence of New and Old Energy Labels on Consumer Judgements and Decisions about Household Appliances. *Energies* **2022**, *15*, 1260. [CrossRef]
151. Luthra, S.; Kumar, S.; Kharb, R.; Ansari, M.F.; Shimmi, S.L. Adoption of Smart Grid Technologies: An Analysis of Interactions among Barriers. *Renew. Sustain. Energy Rev.* **2014**, *33*, 554–565. [CrossRef]
152. Coskun, A.; Zimmerman, J.; Erbug, C. Promoting Sustainability through Behavior Change: A Review. *Des. Stud.* **2015**, *41*, 183–204. [CrossRef]
153. One-Song Shower Challenge. Available online: https://open.spotify.com/playlist/30Ie39BhbC7nUw7JVA6SAV (accessed on 19 July 2023).
154. Fahim, M.; Kazmi, S.M.A.; Khattak, A.M. ApplianceNet: A Neural Network Based Framework to Recognize Daily Life Activities and Behavior in Smart Home Using Smart Plugs. *Neural Comput. Appl.* **2022**, *34*, 12749–12763. [CrossRef]
155. Myenergi. Renewable Energy Products Making Eco Energy Easy. Available online: https://www.myenergi.com/ (accessed on 19 July 2023).
156. Electricity Maps. Available online: http://electricitymap.tmrow.co (accessed on 19 July 2023).
157. BIC Academy Quiz. Available online: https://apps.apple.com/us/app/bic-academy-quiz/id1603208610 (accessed on 19 July 2023).
158. Energielabel. Available online: https://apps.apple.com/de/app/energielabel/id1543159006 (accessed on 19 July 2023).
159. AWorld in Support of ActNow. Available online: https://play.google.com/store/apps/details?id=app.aworld&hl=en (accessed on 19 July 2023).
160. Kora Sustainability. Available online: https://kora.app/ (accessed on 19 July 2023).
161. Carbon Donut Makes Climate Action Easy. Available online: https://www.sparksustainability.com/carbon-donut (accessed on 19 July 2023).
162. Zero Waste Goals. Available online: https://play.google.com/store/apps/details?id=mipb.com.zerowasteideas&hl=en_US (accessed on 19 July 2023).
163. Eevie: Employee Climate Engagement Platform. Available online: https://www.eevie.io/ (accessed on 19 July 2023).
164. JouleBug. Available online: https://www.joulebug.com/ (accessed on 19 July 2023).
165. Johnson, D.; Horton, E.; Mulcahy, R.; Foth, M. Gamification and Serious Games within the Domain of Domestic Energy Consumption: A Systematic Review. *Renew. Sustain. Energy Rev.* **2017**, *73*, 249–264. [CrossRef]
166. Our Top 21 Environmental Campaigns of 2021. *Greenh. Commun*. 2021. Available online: https://greenhouse.agency/blog/our-top-21-environmental-campaigns-of-2021/ (accessed on 19 July 2023).
167. The Climate Coalition. Available online: https://www.theclimatecoalition.org/about-us (accessed on 19 July 2023).
168. #ClimateChangedMe. Available online: https://www.climatechanged.me/ (accessed on 19 July 2023).
169. Race to Zero. Available online: https://racetozero.unfccc.int/ (accessed on 19 July 2023).
170. Nations, U. Act Now. Available online: https://www.un.org/en/actnow (accessed on 19 July 2023).
171. Nations, U. Communication Materials. Available online: https://www.un.org/en/actnow/communication-materials (accessed on 19 July 2023).
172. Axon, S.; Morrissey, J.; Aiesha, R.; Hillman, J.; Revez, A.; Lennon, B.; Salel, M.; Dunphy, N.; Boo, E. The Human Factor: Classification of European Community-Based Behaviour Change Initiatives. *J. Clean. Prod.* **2018**, *182*, 567–586. [CrossRef]
173. Trickett, E.J. Multilevel Community-Based Culturally Situated Interventions and Community Impact: An Ecological Perspective. *Am. J. Community Psychol.* **2009**, *43*, 257–266. [CrossRef]
174. Koirala, B.P.; Araghi, Y.; Kroesen, M.; Ghorbani, A.; Hakvoort, R.A.; Herder, P.M. Trust, Awareness, and Independence: Insights from a Socio-Psychological Factor Analysis of Citizen Knowledge and Participation in Community Energy Systems. *Energy Res. Soc. Sci.* **2018**, *38*, 33–40. [CrossRef]
175. Perez, N.; Riederer, P.; Inard, C. Development of a Multiobjective Optimization Procedure Dedicated to the Design of District Energy Concept. *Energy Build.* **2018**, *178*, 11–25. [CrossRef]
176. Kyriakodis, G.-E. Eco-District Design and Decision Process through Building Energy and Local Microclimate Assessment. In Proceedings of the PLEA 2017, Edinburgh, Scotland, 3–5 July 2017.
177. Tarekegne, B.; Kazimierczuk, K.; O'Neil, R. *Coal-Dependent Communities in Transition: Identifying Best Practices to Ensure Equitable Outcomes*; OSTI: Washington, DC, USA, 2021; p. PNNL-31909, 1821478.
178. Shen, Y.T.; Chen, P.C.; Jeng, T.S. Design and Evaluation of Eco-Feedback Interfaces to Support Location-Based Services for Individual Energy Awareness and Conservation. In *Human-Computer Interaction. Towards Intelligent and Implicit Interaction*; Lecture Notes in Computer Science; Kurosu, M., Ed.; Springer: Berlin/Heidelberg, Germany, 2013; Volume 8008, pp. 132–140, ISBN 978-3-642-39341-9.

179. Burchell, K.; Rettie, R.; Roberts, T.C. Householder Engagement with Energy Consumption Feedback: The Role of Community Action and Communications. *Energy Policy* **2016**, *88*, 178–186. [CrossRef]
180. Ramesh, M.V. Integration of Participatory Approaches, Systems, and Solutions Using IoT and AI for Designing Smart Community: Case Studies from India. In Proceedings of the 1st ACM International Workshop on Technology Enablers and Innovative Applications for Smart Cities and Communities, New York, NY, USA, 13–14 November 2019; pp. 4–5.
181. Suboticki, I.; Heidenreich, S.; Ryghaug, M.; Skjølsvold, T.M. Fostering Justice through Engagement: A Literature Review of Public Engagement in Energy Transitions. *Energy Res. Soc. Sci.* **2023**, *99*, 103053. [CrossRef]
182. Ritala, P. Innovation for Sustainability: Sceptical, Pragmatic, and Idealist Perspectives on the Role of Business as a Driver for Change. In *Innovation for Sustainability*; Palgrave Studies in Sustainable Business In Association with Future Earth; Bocken, N., Ritala, P., Albareda, L., Verburg, R., Eds.; Springer International Publishing: Cham, Swizterland, 2019; pp. 21–34, ISBN 978-3-319-97384-5.
183. Voulvoulis, N.; Giakoumis, T.; Hunt, C.; Kioupi, V.; Petrou, N.; Souliotis, I.; Vaghela, C.; binti Wan Rosely, W.I.H. Systems Thinking as a Paradigm Shift for Sustainability Transformation. *Glob. Environ. Chang.* **2022**, *75*, 102544. [CrossRef]
184. Steg, L.; Shwom, R.; Dietz, T. What Drives Energy Consumers?: Engaging People in a Sustainable Energy Transition. *IEEE Power Energy Mag.* **2018**, *16*, 20–28. [CrossRef]
185. Schultz, P.W.; Kaiser, F.G. Promoting Pro-Environmental Behavior. In *The Oxford Handbook of Environmental and Conservation Psychology*; Clayton, S.D., Ed.; Oxford University Press: Oxford, UK, 2012; pp. 556–580. ISBN 978-0-19-973302-6.
186. Lange, F.; Dewitte, S. Measuring Pro-Environmental Behavior: Review and Recommendations. *J. Environ. Psychol.* **2019**, *63*, 92–100. [CrossRef]
187. Corraliza, J.A.; Berenguer, J. Environmental Values, Beliefs, and Actions: A Situational Approach. *Environ. Behav.* **2000**, *32*, 832–848. [CrossRef]
188. Steg, L.; Vlek, C. Encouraging Pro-Environmental Behaviour: An Integrative Review and Research Agenda. *J. Environ. Psychol.* **2009**, *29*, 309–317. [CrossRef]
189. Lilley, D. Design for Sustainable Behaviour: Strategies and Perceptions. *Des. Stud.* **2009**, *30*, 704–720. [CrossRef]
190. Deutschmann, J.W.; Postepska, A.; Sarr, L. Measuring Willingness to Pay for Reliable Electricity: Evidence from Senegal. *World Dev.* **2021**, *138*, 105209. [CrossRef]
191. Dent, E.B.; Goldberg, S.G. Challenging "Resistance to Change". *J. Appl. Behav. Sci.* **1999**, *35*, 25–41. [CrossRef]
192. Weder, F.; Tungarat, A.; Lemke, S. Sustainability as Cognitive "Friction": A Narrative Approach to Understand the Moral Dissonance of Sustainability and Harmonization Strategies. *Front. Commun.* **2020**, *5*, 8. [CrossRef]
193. Kahan, D.M.; Wittlin, M.; Peters, E.; Slovic, P.; Ouellette, L.L.; Braman, D.; Mandel, G.N. The Tragedy of the Risk-Perception Commons: Culture Conflict, Rationality Conflict, and Climate Change. *SSRN Electron. J.* **2011**, 2011–2026. [CrossRef]
194. Thomas, H. Service Design: Can We Design for Sustainable Consumption? *Design Voices 2019.* Available online: https://medium.com/design-voices/service-design-can-we-design-for-sustainable-consumption-8d0a8e8ee010 (accessed on 19 July 2023).
195. Whitmarsh, L. Behavioural Responses to Climate Change: Asymmetry of Intentions and Impacts. *J. Environ. Psychol.* **2009**, *29*, 13–23. [CrossRef]
196. Lorenzoni, I.; Nicholson-Cole, S.; Whitmarsh, L. Barriers Perceived to Engaging with Climate Change among the UK Public and Their Policy Implications. *Glob. Environ. Chang.* **2007**, *17*, 445–459. [CrossRef]
197. Rees, W. What's Blocking Sustainability? Human Nature, Cognition, and Denial. *Sustain. Sci. Pract. Policy* **2010**, *6*, 13–25. [CrossRef]
198. Osbaldiston, R.; Schott, J.P. Environmental Sustainability and Behavioral Science: Meta-Analysis of Proenvironmental Behavior Experiments. *Environ. Behav.* **2012**, *44*, 257–299. [CrossRef]
199. Burn, S.M.; Oskamp, S. Increasing Community Recycling with Persuasive Communication and Public Commitment. *J. Appl. Soc. Psychol.* **1986**, *16*, 29–41. [CrossRef]
200. Odou, P.; Darke, P.; Voisin, D. Promoting Pro-Environmental Behaviours through Induced Hypocrisy. *Rech. Appl. En Mark. Engl. Ed.* **2019**, *34*, 74–90. [CrossRef]
201. Psychology Today. Are You a Sustainability Hypocrite? Available online: https://www.psychologytoday.com/us/blog/presence-mind/201305/are-you-sustainability-hypocrite (accessed on 19 July 2023).
202. Korteling, J.E.; Paradies, G.L.; Sassen-van Meer, J.P. Cognitive Bias and How to Improve Sustainable Decision Making. *Front. Psychol.* **2023**, *14*, 1129835. [CrossRef] [PubMed]
203. Palmucci, D.N.; Ferraris, A. Climate Change Inaction: Cognitive Bias Influencing Managers' Decision Making on Environmental Sustainability Choices. The Role of Empathy and Morality with the Need of an Integrated and Comprehensive Perspective. *Front. Psychol.* **2023**, *14*, 1130059. [CrossRef]
204. Engler, J.-O.; Abson, D.J.; Von Wehrden, H. Navigating Cognition Biases in the Search of Sustainability. *Ambio* **2019**, *48*, 605–618. [CrossRef]
205. Brand, J.L.; Augustin, S. Can We Sustain Sustainability? A Critical Synthesis of Pertinent Literature. *Sustainability* **2021**, *13*, 12753. [CrossRef]
206. Weber, E.U. Breaking Cognitive Barriers to a Sustainable Future. *Nat. Hum. Behav.* **2017**, *1*, 0013. [CrossRef]
207. Iqbal, W.; Tang, Y.M.; Lijun, M.; Chau, K.Y.; Xuan, W.; Fatima, A. Energy Policy Paradox on Environmental Performance: The Moderating Role of Renewable Energy Patents. *J. Environ. Manag.* **2021**, *297*, 113230. [CrossRef]

208. The Circular Design Guide. Available online: https://www.circulardesignguide.com/ (accessed on 26 July 2023).
209. Fry, T. *Design Futuring: Sustainability, Ethics and New Practice*; Bloomsbury Publishing: London, UK, 2008.
210. Angheloiu, C.; Chaudhuri, G.; Sheldrick, L. Future Tense: Alternative Futures as a Design Method for Sustainability Transitions. *Des. J.* **2017**, *20*, S3213–S3225. [CrossRef]