energies

MDPI

Review

Review on the Importance of Gender Perspective in Household Energy-Saving Behavior and Energy Transition for Sustainability

Bindu Shrestha [1], Sudarshan R. Tiwari [2], Sushil B. Bajracharya [2], Martina M. Keitsch [3] and Hom B. Rijal [4,*]

1 Cosmos College of Management and Technology, Pokhara University, Lalitpur 44800, Nepal; shresthabindu@gmail.com
2 Institute of Engineering, Tribhuvan University, Lalitpur 44800, Nepal; srtiwari@ioe.edu.np (S.R.T.); sushil_bajracharya@hotmail.com (S.B.B.)
3 Department of Design, Norwegian University of Science and Technology, 7491 Trondheim, Norway; martina.keitsch@ntnu.no
4 Graduate School of Environmental and Information Studies, Tokyo City University, Yokohama 224-8551, Japan
* Correspondence: rijal@tcu.ac.jp

Abstract: Energy-saving and efficiency represent a crucial role in achieving a clean environment as well as economic and social development, providing substantial benefits to stakeholders, including householders. Better cost savings can be achieved by simply changing behavior. However, real energy users lack proper technical energy knowledge, awareness, and education in most cases. In most countries, women are involved in a higher percentage of energy activities in household chores but have less gender participation in energy decisions. In this regard, a gender perspective effectively understands energy users' pragmatic and strategic needs for energy-saving behavior improvement. Previous literature reviews have been focusing on specific aspects of energy sustainability; however, no review has focused on energy-saving from a gender perspective to the best of our knowledge. It aims to provide a systematic review of literature on energy-saving and management, highlighting the importance of gender roles and fulfilling the literature's study gaps that provide future possible research streams. The review finds that females use lower energy than males in household activities that has supported in household energy-saving behavior. In addition, gender, income, family composition, ownership, and education are significant influencing factors in energy-saving behavior, and gender differences are rooted in socialization, responsibility, and choice of energy appliances that have impacted energy decisions influencing energy-saving behavior and sustainability goals.

Keywords: household energy; energy-saving; gender; sustainability

Citation: Shrestha, B.; Tiwari, S.R.; Bajracharya, S.B.; Keitsch, M.M.; Rijal, H.B. Review on the Importance of Gender Perspective in Household Energy-Saving Behavior and Energy Transition for Sustainability. *Energies* **2021**, *14*, 7571. https://doi.org/10.3390/en14227571

Academic Editor: Ioan Sarbu

Received: 13 September 2021
Accepted: 5 November 2021
Published: 12 November 2021

1. Introduction

1.1. Overview

Energy is a vein in economic development and a prominent contributor to the Sustainable Development Goals (SDGs) [1]. The increasing urbanization is one challenging factor to increase energy consumption, and the current energy world is highly dependent on fossil-fuel-based energy, with most countries depending on imported fuels. Moreover, household energy consumption globally reports for a 35% share of total energy and is expected to increase by 20–40% in 2040 [2]. The household is a significant energy consumer and the most gendered sphere of society in most cultures [3,4], but few studies have emphasized that household energy use could be reduced by 10–30% simply by changing its inhabitants' behaviors without compromising their comfort [5]. A WHO [6] study identifies that the inaccessibility of cleaner technologies and women's low participation are significant barriers to development. Women are three times more involved in household chores than men in most countries [7,8]. UNDP highlights that placing modern energy

efficiency as an individual goal has resulted in piecemeal development [1]. As a result, more than one billion people still lack access to electricity, and 2.9 billion people live without clean cooking [9]. Simultaneously, ENERGIA [10] claims that energy planning and policy have become gender-blind and fail to recognize pragmatic needs (i.e., men's and women's different needs).

1.2. Importance of Household Energy-Saving for Sustainability

The International Energy Agency [9] sets a target to achieve a 3% improvement in energy efficiency until 2030, recognizing the sustainability benefits of securing a country's energy resources, reducing fluctuation on fuel prices, ensuring a clean environment, and reducing dependence on imported energy. It uncovers that improved energy-efficient households are primary vehicles to improve sustainability; however, the achievement is still low. The IEA has highlighted that energy-saving has tremendous potential to boost economic growth, but the global efficiency rate has decreased. In 2018, the primary energy intensity improved by only 1.2%, less than in 2017 (1.7%). The 1.2% upgrade in energy intensity accounted for around $1.6 trillion more GDP [9]. The IEA [11] has increased the investment in energy efficiency by 0.6% more in 2018 than in 2017 in all sectors, including buildings, but still, the level of achievement is low. It has been realized that changes in technology and behavior can boost energy-saving [12]. Simultaneously, it is equally important to assure equitable access to digital technology and infrastructure for all. When it equally meets the needs of men and women, it fulfills the equality and accessibility of energy and conserves it for future generations to achieve sustainability goals.

1.3. Importance of Gender Participation in Household Energy Decisions

Women have a pivotal role in the transition towards sustainable energy practices in households as they are primary energy users and can influence society [13]. The environmental literature shows that women are likely to save energy by 22% more compared to men [14]. However, women are mostly missing in energy-related activities and industries, ignoring their generative activities [15,16]. For instance, only 4% of women have participated in the World Energy Council chairs (WEC) and 18% in secretaries. Even though women remain more active in household-related energy use, but are less involved in electrical appliance purchases in most countries [16], it indicates the limitations of real energy user's participation in energy-related decisions. The evidence shows that women's involvement in the energy sector can benefit it productively [17–20]. Most studies have recognized the need to understand the sensitivity of gender differences in household energy for the energy-saving implications [21–24]. However, scant attention is given to gender participation for sustainable energy use [21,22]. The gender lens in energy decisions contributes to revealing the actual scenario as a crucial factor in SDGs goal [15,25].

1.4. Objectives

The study aims to review the literature critically to address the gender role in energy and sustainability. The specific objectives are:

a. to address the association between energy usage/saving and impacts in sustainable development and
b. to ascertain how gender participation in energy-saving behavior supports sustainable development

2. Materials and Methods

This paper has executed a systematic review to provide a rigorous methodology for identifying energy-saving behavior from a gender perspective. It aims to track down relevant existing studies based on the research objectives to evaluate the contributions drawing insights, conclusions, and research sectors. It outlines and analyzes all the relevant studies concerning energy-saving behavior from a gender lens. It has used the keywords to search relevant papers either in article abstract, title, and list of keywords as shown in

Table 1. The largest online databases of peer-reviewed literature, i.e., Scopus, ScienceDirect, and Wiley Online, have been used as primary sources.

Table 1. Keywords used in the literature search.

Research Area	Keywords
Energy issue	Energy Energy consumption and efficiency Household energy-saving behavior
Gender role	Gender lens Gender differences Gender needs Gender equality

The literature search is presented in Table 2. The review process identified 80 papers suitable for a systematic review. The considerable recent publication reveals significant importance in the topic and few studies underline the need for a review to identify and guide the significant research streams, as shown in Figure 1.

Table 2. The selection process of articles.

Step	Description	Total
Keywords search	Articles need to fulfill the search link to their title, abstract, or main text	3037
Journal selection	Articles of peer-reviewed journals	1814
Content analysis	Duplicates were avoided and ensured by scrutinizing the abstract on relevant topics	500
Snowball search	Forward and backward searching refering to previous articles	100
Sample size	-	80

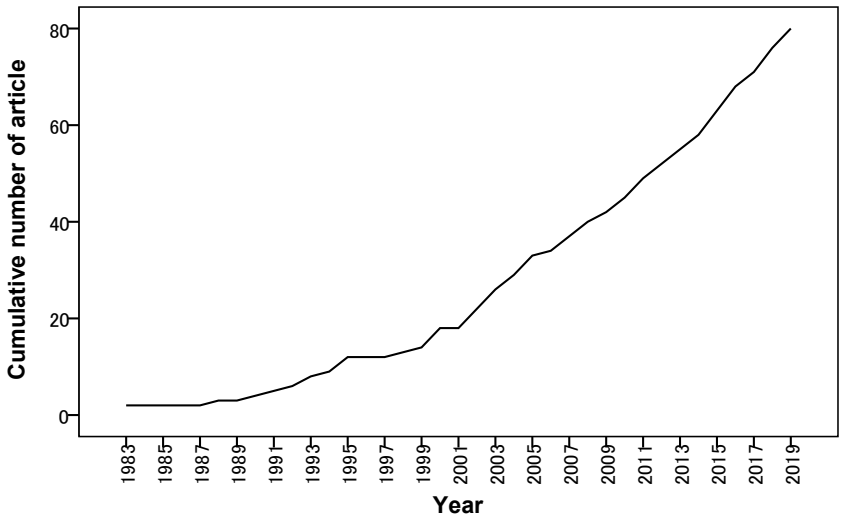

Figure 1. Number of articles in years.

The study gives detailed insights into energy-saving/consumption studies done across the world. The research articles are broadly classified into four major categories to analyze the results in detail, as shown in Figure 2. A concept of content analysis is based on a conceptual framework to ensure a rigorous methodology for evaluating, classifying, and discussing the literature review. Remarkably, two aspects are considered: the first aspect

systematizes the importance of gender in the energy sector. The second aspect focuses on envisioning the energy-saving process and the importance of gender perspectives from case studies and model development. The presented literature review focuses on defined research objectives to detect the existing theoretical gaps and identify further research streams. The framework envisions two significant relevant aspects of energy and gender. The gender differences and participation in energy decisions remain as sub-sections in this study. Qualitative and quantitative data are approached from different cases worldwide done by previous authors along with the model development. It exhibits a comparison on energy-saving having gender participation and other variables.

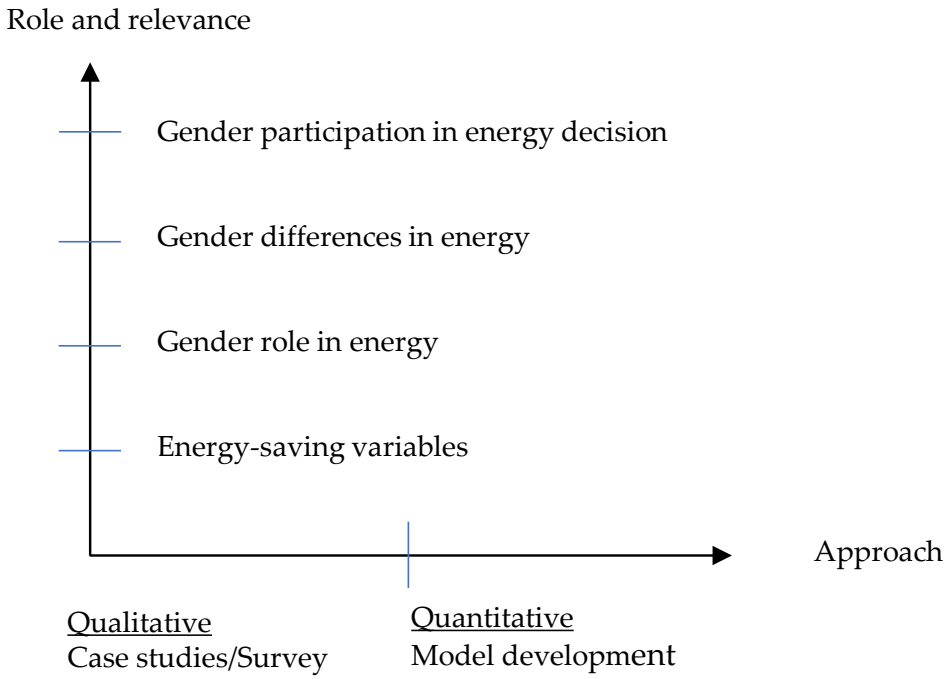

Figure 2. Concept of analysis on energy-saving process in gender lens.

3. Results and Discussion

3.1. Energy-Saving Concept Model Development

The energy model development history has contributed to understanding the importance of energy-saving and gaps in the previous studies. The energy-saving concept was raised around fifty years after the world energy crisis in the 1970s considering sustainability was thought to reduce dependence and increase energy security for sustainability. Dholakia et al. [26] introduced the model development of energy consumption as a macro−micro model. The model significantly established the vision of macro choices (socio-political system) defining micro-level phenomena. However, it failed to include behavior integration of energy users and remained as only a theoretical application. Understanding this gap of energy-related behaviors, Van Raaij and Verhallen [27,28] structured a behavior model highlighting the importance of energy-saving habits; however, it still overlooked a gender perception in the energy behavior and emphasized it as a hybrid application.

In 1992, Lutzenhiser [29] derived a ground-breaking cultural model from understanding energy behavior from a cultural perspective emphasizing socio-cultural factors. The model focuses on a theoretical outline of energy consumption on the cultural inertia linking to the physical-economic dimension in the broader context. This cultural perspective analyzes energy flows, energy technologies, and energy-related decision-making. Numerous analysts [29–31] have outlined household energy choices and explicate that the higher the socio-economic status, the more scaled up in cleaner fuel consumption in a linear progression and recognized as energy ladder model. The model perceives household energy in three divisions as traditional, transition, and advanced fuels. Fuel switching

from traditional to modern fuels is considered a ladder preference as fuel transition for development [32] However, Yu et al. [33] have discovered that households' energy choices and consumption behaviors notably varied tremendously across geographic locations due to disparities in the energy sources' availability.

Additionally, few studies have emphasized that asset ownership structure has a significant role in the household. Nasir et al. [34] uncovered that women's asset ownership and household prosperity significantly impact solid fuel uses for less consumption and better health outcomes that significantly elevate social transformation. From a social and engineering perspective, Hitchcock [35] perceived household energy as a system model—a physical and human interaction system influenced by technical and social change revealing practical application. Wilk [36] introduced a multi-genic model to reveal an interlinkage of household energy consumption behavior and gender in the development of the regulations; however, it has remained theoretical only.

Further, Yust et al. [37] elaborated the household energy pattern as the human organism in three interlinked natural, social, and designed environments and generated an ecosystem model as a practical approach. However, although this model examined the interlinkages of environment and energy uses as sustainability concept, it fails to recognize the gender role in energy-saving behavior. Simultaneously, from an anthropological perspective, Keirstead [38] devised an actor-networked model that emphasized diverse processes from an agent-based approach, identifying the integration of domestic renewables and energy-efficiency incentives for energy-saving behavior as a practical application (Table 3). It highlights the role of government policies, markets, society, and household variables, but it still limits household energy behavior in the decision-making process, as shown in Table 3. Similarly, gender participation in the decision-making process plays a leading role in influencing saving behavior.

Table 3. Development of energy consumption models.

Authors	Country	Response Variables	Models	Application
Dholakia et al.1983 [26]	United States	Sociopolitical structure, social choice, choice alternatives, and demographic and physical characteristics.	Macro−micro- model Political model	Theory
Van Raaij and Verhallen, 1983 [27]	The Netherlands	Socio-economic factors, lifestyle, climate, building characteristics, energy-related attitude, cost-benefit, information and relationship.	Behavior model	Hybrid
Lutzenhiser, 1992 [29]	United States	Lifestyle, socio-cultural, demographics, cultural values.	Cultural model	Practical
Hitchcock, 1993 [35]	United Kingdom	Physical and human subsystem.	System model	Practical
Yust et al. 2002 [37]	United States	Natural, social, designed environment in the human organism.	Ecosystem model	Practical
Wilk, 2002 [36]	Global Context	Habit, individual choice, social needs, cultural values, family member values (Global Consumption Model).	Multi-genic model Anthropology perspective	Theory
Keirstead, 2006 [38]	United Kingdom	Physical environment, government, market, household, and society.	Actor-networked model	Practical
Wilson and Dowlatabadi, 2007 [39]	Global Context	Conventional and behavioral economics model, technology diffusion model. Social psychology model, sociology decision model,	Decision-making model	Hybrid
Stephenson et al., 2010 [40]	New Zealand	material culture, energy practices, cognitive norms.	Energy culture model	Practical

In this regard, Wilson and Dowlatabadi [39] revealed factors of economic and sociological grounds on energy decisions to influence saving behavior that comprises psychological (values, attitudes, and norms) and contextual (energy choices, financial incentives, social norms, and energy technologies) spheres with interventions to change behavior as a hybrid application. Stephenson et al. [40] explored the energy culture framework to view habitual behavior and the cultural importance of energy and has expanded the study as interdisciplinary research to understand the drivers and interactions that occur as intricate patterns of energy-related behavior at a household level and remaining practical application (Table 3). Although it still disregards the gender role in the energy decision-making policy, this shortcoming becomes apparent when encountered with multifaceted energy efficiency problems.

3.1.1. Energy-Saving Benefits for Sustainability

The energy model development directs towards an energy-saving approach and generates important linkages with energy, gender, and sustainability, as shown in Figure 3. Building characteristics, habits, socio-economic factors, and energy price choices have direct and cultural values/norms that indirectly link to the energy consumption pattern and energy-saving behavior (Figure 3). While cultural norms and habits are directly linked to gender issues, building characteristics and energy market price choices are less considered to be gender issues. Gender has enormously contributed to the energy-saving behavior for achieving the sustainability goal. Historical energy model development has proved that socio-economic variables, including gender, have directly or indirectly influenced the energy-saving phenomena for achieving long-term goals of sustainability.

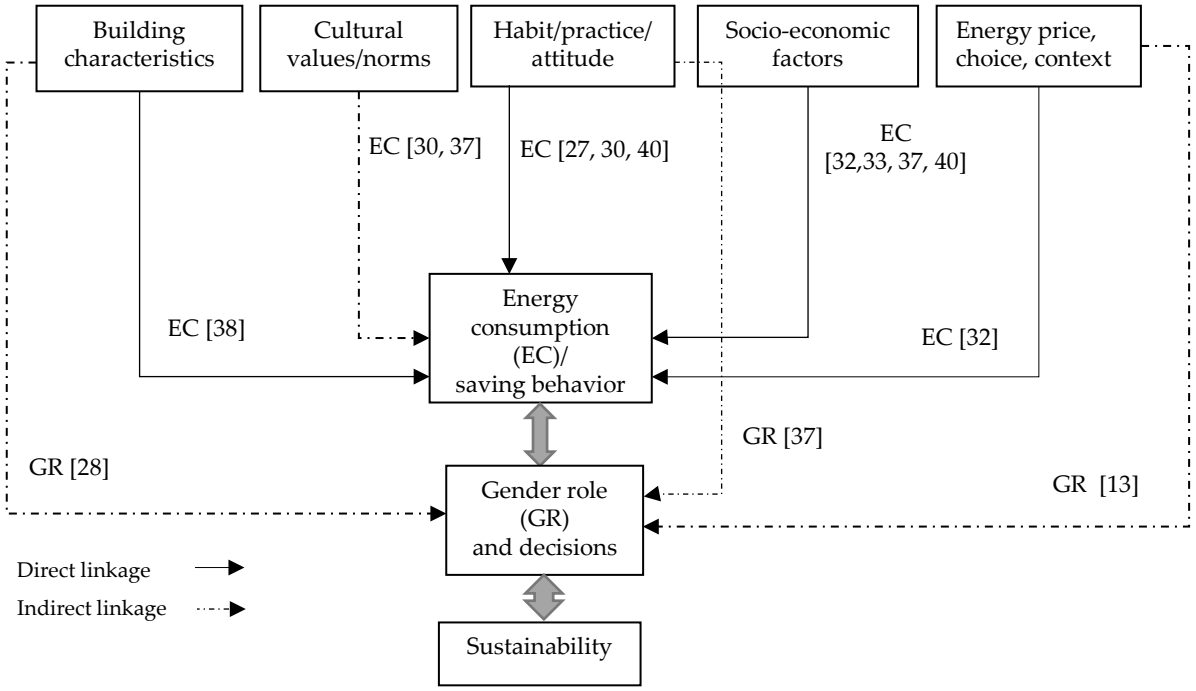

Figure 3. Variables' linkages with the key theme.

3.1.2. Energy-Saving Approach and Influencing Variables

Energy-saving behavior does not occur in isolation and is strongly based on energy usage and purchase activities. The Behavioral Demand Response (BDR) concept is one of critical and effective reduction of residential consumption, encouraging residences' habits and behavior [41]. Previous studies show that BDR's absolute impacts on reducing energy range from 0.05 to 0.09 kW [42]. The literature advocates that energy-saving behavior could reduce energy demand up to 22%. Similarly, home appliances could reduce

electricity demand by about 29 to 50%, applying behavioral BDR strategy for the long run as an energy-saving behavior [43]. Investment and curtailment behavior is one of the important parameters of BDR for energy-saving strategy. Most of the studies [39–41] show that energy-saving activities as BDR parameters emerged in two categories: habitual or curtailment for direct energy-saving choices [44] or adjustment [45] and usage-related or curtailment focused on everyday energy use activities as structural adjustment. The second category is adopting energy-efficient technologies and purchase-related behavior [46] as one-shot behavior without changing daily behaviors. However, both have their benefits: one provides a technical solution, and the other relates to habit improvement with specific energy-saving measures.

The studies reflect that people have less acceptance of conserving behavior in daily habits than energy-efficient behavior measures [44,45]. Exploring the practical situation, Sütterlin et al.'s study [46] highlights that people have less knowledge about energy-saving, and they think that energy-efficient behavior is separate from the purchasing behavior of daily products as a distinction from curtailment behavior. It reveals that energy behaviors are more influenced by habits and affect one's lifestyle. Nowadays, there has been an increasing need for using advanced technology to boost demand response products to provide flexible and smart services to the system than conventional [47]. The use of an automated demand system as a smart home helps to reduce variable costs by integrating renewable energies [48]. However, it demands the need for proper knowledge, awareness, and financial investments to convince dwellers to be part of BDR system [48,49].

Numerous studies have reflected that socio-economic, personal beliefs, and intentions significantly influence energy-saving behavior and attitudes [39,45,46,50]. Environmentally significant behavior can be classified into four categories: attitudinal (values, belief, norms), personal determinants (age, income, education), habits or routines, and contextual forces (community expectation or governmental regulations) [50]. Attitudinal factors and contextual forces are indirectly addressed through a consumer's belief or perception of an individual's perceived social pressure with subjective considerations. Inhabitants are required to perform a set of behaviors for energy-saving action, depending on knowledge and skills, such as literacy, income, social status, and power [45,46]. Those sociodemographic variables provide inhabitants' scope of action; they are proxies for personal factors or capabilities, as shown in Table 4.

Table 4. Identified influencing variables in energy-saving for sustainability.

Influencing/Dependable Variables	Authors
Energy-saving—Socioeconomic, personal beliefs, intentions, and attitudes	Stern, 2000 [50]; Stern et al. 1995 [45]; Sütterlin et al., 2011 [46]; Wilson and Dowlatabadi, 2007 [39]
Attitudinal, personal determinants, habits or routines, and contextual forces.	Stern, 2000 [50]; Sütterlin et al., 2011 [46]
Ownership, income, family composition, and age	Barr et al., 2005 [48]; Dillman et al., 1983 [44]; Painter et al., 1983 [51]; Trotta, 2018 [52]
Gender, household size, education, and age group	Barr et al., 2005 [48]
Income, family composition, location, and education	Kerkhof et al., 2009 [53]; Wall and Crosbie, 2009 [54]; Yohanis, 2012 [55]

The demographic composition of energy users has a valuable role with a set of objective variables that helps to define energy patterns: homeownership, income, family size, and age [44,48,51,52]. The home-ownership and income have a more significant contribution to capital investment for energy-saving measures [44]. However, those variables are not enough for an impactful result on energy-saving and efficiency analysis because gender, household size, education, and age group, including the above factors, frame the energy-saving behaviors [44]. Similarly, the age of headship has formed a positive relationship linked to income and homeownership. It can be summarized that income, type of

house, family composition, location, and education are significant factors in energy-saving behavior [53–55]. However, the relationship between education and income is complicated in understanding energy use behavior (Table 4).

Various studies worldwide exhibit that women who use less energy than men have a positive attitude towards energy savings (Table 5). Similarly, the age factor is one of the critical factors in energy consumption. As people become older, they tend to use energy less and adopt an attitude toward using efficient technologies. Females' education also has an impact on household energy and attitude towards clean energy, as shown in Table 5. Previous studies reveal that the relationship of age, education, and energy consumption is linearly associated in increasing tendency.

Table 5. Energy-saving by gender and other variables in various studies.

Authors	Country/Region	Sector/Concept	Energy-Saving
Räty and Carlsson-Janyama, 2009 [56]	Germany and Norway	Housing, food, transport sectors	Men used 7–80% more energy for transportation than women in Germany and Norway. Men used 30% more energy than women for food (going to restaurants).
Han et al., 2009 [57]	World Context	Ecofriendly concept	Women/older people are engaged in green ecological behaviors and purchase decisions compared to men.
Yue et al., 2013 [58]	China	Interpersonal behavior	Older people follow more energy-usage reduction behavior than those over 56 years. Middle-aged people have high consumption power to buy energy-efficient products but less time and energy to engage in usage reduction and interaction.
Do Paco et al., 2015 [59]	Portugal and United Kingdom	Attitude of college students	Female students have more positive attitudes towards energy saving compared to male students.
Mills and Schleich, 2012 [60]	EU countries and Norway	Family size consideration	Households with young children have higher levels of adopting energy-efficient technologies for energy savings. Households with elderly members have financial savings with lower levels of technology adoption.
Thanh Nguyen et al., 2021 [61]	Vietnam	Aged group	Older people have higher energy needs, such as more heating and air conditioning that increase electricity consumption.
Hori et al. (2013) [62]	Asian Cities	Community-based activities	Women and higher-aged people are higher in social interaction linked to energy-saving behaviors.
Sovacool et al., 2018 [63]	World Context	Electric appliances and electric vehicles	Educated, employed men below middle age (30–45) are eager to buy efficient appliances.

Table 5. *Cont.*

Authors	Country/Region	Sector/Concept	Energy-Saving
Wang et al., 2019 [64]	China	Household	Males use 1.2 to 1.5 times higher energy than females.
Matsumoto, 2019 [65]	Japan	Household chores at night	Females used 0.14 kWh more energy than males due to more household works during sleeping time.
Pandey and Chaubal, 2011 [66] Nikus and Wayessa, 2021 [67]; Rahut et al., 2014 [68]	India, Ethopia, and Bhutan	Household energy/clean fuel use	The higher the female education, the greater likelihood of clean fuels being used (r = 0.46). When household is female-headed (sig. 5%), a higher use of clean fuel is used.
Burke and Dundas, 2015 [69]	Brazil	Household energy	With a greater percentage of female labor participation, there is a decrease in solid fuel use up to 25%.
Grünewald and Diakonova, 2020 [70]	United Kingdom	Household energy	Male single households use 13% more energy compared to female single households.
Shrestha et al., 2020 [71]	Nepal	Household	Up to 23% energy bill saving in households due to female participation in energy decisions.

The trend of energy consumption patterns of males and females shows that females use lower energy than males in household activities, as shown in Figure 4. Previous cases exhibit that females attempt to use less energy by substituting expensive fuels with cheaper ones or waste fuel and following the multiple fuels model to save household energy. In some contexts, females adapt themselves by drinking hot beverages and putting more clothes on the body to reduce heating energy. However, the age of females and education also influence energy-saving behavior and attitude (Table 5). In developed countries, energy consumption is higher compared to less developed countries due to energy accessibility and affordability [56,72]. Females of less developed countries are more responsible for daily fuel management due to social roles and socialization patterns.

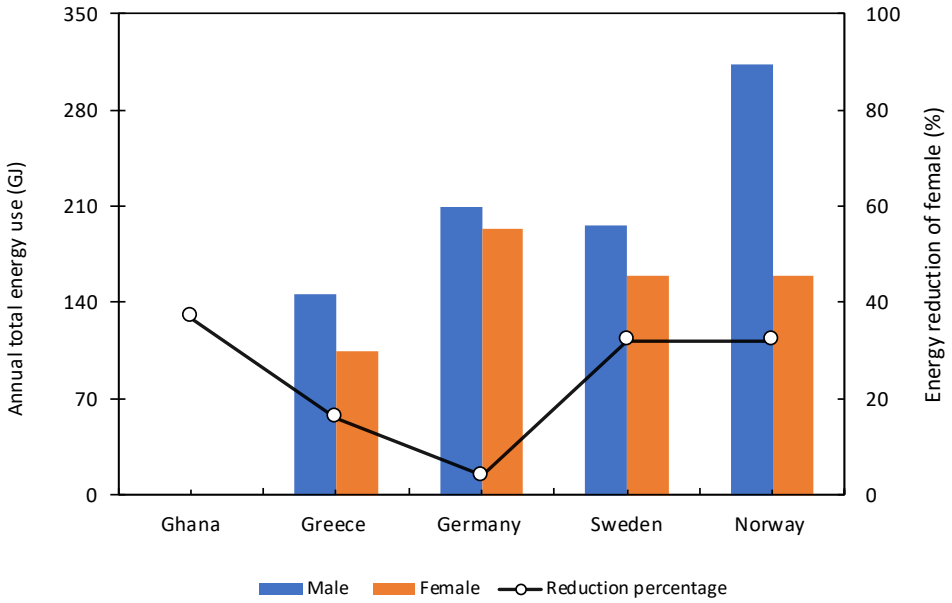

Figure 4. Trend of household energy use and saving by male vs. female [56,72].

3.1.3. Linkage of Energy-Saving and Energy Decision

Numerous researchers [22,39,56] show the importance of energy decisions in the household to lower energy consumption and suggest theoretical energy decision models at the household level. The household energy decision models for changing behavior as design interventions can help to act as behavioral drivers for intervention. These models have a more extensive understanding of theoretical preferences applied in various disciplines for understanding behavior as well as designing and evaluating interventions. For instance, technology adoptions and attitude-based decision models refer to innovation-decision processes related to the attitude-based theories of behavior. It suggests that the attributes of innovations need to focus on both product development and marketing of energy-efficient knowledge and behaviors. In comparison, the social and environmental psychology model has an extensive focus on household energy efficiency and saving behavior. Wilson and Dowlatabadi [39] highlight that a proper set of information being shared to raise awareness based on beliefs is more useful to influence people's behavior. It suggests that the study of psychosocial characteristics is essential to understand the Value–Belief–Norm (VBN) system.

VBN theory helps to map contextual domains including variables specific to the individual (skills and know-how) and shared knowledge. It suggests that information and education-based interventions can influence beliefs and stimulate norms for social change. The social construction of decision-making highlights the importance of social dimensions of household energy use study to understand the efficiency gap. It helps to understand habitual activities (daily routine), energy constraints, marketing process, and impetus for efficiency and energy-saving behavior.

3.2. Gender Concept Development for Sustainability

Gender accounts for a crucial role from a social aspect of energy-saving process analysis because men and women have different needs. Existing gender norms, including power relations between them, are likely to focus less on the benefits of women in most countries like in Asia, where socially and culturally defined gender norms have created barriers to energy-related activities [10]. However, gender norms are also changing in most sectors of the world, especially about education, while energy policies and programs are yet to be aligned to these transformations. Women are still in the minority in the energy decision sector and policies. Only a handful of women are in energy policy and decision-making chairs. Some countries do not realize these needs because they do not have gender-disaggregated data that hinders an actual scenario from ensuring gender equality. Numerous studies [10,17,19] show that women are more attentive and willing to adopt green products and an energy-saving attitude. Despite having evidence that women's involvement in the energy sector can improve it productively and innovatively, they are not authoritative enough to come on the energy front lines.

There is a global commitment to the SDGs, including access to sustainable energy for all by 2030 [73]. The gender dimension of the energy transition is integrated into both SDG's 5 (gender equality) and SDG's 7 (affordable and clean energy). However, gender has been serving at least eight SDGs reinforcing all together, particularly to achieve the SDG's target and fill the inequality gap in society; gender role is critical when the energy is in transition.

3.2.1. Historical Significance of Energy and Gender Integration

Looking at history, women have made a remarkable contribution since ancient periods in different sectors of the world, for instance, the scientific world. In the 21st century, various energy initiatives have focused on the active participation of gender and minority groups in energy careers, especially in Northern countries [20,74]. Clancy and Roehr [20] underline that energy is accessible every day, taken for granted, and ultimately rendered unseen in Northern countries. It has resulted in high consumption without consideration of consequences. For instance, the United States and Canada usually consume more energy

per capita than in any country of Asia and Africa. At the same time, the linkage between energy and gender is virtually invisible as men and women are seen as equal in their use of energy because it is believed that the role of women in energy use ends once modern forms of energy became readily available. However, the gender perspective recognizes that most energy projects and programs have ignored at least partially the women's needs, constraints, and contributions [75]. The history shows that it lacks gender analysis to understand the cultural, social, and gender-specific roles of men and women in society.

There is a significant contrast between North and South and in terms of gender roles and norms in energy; however, there are strong similarities in sustainability targets to achieve social, economic, and environmental justice, including energy decision-making. There are minimal studies about the North's experiences on energy and gender; however, Clancy and Roehr [18,20] show that women in the North have also demonstrated the potential contributors in energy efficiency in the energy transition. Household energy use also reflects the gender differences in Northern society [17,75]. The study shows that many singles, senior women, and women-led families spend at least 20% of their income on heating and electricity, as poverty is linked to less energy-efficient housing and reliance on older inefficient appliances.

The current energy transition towards the efficient world through technologies and to achieve Home Energy Management Systems (HEMS) is a critical concern about energy and the environment, focusing on energy consumption as well as social and economic factors [76]. HEMS includes both hardware (smart technology) and software (monitoring) on the energy usage and saving phenomena. It has resulted in people having a central role in the energy equation, and women are also becoming noticeable. Many studies [21,55,56] show that women have the capacity to move towards sustainable energy in energy choices as they are more supportive of soft energy (renewable) and opposing hard energy (oil, gas, and nuclear). Northern women have been actively involving in energy issue to shape a gender-sensitive movement towards sustainability. For instance, there is an increasing women's network in the energy sector, but the critical energy decisions continue as a male domain [74,75]. For example, in Canada, women contribute 24% in the petroleum sector, 60% in sales and services, and one-quarter professional positions. It shows that the number of women in the Oil and Gas sector in Canada has been increasing after addressing equity in the sector for the last two decades. Cecelski [75] has expressed that women have not been excluded intentionally nor overlooked, but they are simply defined out of the energy sector. The energy sector is defined by capital-intensive, large-scale, and management-intensive activities that demand high technology and high-level expertise. Due to this thought, not only women, but many people with low socio-economic status are not involved in this sector due to a lack of energy networking.

3.2.2. Major Themes in Energy and Gender for Sustainability

The historical initiation of energy networking through two significant events remarkably demonstrated the importance of gender mainstreaming in the energy debate: the 1992 Rio Summit and the 1995 Beijing conference [77]. The series of such events has supported women's organizations in the frontier profile in international advocacy and policy due to an energetic part in the UN Conference on Environment and Development with key themes and sub-themes linking energy and gender (Table 6).

Since 1995, visible awareness activities in workshops and meetings on women and energy have been organized tremendously [77]. In 2000, the Millennium Development Goals included a specific goal on gender and equality and empowerment. In 2002, the world summit on sustainable development had reinforced gender issues, and since 2015, the participation of women in energy and environmental issues has been rising positively, as listed in Table 6. Overall, the importance of gender role has been realized along the positive impact on the energy sector in integrating clean energy globally; however, it is not as contagious as it should be.

Table 6. Key themes and subthemes linking energy-saving and gender for sustainability [75,77].

Key Theme—Linking Energy and Gender	Sub-Theme
1981: Renewable sources of energy	Women and energy
1984: Energy and health	Biomass fuel combustion and health
1985: Community energy	Community forestry and energy
1992: Energy and environment	Women, wood fuel, and survival
1995: ENERGIA—sustainable energy	International network
1996: Energy and environment	Women's role in renewable energy
1997: Women's role in energy	Gender in energy, renewable energy
1998: Sustainable global energy	Women and energy sustainability
2001: Sustainable development	Energy and gender needs
2002: Levels of sustainability	Energy accessibility
2006: Climate change	Energy, air pollution, industrial link
2015: Sustainable energy	Renewable energy and environment

3.2.3. Gender Differences in the Household Energy-Saving Behavior and Decisions

Exploration of energy gendering in a broader picture of energy-related behavior on usage and purchase activities across different economies can be enhanced by understanding gender differences as an integral part in energy and gender integration. Ryan [23] has summarized that women are less involved in energy decision-making. Parikh [21] has advocated that women provide 30% of national energy resources, but they are emphasized for advanced technology development. Clancy and Roehr [20], from the North American experience, have highlighted that women have little voice in higher decisions due to cultural and gender identity and emphasize the study of gender differences for energy policy. Women are more positive towards energy-saving than men [14], and Vainio and Paloniemi [78] also identified that Nordic females are positively active in energy-saving activities.

The gender differences are distinct in private and public energy activities [79]. In many countries, women are more active in the private arena than men. These household activities involve more individual decisions on energy-purchase [14]. Women are sensitive to problems about their children's future [80,81] so they exhibit a higher tendency to conserve energy resources. In contrast, men hold higher levels of environmental knowledge than women [14,63,82]. Understanding the roots of gender differences only helps to develop a proper energy-saving policy.

- *Roots of gender differences*

Three major reasons for gender differences are recognized, depending on different socio-economic and subjective factors. First, one possible reason is gender socialization and social roles with disparities in opportunities rather than inherent differences [65–67]. The socialization theory elaborates as men are considered as breadwinners, masters, and competitive. At the same time, women are considered caregivers and have compassionate roles in shaping their role in society and cultural norms [83] (Figure 5).

Second, energy perception and responsibility are further reasons for the gender difference in energy activities. Men are considered to work outside and are less focused on household work compared to women [84]. Women are careful about energy security due to the high responsibility of households, and this is seen as higher in married women having children, in particular. Men and women are different in their perception of the purchasing decision issues due to different moral development, and gender role regulates it (Figure 5).

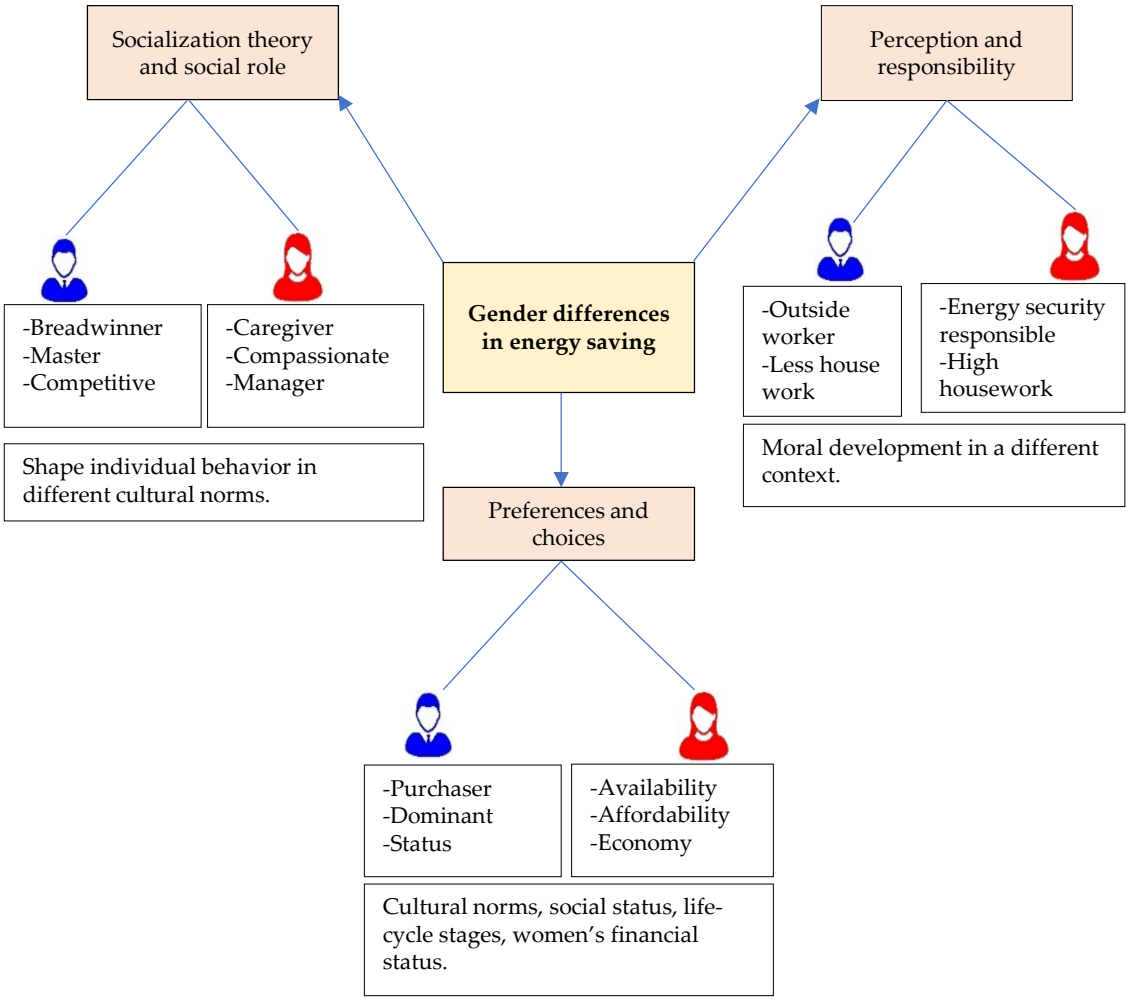

Figure 5. Process of gender differences in energy-saving.

Third, different energy uses and energy appliance selection patterns between men and women also contribute to the gender differences in energy-saving behavior [14]. In most South Asian countries, women are responsible for daily energy management, and they spend three times more on domestic activities than men [7,8]. In most countries, men purchase energy appliances with a dominant role in the household economies, and women use those appliances in a higher range but they have low voices in energy decisions [16]. The women participate less in purchasing decisions, which creates a knowledge and information gap between users, industries, and policymakers. Conclusively, we can say that gender difference is still rooted in society, which hinders achieving gender equality in energy decisions, and it influences energy-saving behavior (Figure 5).

3.2.4. Gender Participation in Household Energy Decision to Impact Energy-Saving

Gender participation is driven by work division and bargaining power [84,85]. Patriarchal societies with a socio-cultural construct are one compelling element in the household labor division because of women's lower voice and low participation [86]. Social status, life-cycle phases, women's financial stability, and budget planning are critical factors in the energy decision [87]. Low participation of women in energy-related purchases with low economic status strongly impacts their energy preferences. A recent South Asian study shows that women's involvement in electrical appliance purchases increased energy interests and ultimately helped lower electricity bills up to 23% compared to average bills in Kathmandu study, Nepal [88], and supported the achievement of economic benefits, social upliftment, and an energy-efficient environment, supporting sustainability goals.

Additionally, Permana et al. [89] have explored the correlation between women's roles and level of household energy consumption and have found that when women are dominant decision-makers in the household, energy consumption tends to be significantly lower. Women's participation in energy decisions is essential for mainstreaming gender into policies on energy efficiency. Women's decision-making power in the production and allocation of energy has a more significant impact on the development policies [90]. Those studies have comprehensively concluded that women's participation in energy decisions has a pivotal role in the households, and energy authorities should not neglect women's significant contribution as householders in the policy process.

Gender participation in energy decisions (use, purchase, and maintenance) is based on rooted gender differences in society and is influenced by responsible variables to offer inequality situations, as shown in Figure 6. It suggests that active participation, equal upbringing, and increased knowledge can improve gender in energy decisions.

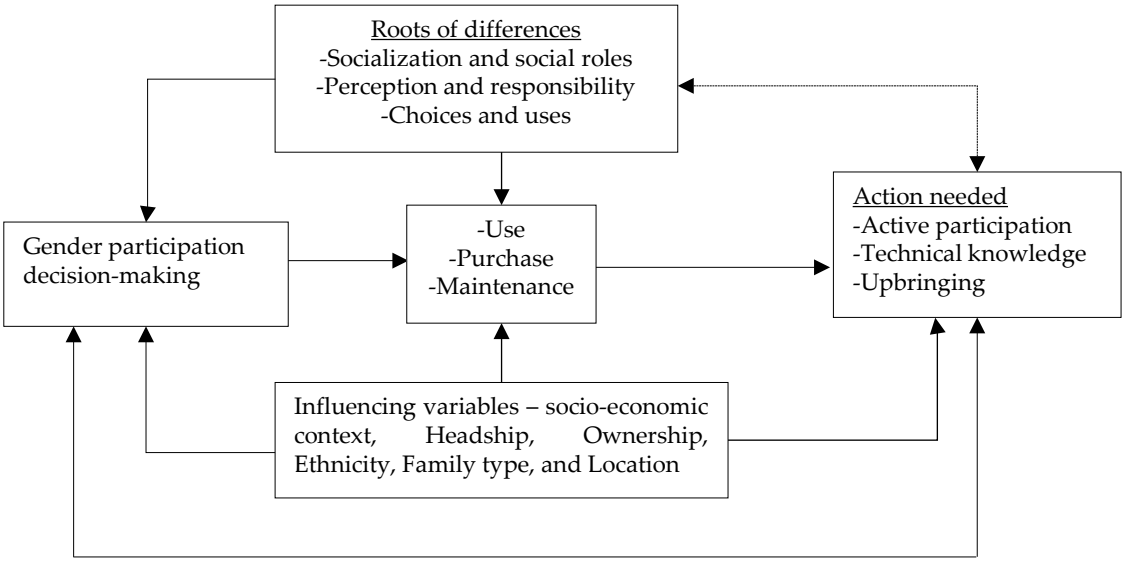

Figure 6. Theoretical framework on gender differences and role in decision-making.

3.3. Overall Discussion and Limitations of the Study

The household is a critical arena to frame gender perspective, having asymmetrical power relations and being often the basis for inequality. It is suggested to revise existing norms and standards by deconstructing structural and cultural conditions and questioning the gendered world itself [91]. Energy studies have concluded that psychological and structural strategies have a significant role in changing people's mindset and perception, increasing motivation, and changing the context structurally on energy efficiency and saving behaviors [50,51], increasing gender participation in energy decisions.

The key themes of the present literature (energy and gender) and corresponding subthemes across different levels of analysis are presented in Table 7. The analysis of the selected peer-reviewed papers presented a limited study on the gender-disaggregated data on energy decisions at the micro and macro level with limited gender awareness and energy education. Various research streams can be enhanced to reduce existing gaps, as presented in Table 7. The first stream of research consists of evaluating social values and networking features for energy-saving performance improvements as information collected from 1983 to 2021. The second stream has been recognized as improving and facilitating gender data, technical education, and awareness from assessing pragmatic and strategic needs to improve the gender and energy integration level. The research stream based on energy-saving improvement directs to potential research opportunities towards developing energy networking business, industrial linkage, household energy decisions, and clean energy infrastructure investment. On the other hand, the research stream based on gender

lens guides possible research prospects to gender awareness, sensitization, improvement in the sex-disaggregated study, and mainstreaming approach to improving the gender and energy integration (Table 7).

Table 7. Research streams and existing gaps.

Research Stream		Gaps and Future Research Streams
Theme	**Sub-Theme**	
Energy consumption and saving	Energy technology design Cultural perspective	Social perspective Energy networking business Industrial linkage Clean energy infrastructure Household energy decisions
Energy and gender integration	Economic perspective (energy ladder) Pragmatic needs Strategic needs	Gender education Gender sensitization Gender-disaggregated Gender education and awareness Mainstreaming gender into energy decisions

4. Conclusions

Reviewing the household energy-saving behavior while keeping gender roles in consideration concludes that gender-sensitive energy policy has a remarkable role in changing people's mindset and perceptions to increase motivation, change their habits, and increase gender participation. Energy-saving behavior has a strength to achieve SDG goal 7 in terms of energy security, accessibility, and affordability for all. At the same time, gender participation in energy indicates the level of gender equality concept to achieve SDG 5. The integrated concept of gender and energy as a common goal may help accelerate the remaining eight SDG goal achievements. Conclusively, the important factors in energy-saving enhancement from gender perspective can be listed as:

- Building features, habits, and socio-economic factors have a major role in energy-saving behavior, and cultural norms/values are strongly linked to gender participation in energy decisions.
- The variables of gender, income, type of house, family composition, location, headship, age-group, ownership, and education are significant influencing factors in energy-saving behavior.
- The gender differences study recognized that socialization, social roles, perception, responsibility, and choice of energy appliances are roots of differences in energy decisions.
- Females use lower energy than males in household activities that has enhanced in household energy-saving.
- Holistic energy networking, gender education, infrastructure development, and mainstreaming gender approach are required to achieve sustainability with the realization of gender importance.

It is suggested to expand the gender-disaggregated study in household energy consumption and saving patterns as the influence of education, income, age, and cultural factors. It may help to mainstream gender in energy policy in a contextual approach.

Author Contributions: As a primary author, B.S. contributed to the data collection, analysis, review writing, and preparing the final draft of the manuscript. S.R.T. edited the content of the paper. S.B.B. and M.M.K. contributed to the advising on format and content. H.B.R. revised and edited the paper's content, contributed to structuring the paper, and advised on the review analysis. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: Not applicable.

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

References

1. Habtezion, S. *Gender and Sustainable Energy: Training Module 4*; United Nations Development Programme: New York, NY, USA, 2016.
2. Santamouris, M. Energy consumption and environmental quality of the building sector. In *Minimizing Energy Consumption, Energy Poverty and Global and Local Change in the Built Environment: Innovating to Zero*; Elsevier: Amsterdam, The Netherlands, 2019.
3. Barr, S.; Prillwitz, J. Household analysis: Researching 'green' lifestyle a survey approach. In *Methods of Sustainability Research in Social Sciences*, 1st ed.; SAGE: London, UK, 2013; pp. 29–47.
4. Fahy, F.; Rau, H. *Methods of Sustainability in the Social Sciences*, 1st ed.; SAGA: London, UK, 2013.
5. Owens, J.; Wilhite, H. Household energy behavior in Nordic countries-an unrealized energy saving potential. *Energy* **1988**, *13*, 853–859. [CrossRef]
6. WHO. *Fuel for Life: Household Energy and Health*; WHO: Geneva, Switzerland, 2006.
7. Van Aelst, K. *Household Decision-Making and Gender Relations in Tanzania: Literature and Theory Review*; Working Paper; Universiteit Antwerpen: Antwerpen, Belgium, 2014.
8. Missri, E. *Gender Differences in Decision Making Processes: A Computerized Experiment*; A Paper on Honors Seminar; IDC Herzliya: Herzliya, Israel, 2008.
9. IEA. *The Energy Progress Report*; World Bank: Washington, DC, USA, 2019.
10. ENERGIA. International Network on Gender and Sustainable Energy. In *Gender in the Transition to Sustainable Energy for All: From Evidence to Inclusive Policies*; ENERGIA: The Hague, The Netherlands, 2019; pp. 1–8.
11. IEA. Energy and Gender, International Energy Association. 2020. Available online: https://www.iea.org/topics/energy-and-gender (accessed on 1 June 2020).
12. IEA. Nepal, International Energy Association. 2017. Available online: https://www.iea.org/sankey/#?c=Nepal&s=Balance (accessed on 5 March 2020).
13. Milne, W. Women, Energy and Sustainability: Making Links, Taking Action. *Can. Woman Stud.* **2003**, *23*, 55–60.
14. Huang, W.; Chao, M. Gender differences in energy-saving behavior. In Proceedings of the 6th Latin American Energy Economics Meeting, Rio de Janerio, Brazil, 2–5 April 2017.
15. Ceceiski, E.W. From Rio to Beijing Engendering the energy debate New perspectives on energy. *Energy Policy* **1995**, *23*, 561–575.
16. Wu, X. Men Purchase, Women Use: Coping with Domestic Electrical Appliances in Rural China. *East Asian Sci. Technol. Soc. Int. J.* **2008**, *2*, 211–234. [CrossRef]
17. Clancy, J.; Ummar, F.; Shakya, I.; Kelkar, G. Appropriate gender-analysis tools for unpacking the gender-energy-poverty nexus. *Gend. Dev.* **2007**, *15*, 241–257. [CrossRef]
18. Clancy, J.; Feenstra, M. *Women, Gender Equality and the Energy Transition in the EU.*; European Parliament: Strasbourg, France, 2019.
19. Nelson, S.; Kuriakose, A.T. *Gender and Renewable Energy: Entry Points for Women's Livelihoods and Employment*; Climate Investment Funds: Washington DC, USA, 2017.
20. Clancy, J.; Roehr, U. Gender and energy: Is there a Northern perspective? *Energy Sustain. Dev.* **2003**, *7*, 44–49. [CrossRef]
21. Parikh, J. Hardships and health impacts on women due to traditional cooking fuels: A case study of Himachal Pradesh, India. *Energy Policy* **2011**, *39*, 7587–7594. [CrossRef]
22. Paul, M.M.; Kumari, M.C. Decision Making: A Significant Indicator for Economic Empowerment of Women. *Int. J. Sci. Res.* **2016**, *5*, 1200–1202. [CrossRef]
23. Ryan, S.E. Rethinking gender and identity in energy studies. *Energy Res. Soc. Sci.* **2014**, *1*, 96–105. [CrossRef]
24. UNDP. *Human Development Report 2011: Sustainability and Equity: A Better Future for All*; UNDP: New York, NY, USA, 2011; Volume 29.
25. Wilhite, H. Energy Consumption as Cultural Practice: Implications for the Theory and Policy of Sustainable Energy Use. In *Cultures of Energy: Power, Practices, Technologies*; EBSCO: Ipswich, MA, USA, 2013; pp. 60–72.
26. Dholakia, R.R.; Dholakia, N.; Firat, A.F. From social psychology to political economy: A model of energy use behavior. *J. Econ. Psychol.* **1983**, *3*, 231–247. [CrossRef]
27. Van Raaij, W.F.; Verhallen, T.M.M. A Behavioral model of residential energy use. *Econ. Psychol.* **1983**, *3*, 39–63. [CrossRef]
28. Van Raaij, W.F.; Verhallen, T.M.M. Patterns of residential energy behavior. *J. Econ. Psychol.* **1983**, *4*, 85–106. [CrossRef]
29. Lutzenhiser, L. A cultural model of household energy consumption. *Energy* **1992**, *17*, 47–60. [CrossRef]
30. Kuhe, A.; Bisu, D.Y.; Iortyer, H.A. Optimization of cooking energy mix, an alternative strategy to reduce deforestation: An example of households and restaurants in the Bauchi Metropolis, Nigeria. *Afr. J. Sci. Technol. Innov. Dev.* **2017**, *9*, 207–213. [CrossRef]
31. Masera, O.R.; Saatkamp, B.D.; Kammen, D.M. From linear fuel switching to multiple cooking strategies: A critique and alternative to the energy ladder model. *World Dev.* **2000**, *28*, 2083–2103. [CrossRef]
32. Muller, C.; Yan, H. Household Fuel Use in Developing Countries: Review of Theory and Evidence. *Energy Econ.* **2018**, *70*, 429–439. [CrossRef]
33. Yu, B.; Zhang, J.; Fujiwara, A. Analysis of the residential location choice and household energy consumption behavior by incorporating multiple self-selection effects. *Energy Policy* **2012**, *46*, 319–334. [CrossRef]

34. Nasir, Z.A.; Murtaza, F.; Colbeck, I. Role of poverty in fuel choice and exposure to indoor air pollution in Pakistan. *J. Integr. Environ. Sci.* **2015**, *12*, 107–117. [CrossRef]
35. Hitchcock, G. An integrated framework for energy use and behavior in the domestic sector. *Energy Build.* **1993**, *20*, 151–157. [CrossRef]
36. Wilk, R. Consumption, human needs, and global environmental change. *Glob. Environ. Chang.* **2002**, *12*, 5–13. [CrossRef]
37. Yust, B.L.; Guerin, D.A.; Coopet, J.G. Residential energy consumption: 1987 to 1997. *Fam. Consum. Sci. Res. J.* **2002**, *30*, 323–349. [CrossRef]
38. Keirstead, J. Evaluating the applicability of integrated domestic energy consumption frameworks in the UK. *Energy Policy* **2006**, *34*, 3065–3077. [CrossRef]
39. Wilson, C.; Dowlatabadi, H. Models of Decision Making and Residential Energy Use. *Annu. Rev. Environ. Resour.* **2007**, *32*, 169–203. [CrossRef]
40. Stephenson, J.; Barton, B.; Carrington, G.; Gnoth, D.; Lawson, R.; Thorsnes, P. Energy cultures: A framework for understanding energy behaviours. *Energy Policy* **2010**, *38*, 6120–6129. [CrossRef]
41. Dietrich, K.; Latorre, J.M.; Olmos, L.; Ramos, A. Demand Response Mechanism Design and the Impact of Crucial Parameters on its Effectiveness. 2014, pp. 1–11. Available online: https://www.iit.comillas.edu/documentacion/IIT-13-027A/Demand_Response_Mechanism_Design_and_the_Impact_of_Crucial_Parameters_on_its_Effectiveness (accessed on 10 September 2021).
42. Thayer, D.; Brummer, W.; Smith, B.A.; Aslin, R.; Gas, P. Is Behavioral Energy Efficiency and Demand Response Really Better Together? *ACEEE Summer Study Energy Effic. Build.* **2016**, 1–11.
43. Khan, I. Energy-saving behaviour as a demand-side management strategy in the developing world: The case of Bangladesh. *Int. J. Energy Environ. Eng.* **2019**, *10*, 493–510. [CrossRef]
44. Dillman, D.A.; Rosa, E.A.; Dillman, J.J. United States: The Poor Accept Lifestyle Cutbacks. *Econ. Psychol.* **1983**, *3*, 299–315. [CrossRef]
45. Stern, P.C.; Guagnano, G.A.; Dietz, T. Influences on attitude behaviour relationships: A natural experiment with curbside recycling. *Environ. Behav.* **1995**, *27*, 699–718.
46. Sütterlin, B.; Brunner, T.A.; Siegrist, M. Who puts the most energy into energy conservation? A segmentation of energy consumers based on energy-related behavioral characteristics. *Energy Policy* **2011**, *39*, 8137–8152. [CrossRef]
47. Poortinga, W.; Steg, L.; Vlek, C.; Wiersma, G. Household preferences for energy-saving measures: A conjoint analysis. *Econ. Psychol.* **2003**, *30*, 49–64. [CrossRef]
48. Barr, S.; Gilg, A.W.; Ford, N. The household energy gap: Examining the divide between habitual- and purchase-related conservation behaviours. *Energy Policy* **2005**, *33*, 1425–1444. [CrossRef]
49. Ribó-Pérez, D.; Larrosa-López, L.; Pecondón-Tricas, D.; Alcázar-Ortega, M. A critical review of demand response products as resource for ancillary services: International experience and policy recommendations. *Energies* **2021**, *14*, 846. [CrossRef]
50. Stern, P.C. New Environmental Theories: Toward a Coherent Theory of Environmentally Significant Behavior. *J. Soc. Issues* **2000**, *56*, 407–424. [CrossRef]
51. Painter, J.; Semenik, R.; Belk, R. Is there a generalized energy conservation ethic? A comparison of the determinants of gasoline and home heating energy conservation. *J. Econ. Psychol.* **1983**, *3*, 317–331. [CrossRef]
52. Trotta, G. Factors affecting energy-saving behaviours and energy efficiency investments in British households. *Energy Policy* **2018**, *114*, 529–539. [CrossRef]
53. Kerkhof, A.C.; Benders, R.M.J.; Moll, H.C. Determinants of variation in household CO2 emissions between and within countries. *Energy Policy* **2009**, *37*, 1509–1517. [CrossRef]
54. Wall, R.; Crosbie, T. Potential for reducing electricity demand for lighting in households: An exploratory socio-technical study. *Energy Policy* **2009**, *37*, 1021–1031. [CrossRef]
55. Yohanis, Y.G. Domestic energy use and householders' energy behaviour. *Energy Policy* **2012**, *41*, 654–665. [CrossRef]
56. Räty, R.; Carlsson-Kanyama, A. *Comparing Energy Use by Gender, Age and Income in Some European Countries*; Research Support and Administration, Swedish Defence Research Agency: Stockholm, Sweden, 2009.
57. Han, H.; Hsu, L.T.; Lee, J.S. Empirical investigation of the roles of attitudes toward green behaviors, overall image, gender, and age in hotel customers' eco-friendly decision-making process. *Int. J. Hosp. Manag.* **2009**, *28*, 519–528. [CrossRef]
58. Yue, T.; Long, R.; Chen, H. Factors influencing energy-saving behavior of urban households in jiangsu province. *Energy Policy* **2013**, *62*, 665–675. [CrossRef]
59. Do Paco, A.; Shiel, C.; Cotton, D.; Lavrador, T. Does Gender Really Matter When We Are Talking About Energy Saving Attitudes and Behaviours? In Proceedings of the International Congress on Public and Nonprofit Marketing, Vitoria, Brazil, 24–27 June 2015; pp. 1–13.
60. Mills, B.; Schleich, J. Residential energy-efficient technology adoption, energy conservation, knowledge, and attitudes: An analysis of European countries. *Energy Policy* **2012**, *49*, 616–628. [CrossRef]
61. Thanh Nguyen, T.; Trung Duong, K.; Anh Do, T. Situational factor affecting energy-saving behavior in direct approaches in Hanoi City. The role of socio-demographics. *Cogent Psychol.* **2021**, *8*, 8634. [CrossRef]
62. Hori, S.; Kondo, K.; Nogata, D.; Ben, H. The determinants of household energy-saving behavior: Survey and comparison in five major Asian cities. *Energy Policy* **2013**, *52*, 354–362. [CrossRef]

63. Sovacool, B.K.; Kester, J.; Noel, L.; de Rubens, G.Z. The demographics of decarbonizing transport: The influence of gender, education, occupation, age, and household size on electric mobility preferences in the Nordic region. *Glob. Environ. Chang.* **2018**, *52*, 86–100. [CrossRef]
64. Wang, J.; Zhu, J.; Ding, Z.; Zou, P.X.W.; Li, J. Typical energy-related behaviors and gender difference for cooling energy consumption. *J. Clean. Prod.* **2019**, *238*. [CrossRef]
65. Matsumoto, S. Daily Habits and Energy Consumption: Go to Bed Earlier for Environmental Protection. *Eur. J. Sustain. Dev.* **2019**, *8*, 54. [CrossRef]
66. Pandey, V.L.; Chaubal, A. Comprehending household cooking energy choice in rural India. *Biomass Bioenergy* **2011**, *35*, 4724–4731. [CrossRef]
67. Nikus, T.A.; Wayessa, B.G. Determinants of household energy choice in West Shoa Zone: In the case of Ambo Town. *Int. J. Green Energy* **2021**. [CrossRef]
68. Rahut, D.B.; Das, S.; De Groote, H.; Behera, B. Determinants of household energy use in Bhutan. *Energy* **2014**, *69*, 661–672. [CrossRef]
69. Burke, P.J.; Dundas, G. Female Labor Force Participation and Household Dependence on Biomass Energy: Evidence from National Longitudinal Data. *World Dev.* **2015**, *67*, 424–437. [CrossRef]
70. Grünewald, P.; Diakonova, M. Societal differences, activities, and performance: Examining the role of gender in electricity demand in the United Kingdom. *Energy Res. Soc. Sci.* **2020**, *69*, 101719. [CrossRef]
71. Shrestha, B.; Bajracharya, S.B.; Keitsch, M.M.; Tiwari, S.R. Gender differences in household energy decision-making and impacts in energy saving to achieve sustainability: A case of Kathmandu. *Sustain. Dev.* **2020**, *28*, 1049–1062. [CrossRef]
72. Asibey, M.O.; Ocloo, K.A.; Amponsah, O. Gender differences and productive use of energy fuel in Ghana's rural non-farm economy. *Energy* **2021**, *215*, 119068. [CrossRef]
73. UNDP, The global goals for sustainable development. In *Sustainable Development Goals*; UNDP: New York, NY, USA, 2020.
74. Fehner, T. History of Women in Energy Department. 2014. Available online: https://www.energy.gov/articles/history-women-energy-department (accessed on 2 June 2021).
75. Cecelski, E. *The Role of Women in Sustainable Economic Development*; Thomson Reuters: Toronto, ON, Canada, 2012; pp. 1–38.
76. Mahapatra, B.; Nayyar, A. Home energy management system (HEMS): Concept, architecture, infrastructure, challenges and energy management schemes. *Energy Syst.* **2019**. [CrossRef]
77. Moser, C.; Moser, A. Gender mainstreaming since Beijing: A review of success and limitations in international institutions. *Gend. Dev.* **2005**, *13*, 11–22. [CrossRef]
78. Vainio, A.; Paloniemi, R. The complex role of attitudes toward science in pro-environmental consumption in the Nordic countries. *Ecol. Econ.* **2014**, *108*, 18–27. [CrossRef]
79. Hunter, L.M.; Hatch, A.; Johnson, A.; Hunter, L.M.; Hatch, A. Johnson, Aaron Cross-National Gender Variation in Environmental Behaviors. *Soc. Sci. Q.* **2004**, *85*, 677. [CrossRef]
80. Do Paço, A.; Varejão, L. Factors affecting energy saving behaviour: A prospective research. *J. Environ. Plan. Manag.* **2010**, *53*, 963–976. [CrossRef]
81. Sigmon, S.T.; Stanton, A.L.; Snyder, C.R. Gender Differences in Coping: A Further Test of Socialization and Role Constraint Theories. *Sex. Roles* **1995**, *33*, 565–587. [CrossRef]
82. Wallhagen, M.; Eriksson, O.; Sörqvist, P. Gender differences in environmental perspectives among urban design professionals. *Buildings* **2018**, *8*, 59. [CrossRef]
83. Crow, S.M.; Fok, L.Y.; Hartman, S.J.; Payne, D.M. Gender and values: What is the impact on decision making? *Sex. Roles* **1991**, *25*, 255–268. [CrossRef]
84. Ponthieux, S.; Meurs, D. Gender inequality. In *The Cambridge Handbook of Income Distribution*; Anthony, B., Atkinson, F.B., Eds.; Elsevier: Amsterdam, The Netherlands, 2018; Volume 1, pp. 983–1145, ISBN 9781108656184.
85. Dyson, T.; Moore, M. On Kinship Structure, Female Autonomy, and Demographic Behavior in India. *Popul. Dev. Rev.* **1983**, *9*, 35–60. [CrossRef]
86. Alem, Y.; Hassen, S.; Köhlin, G. *Decision-Making within the Household: The Role of Autonomy and Differences in Preferences Decision-making within the Household: The Role of Autonomy and Differences in Preferences*; University of Gothenburg: Gothenburg, Sweden, 2018; Volume 2473.
87. Davis, H.L. Decision Making within the Household. *J. Consum. Res.* **2002**, *2*, 241. [CrossRef]
88. Shrestha, B.; Tiwari, S.; Bajracharya, S.; Keitsch, M. Role of gender participation in urban household energy technology for sustainability: A case of Kathmandu. *Discov. Sustain.* **2021**, *2*, 19. [CrossRef]
89. Permana, A.S.; Aziz, N.A.; Siong, H.C. Is mom energy efficient? A study of gender, household energy consumption and family decision making in Indonesia. *Energy Res. Soc. Sci.* **2015**, *6*, 78–86. [CrossRef]
90. Doss, C. Intrahousehold bargaining and resource allocation in developing countries. *World Bank Res. Obs.* **2013**, *28*, 52–78. [CrossRef]
91. Jalusic, V. *Stretching and Bending the Meanings of Gender in Equality Politics*; Routledge: Oxfordshire, UK, 2009; Volume 26, pp. 52–67.