applied sciences

MDPI

Article

Demand Response Requirements from the Cultural, Social, and Behavioral Perspectives

Mohammadreza Shekari [1], Hamidreza Arasteh [2], Alireza Sheikhi Fini [2] and Vahid Vahidinasab [3,*]

[1] Power Systems Group, Department of Electrical and Computer Engineering, Tarbiat Modares University, Tehran 14155-6343, Iran; m_shekari@modares.ac.ir
[2] Power Systems Operation and Planning Research Department, Niroo Research Institute, Tehran 14665-517, Iran; harasteh@nri.ac.ir (H.A.); asheikhi@nri.ac.ir (A.S.F.)
[3] Department of Engineering, School of Science and Technology, Nottingham Trent University, Nottingham NG11 8NS, UK
* Correspondence: vahid.vahidinasab@ntu.ac.uk

Abstract: Demand-side response programs, commonly known as demand response (DR), are interesting ways to attract consumers' participation to improve electric consumption patterns. Customers are encouraged to modify their usage patterns in reaction to price increases through DR programs. When wholesale market prices are high or network reliability is at risk, DR can help to establish a balance between electricity generation and consumption by providing incentives or considering penalties. The overall objective of adopting DR programs is to increase network reliability and decrease operational costs. Nevertheless, the successful deployment of DR programs requires a set of conditions without which no success can be guaranteed. Implementing DR programs and achieving customers' optimal power consumption behavior could be obtained through technical methods, such as using smart home appliances and big data techniques. However, even if each of these approaches is correctly implemented, they are not able to address all aspects of the problem. The findings of several studies demonstrate that, in addition to technical and economic concerns, social, cultural, and behavioral variables play a significant role in DR implementation. Therefore, this paper investigated the social, cultural, and behavioral variables as critical requirements for implementing DR programs. Furthermore, a theoretical framework and an analytical model of the elements impacting the electricity consumption are introduced that should be considered by the planners.

Keywords: demand response; behavioral requirements; cultural and social perspectives; consumption pattern; theoretical framework; analytical model

Citation: Shekari, M.; Arasteh, H.; Sheikhi Fini, A.; Vahidinasab, V. Demand Response Requirements from the Cultural, Social, and Behavioral Perspectives. *Appl. Sci.* **2021**, *11*, 11456. https://doi.org/10.3390/app112311456

Academic Editors: Amjad Anvari-Moghaddam, Somayeh Asadi, Behnam Mohammadi-Ivatloo, Mohammad Shahidehpour and Andreas Sumper

Received: 19 September 2021
Accepted: 22 November 2021
Published: 3 December 2021

1. Introduction

Energy issues were not considered a major concern prior to the 1973 oil crisis [1]. The trend in energy consumption shifted dramatically when crude oil and energy costs rose. Thus, oil-importing countries moved toward more energy savings and better utilization of available resources [2]. Aside from the technological considerations, customer participation in energy management has gained much attention. Therefore, numerous studies were conducted to discover an efficient solution based on customers' behaviors in order to optimize energy consumption patterns. Demand side management (DSM) programs are widely used to modify the overall consumption profile in order to reduce electricity costs. DSM refers to a set of actions aimed to control and optimize energy consumption and minimize expenses, from grid charges to general system charges, such as taxes [3]. However, DSM encompasses a broader concept of energy management, whereas demand response (DR) focuses more on electricity demand [4]. DR programs are significant globally, due to their potential to engage end-users in the power supply chain [5,6]. Customers'

ability to modify their consumption patterns in response to market/system signals is defined as DR [7,8].

DR implementation is highly dependent on the customers' decisions. Regardless of whether the decisions are responsive or not, the implementation of DR is considered a multifaceted subject. In reality, in addition to the electrical aspect, other factors such as economic, cultural, social, and behavioral ones are required for the successful implementation of DR. In this regard, it is important to evaluate humans' actions, beliefs, attitudes, and behaviors in economic, social, and cultural contexts.

Moreover, researchers are increasingly considering how communities respond to various challenges as an important topic. In addition, the relationship between environmental exploitation, and environmental beliefs and values is also considered a significant research area [9].

In order to modify consumers' energy consumption patterns, many scientific solutions have been presented. For example, on the one hand, technical experts believe that technological advancement has the greatest impact on energy consumption optimization [10]. On the other hand, economists mainly have focused on increasing the prices of energy carriers as the primary way to control energy consumption. However, even if each of these approaches is correctly implemented, they are not able to address all the aspects of the problem. The findings of several studies demonstrated that, in addition to technical and economic concerns, social, cultural, and behavioral variables play a significant role in energy consumption and, subsequently, DR implementation.

Furthermore, nowadays, communities are more concerned about the environment, and societies are moving toward more decarbonization. As a result, this factor should be taken into account for developing a DR implementation roadmap. Additionally, economic and financial aspects should be considered in the real world to design and implement practical projects. Thus, aside from the other non-technical factors, the economic part should also be studied for achieving efficient DR implementation.

Nevertheless, the scope of this paper is on identifying the cultural, social, and behavioral factors affecting energy consumption habits and DR programs. However, since different sociological factors are intertwined and cannot be separated in many cases [11,12], economic and environmental factors are also considered in the literature review of this paper.

Culture is the determining element in the development of all long-term human behavior. Culture could be defined as an immaterial and man-made environment that includes values, beliefs, customs, and traditions accepted by the majority of society. The most important feature of culture is stability and adhesion. In other words, culture is defined as the population's lifestyle, including arts, beliefs, and institutions, passed down from generation to generation. Culture has been described as "a whole society's way of existence". As a result, it encompasses etiquette, dress, language, religion, rituals, and art [13]. On the one hand, sustainable human behavior is the result of a particular culture. On the other hand, differences in behaviors are also the result of differences in cultures. As a result, changing sustainable behaviors requires a culture shift. Therefore, to change society's consumption behavior, special credit should be given to the cultural factor [14].

Moreover, the social aspect refers to the interaction of people and other organisms with each other and their collective co-existence. Social organisms, including humans, live collectively in interacting populations [15]. Humans, like other social species, live in interacting communities. This interaction is considered social whether they are aware of it or not, and whether the exchange is voluntary/involuntary.

DR implementation requires a suitable automation system to meet the fluctuating circumstances inside energy networks. However, obtaining a social license, i.e., ensuring the acceptance and agreement of the impacted stakeholder communities, is one of the critical barriers for introducing and sustaining automation systems for implementing DR programs [16,17]. As a result, this paper aims to provide an overview of the existing state of knowledge and remaining problems to understand the social aspects vital for a successful

DR implementation. Therefore, social factors affecting energy consumption have also been examined in conducting this paper's state of the art.

Theoretically, controlling energy consumption has enormous potential benefits for energy resource conservation. However, there are many barriers against DR programs targeting behavioral patterns of energy consumption. Behavior refers to a person's behaviors or reactions in response to external or internal stimuli. Energy behaviors refer to all human activities that have an impact on how energy is used to provide desired services. Maintaining the changed behavior is among one of the most significant challenges. In the short term, incentives and encouragement may have a good effect on people. Still, if their physical and social surroundings remain unchanged, individuals will quickly revert to their former behaviors once the interventions are finished [18]. Various behaviors rely on different procedures. One-time behaviors, such as purchasing an energy-efficient appliance, differ from everyday behaviors, such as turning off the lights. People predicate a lot of their behaviors on those of other people, especially those around them. The implementation of DR programs requires a solid grasp of the implications of daily living routines and behavioral norms on energy usage, as well as a thorough knowledge of the target group and their problems. By understanding important behavioral factors affecting energy consumption, power system operators would be able to modify the consumption behaviors or pave the way for this change. It can also help visualize energy consumption, determine the appropriate time for operators to intervene, and involve stakeholders in DR programs.

Thanks to the existence of appropriate frameworks for economic analysis, such as classical economic theory, there are many research works on the financial obstacles of energy efficiency programs, which can influence the analysis of DR barriers [17]. There is no need to reiterate economic fundamentals because they are so well understood and universally accepted. However, when it comes to DR, fundamental economic mistakes are still widespread [19]. Although the primary focus of this study is on cultural, social, and behavioral factors, the literature review also looks at the most significant economic variables that impact the implementation of DR programs. The major findings of this investigation revealed that economic barriers are primarily defined as those factors that affect the financial willingness of entities and organizations to explore possibilities to supply ancillary services and DR. One of the most significant economic challenges to adopting DR programs is the lack of desirable incentives. This might have a major impact on the rate of participation in DR programs.

The promotion of DSM programs can raise public awareness of environmental concerns and power safety, which are important for DR success [20]. It is found that the potential of DR implementation depends on the weather, building dynamics, occupant preferences and behaviors, as well as the environment. Furthermore, the response of a group of prosumers might be changed depending on the environmental conditions [21]. For example, it was observed that the flexibility of a DR actor was reduced from 500 MW in winter 2018 to 50 MW in spring 2020, due to the environmental factors [22]. Therefore, in addition to the other variables stated above, environmental factors impacting DR deployment are also considered in the literature review.

The rest of the paper is organized as follows. In Section 2, the research hypotheses, methodologies, literature review, concepts, and a theoretical framework are introduced to study the influential factors on energy consumption. Section 3 is dedicated to investigating customers' sensitivity with respect to the electricity prices. Then, some of the important factors in raising the DR programs' participation rate are introduced in Section 4. In Section 5, an analytical model is presented to show the relationship between the proposed cultural, social, and behavioral factors. In addition, the relationship between various factors and electricity consumption behavior is demonstrated in this section. The appropriate discussion, solutions, and outlook are also provided in Section 6. Finally, the conclusions are presented in Section 7.

2. Methodologies, Concepts and Theoretical Framework

The major findings of the literature review in cultural, social, behavioral, economic, and environmental factors that significantly influence energy consumption habits are presented in Tables 1 and 2. The following information was obtained from a study of 53 references over the last 20 years. As the tables show, most studies were conducted on residential customers. The most important factors that were studied are the social and behavioral ones. However, only four references considered all the aspects. It can also be observed that environmental and cultural factors need more attention in future research studies.

Table 1. Taxonomy of the studies from five different aspects.

Ref.	Different Aspects					Type of Customers
	Cultural	Social	Behavioral	Economic	Environmental	
[23]	√		√		√	Urban citizens
[24]	√			√		Residential
[25]			√	√		Residential
[26]		√		√	√	Residential
[27]		√	√			Industrial
[28]		√	√			Residential (Schools)
[29]		√		√		Residential
[30]	√	√				Rural citizens
[31]		√		√		Industrial
[32]	√			√		Industrial and Residential
[33]	√			√		Urban citizens
[34]		√			√	Urban citizens
[35]	√	√			√	Industrial
[36]	√	√	√	√		Residential and Urban citizens
[37]		√	√			Residential
[38]	√	√	√		√	Industrial
[39]				√		Residential
[40]		√	√		√	Urban citizens
[41]			√		√	Residential
[42]	√	√	√			Residential (Schools)
[43]	√			√	√	Urban citizens
[44]			√	√		Residential
[45]	√	√		√		Residential
[46]		√	√			Industrial
[47]		√	√	√		Residential
[48]	√	√	√	√	√	Residential
[49]		√	√			Residential
[50]		√	√			Residential
[51]		√		√	√	Residential
[52]	√			√	√	Country citizens
[53]		√	√		√	Residential
[54]			√	√		Residential
[55]	√		√			Rural citizens
[56]	√					Residential
[57]		√	√	√		Residential and Urban citizens
[58]			√	√		Industrial and Residential
[59]		√		√	√	Residential
[60]		√	√			Industrial and Residential
[61]			√		√	Industrial
[62]	√	√	√			Residential
[63]	√		√	√		Industrial and Residential
[64]		√	√	√		Industrial and Residential
[65]		√	√	√	√	Country citizens
[66]	√	√	√	√	√	Industrial and Residential
[67]			√	√	√	Industrial and Country citizens
[68]			√	√		Industrial and Residential

Table 1. *Cont.*

Ref.	Different Aspects					Type of Customers
	Cultural	Social	Behavioral	Economic	Environmental	
[69]		√	√	√	√	Industrial
[70]	√	√	√	√	√	Residential
[71]		√		√		Industrial and Country citizens
[72]		√		√	√	Industrial
[73]	√	√	√			Residential
[74]	√	√				Residential
[75]	√	√	√	√	√	Industrial and Residential
Percentage	41.50	66.03	64.15	58.49	39.62	-

Table 2. Main results of literature review.

Ref.	Main Results
[23]	There is a close relationship between electricity consumption and gender, environmental lifestyle variables, ecological awareness, and environmental value.
[24]	Cultural attributes, residence, and income have significant effects on electricity consumption.
[25]	Behavioral attributes of residential customers are highly dependent on the characteristics of households, types of residential houses, and the features of the electrical appliances.
[26]	Electricity consumption management at a residential building is dependent on various social and economic factors, including household income, the number of family members, usage rates and prices of electrical appliances, building infrastructure, number of rooms, and education level.
[27]	Customer awareness of energy is introduced as the most important variable in the social aspect of DR programs. Prosumer's energy consumption behaviors are shaped depending on their understanding of the energy system's infrastructure.
[28]	Direct learning through brochures, books, and videos is presented as one of the most significant behavioral variables in enhancing individual engagement in energy management programs, based on the findings of an experiment.
[29]	According to the findings of their experiment, the higher a household's income, the more inefficient their energy usage is. Moreover, the higher the family members' degrees of education and awareness, the more energy efficient their behaviors.
[30]	Rural society's consumption behavior is mainly affected by the ceremonial points of view, which mostly consist of cultural and behavioral issues.
[31]	Energy carrier price increases have an inverse impact on energy consumption, meaning that as prices rise, the energy consumption is reduced. Moreover, the population of the society has a direct influence on energy consumption. However, the authors concluded that the relationship between economic growth and energy consumption is direct in the short term, while inverse in the long term.
[32]	Transparency of information about the electricity supply process, comprehensive explanation of the remaining amount of fossil fuel, improving cultural components, providing effective advice on purchasing electrical appliances, and paving the way for sustainable electricity usage are all important factors for better implementation of DR programs.
[33]	It is stated that cultural and economic capitals are the most critical factors influencing the electricity consumption patterns of urban citizens.
[34]	Gross domestic product (GDP), population size, urban population rate, and age factors significantly affect DSM programs.
[35]	It is essential to consider cultural, social, environmental, and technical factors for designing the DR road map. The authors stated that the most significant aspects in developing an efficient energy framework in various sectors, including industry, transportation, and agriculture, are regulation modification, public education, the reduction of transmission losses, and the enhancement of renewable energy sources (RES) integration.
[36]	The effects of several non-technical factors on energy usage were studied. For example, cultural capital, economic capital, gender, age, education level, employment status, number of electrical appliances in the house, people's views about subsidies, monthly income, and housing style (owned or rented) are among the aspects.
[37]	Energy consumption management in the home is influenced by various social, behavioral, and structural factors, such as people's age, architecture of the house, the building's infrastructure, and people's lifestyles.
[38]	The more that companies value the environment and the more they know about it, the more willing they are to participate in energy management and DR programs.
[39]	In this research, household income is introduced as the most important factor in the improper increase in electricity consumption.
[40]	It is concluded that the "Daylight Saving Time" law has a well-positive impact on the energy consumption of households.
[41]	The amount of energy consumption and the rate of participation in energy consumption management programs largely depends on the type of environmental attitude of individuals. Therefore, the more that people are concerned about the environment, the more willing they are to assist DSM operators by participating in DR programs.
[42]	The effectiveness of TV commercials on modifying students' energy consumption behavior is investigated. Educational advertisements and raising students' awareness of DSM programs have a long-term impact on energy usage optimization.

Table 2. *Cont.*

Ref.	Main Results
[43]	Technology adoption level, urbanization, and economic growth are introduced as the most significant factors in total energy consumption modification, respectively.
[44]	The impact of subsidies on household electricity usage is investigated.
[45]	Based on a study on the socio-cultural factors on the households' energy consumption behaviors, it turns out that international media, high education, high wealth, marital status, and low normativeness affect the energy consumption behaviors.
[46]	Lifestyle, environmental friendliness, and commitment to frugal activities are sociological characteristics that impact DR programs.
[47]	There are direct links between energy conservation and understanding of saving measures, commitment, and awareness of the repercussions of excessive usages, meaning that as the rates of these factors increase, energy conservation behaviors improve.
[48]	They performed an extensive study on the social, cultural, and economic factors that influence home energy usage. The findings reveal that people's attention to the environment, their rate of access to facilities, their level of faith in energy system operators, and their chance to obtain trustworthy news sources for understanding energy management programs play an important role in their consumption patterns.
[49]	People have often objected to the consumption management regulations imposed by power system operators, claiming that the regulations violate their privacy by directly affecting their energy consumption. Furthermore, policies such as influencing people's energy usage to change living standards frequently conflict with social welfare objectives and often have negative repercussions.
[50]	The authors conducted a qualitative and quantitative field study to identify the most important factors in reducing household energy consumption. They claimed that the financial status of the head of the household, the type of housing unit (e.g., apartment, house, or ranch house), and the characteristics of electrical appliances are the most critical factors.
[51]	The size and age of the house, the number of home inhabitants, seasons of the year, and people's age and income influence energy consumption behaviors.
[52]	The more people that a country has, the more efficient its energy usage becomes. The same can be said about the age of people, meaning that the behavior of people consuming electricity becomes more efficient with age. Furthermore, the more economically developed a country is and/or the greater its urban population, the more energy it consumes.
[53]	By studying the concept of domestication, the authors offered a novel strategy to reduce consumption in the private sector. However, they also concluded that energy consumption in the private sector is part of a complex network. As a result, it is important to comprehend this network in order to accomplish a more permanent energy reduction.
[54]	They looked at the current energy consumption patterns in the residential sector and analyzed the reasons behind the usage patterns. This study shows that the role of homeowners in choosing a source of energy is very important and is influenced by the family's income.
[55]	They introduced the energy conservation behavior concept as one of the aspects of sustainable consumer behavior. They concluded that individuals' values and beliefs activate personal norms, which leads to conservation behavior.
[56]	They examined some of the most important assumptions and ideas about how people utilize energy in their homes. They investigated the influence of erroneous conclusions from simplified theories on energy efficiency. They also recommended a new method for reducing energy use.
[57]	Residential energy consumption is influenced by the social and economic factors of the family members, such as gender and income, as well as their vehicles' features and number.
[58]	In collaboration with the private sector and local authorities, the government can encourage people (individuals or communities) to save energy and improve consumption patterns by using their own behavioral insights.
[59]	The country's specific political conditions and the policy framework determine the form of daily consumption of households. The effectiveness of three policy tools (legislative, economic, and communicative) on residential consumption is also investigated.
[60]	Consumers become encouraged to use less energy and improve their consumption behaviors if they receive energy consumption feedback. Customers were asked to record and submit their electricity meter readings. The results showed that individuals who took part in the trial spent 6% to 7% less energy than those who did not.
[61]	A survey is utilized to investigate how procrastination and environmental awareness impact people's heating-energy-saving behaviors. According to the findings, people who have a propensity for procrastination are considerably less likely to engage in most heating energy-saving actions. It was also found that there is a positive relationship between environmental awareness and involvement in daily energy-saving activities, such as reducing the indoor temperature.
[62]	This research developed a multidisciplinary framework by combining home data from a population census, activity-based energy demand modeling, and a survey on behavioral intentions to participate in DR and change energy consumption. The findings emphasize the significance of promoting DR to the majority of people, especially those who are underserved, as well as overcoming behavioral and cultural hurdles to DR promotion.
[63]	Customers should adjust their demand to lower-cost times and avoid higher-cost periods. The cost reductions in network build-out, smoothing peak demand and reducing the pressure on production at peak periods, benefit all DR stakeholders.
[64]	They performed a literature analysis to summarize what is known about how small energy users (e.g., households and small- and medium-sized enterprises) may react to time-of-use electricity tariffs and which tools may be available to assist them in doing so. To predict users' behaviors, they used behavioral science theory.

Table 2. *Cont.*

Ref.	Main Results
[65]	They investigated the challenges of the participation of demand-side resources in the regulated electricity market and provided solutions to overcome DR implementation barriers in this market. They also mentioned the advantages of DR for utilities, and how it may be used in regulated markets.
[66]	They discussed behavioral factors acting as the barriers for energy-saving behaviors, the adoption of energy-efficient and clean technologies, and sustainable mobility options. Finally, they provided a snapshot of how energy ministries, regulatory agencies, and utilities may use behavioral insights to design and execute more successful energy policies and DR programs by analyzing some case studies.
[67]	An analysis of the deployment of demand-side flexibility and DR implementation is provided in order to identify barriers for demand-side flexibility to access relevant markets and products through explicit mechanisms. It focused on explicit DR and addressed implicit DR in conjunction with the explicit one.
[68]	DR concepts and drivers originating the requirement of demand flexibility are provided in this research. A detailed categorization of various DR programs is also provided based on economic, technical, and technological factors. They pointed out that various DR schemes could investigate grid behavior and thus, contribute significantly to grid stability and investment saving.
[69]	This overview of DR implementation has highlighted and covered a number of gaps in knowledge about DR, including the risks of power system transformations, realizable potential, consumer engagement, business models, market design, and regulation.
[70]	They investigated the effects of the householders' and practitioners' views of DR programs on the residential DR acceptance rate. Their findings showed that technical variables could improve practitioners' comprehension of DR, as well as householder agency, which is critical for residential DR adoption. They also found that achieving a decarbonized future based on DR will be difficult without addressing the householders' agencies, and consumers may stay tied to present socio-cultural actions that prevent DR adoption.
[71]	They suggested a social and economic benefit evaluation model to encourage DR participation. In addition, the investment needs for promoting the usage of DR were examined, and practical DR application strategies were proposed.
[72]	They analyzed medium and large industrial clients, based on the significance of the industry sector, the complexity of executing the regulatory framework, and the importance given to the industrial customers in the legislation and DR literature. Consequently, they highlighted the challenges in untying the full DR potential of the productive industries and provided recommendations for the promotion of DR.
[73]	An analytical framework is offered to assist governments in achieving the best possible results from their activities. They developed an evaluation methodology for assessing the effects of different factors in DR implementation, using prior studies and experts' comments. The suggested model considered the intricate interdependencies between variables and dimensions, resulting in a cause–effect diagram that could be used to compare alternative implementation approaches.
[74]	The purpose of this study was to conduct a qualitative, interview-based, comparative assessment of how householders adjust their habits in response to changing power supply networks. In a cross-cultural examination, using theories on temporalities of practices emphasizes the importance of the local socio-material and cultural context.
[75]	Individual, community, organizational, electricity system, and national levels should be considered for developing DSM programs. They suggested the concept of "social license" to propose prospective beneficiaries of future DSM programs. The idea of social license for DSM is presented to demonstrate how post-industrial societies can transit to a low-carbon future by enrolling citizens in the management of electricity systems.

In order to analyze the energy consumption behaviors, it is necessary to determine the affective factors on the load pattern. As a result, it is important to identify the roles and impacts of the cultural (such as education level), social (e.g., family and friends), and behavioral (for instance, attitude) factors affecting consumer behavior [23]. Therefore, this paper identifies the human behavior parameters that could affect electricity consumption. In addition, other non-technical factors affecting the electricity consumption behavior and requirements for implementing the DR programs are also examined in this study.

The main contributions of this paper are as follows:

- A theoretical framework is presented by considering three important sociological factors: familiarizing customers with DSM programs, lifestyle theories, and the new environmental paradigm.
- Different customer's reactions to DR programs with respect to the electricity prices are investigated. A desirability function and loss aversion concept are also introduced.
- The effects of response fatigue, gamification, and subsidies on increasing the DR participation rates are investigated. Finally, considering economic, cultural, and social capitals and their related components, an analytical model is presented.

In order to develop the theoretical framework, the main concepts and sociological perspective of the paper are presented in this section. Examining the relevant theories (as a general guide for answering the questions and accomplishing the mentioned objectives) reveals the following three major sociological factors impacting the involvement rates in DR programs:

- Introducing the DSM programs to customers and investors;
- Investigating consumption and lifestyle theories;
- Examining the new environmental paradigm, as well as value and knowledge.

2.1. Introducing the DSM Programs to Customers and Investors

Without the development of the electrical sector, economic progress and industrial prosperity are impossible. Unfortunately, electricity shortages and forced blackouts have wreaked havoc on the economies of developing countries in recent years. Their recession is inevitable if this pattern continues [76].

Consumption management is one of the important tools utilized by power utility companies or large consumers to reduce consumption peak and smooth the load curve, which increases the energy system's efficiency and reduces the costs. Operating companies use consumption management methods to minimize power shortages during peak hours and improve load factors. Due to their numerous economic, technical, and service benefits, these methods are also used by major consumers, such as factories. One of the most effective ways to improve consumption management is implementing DSM policies, especially DR programs [76].

Power utility companies can substantially reduce power shortages during peak hours by familiarizing their major customers with optimal consumption behaviors and encouraging them to use these methods. For example, electricity companies can offer more expensive electricity during the high-consumption months (such as summer) and cheaper ones during the low-consumption months. This can motivate large companies and industries to cut operational expenses by scheduling yearly leave and vacations during peak consumption months [76]. Owners of large industrial companies can also reduce the cost of electricity consumption by utilizing and adhering to various user-friendly DSM programs provided by electricity companies and research institutes.

2.2. Investigating Consumption and Lifestyle Theories

Every phrase in the social sciences is understandable in its conceptual context. As an example, the term "lifestyle" is closely connected to a collection of concepts, such as culture (objective and subjective), society, content, behavior (e.g., attitude, and value), and social classification. It is impossible to comprehend lifestyle and its related theories without understanding these relationships. Lifestyle applications have generalized concepts and may be utilized in a variety of situations. They are sometimes referred to as "culture and class" by mistake. As a result, we should seek the precise meaning that demonstrates the link between lifestyle and other occurrences and concepts [77].

In sociological literature, lifestyle has two meanings. The first one backs to the 1920s, when the concept of "lifestyle" was commonly used to signify the social level and indicate wealth and social standing. The second one is a new social form that only makes sense in modernity changes and the growth of the consumerist culture. In this sense, lifestyle is a way to define the values, attitudes, and behaviors of individuals, and its importance in social analysis is growing more and more [78].

Traditionally, consumption, as one of the major social phenomena, is used to describe lifestyle. However, given the relevance of energy consumption with lifestyle in this paper, the perspectives of prominent experts who have investigated consumption and lifestyle are analyzed.

2.3. Examining the New Environmental Paradigm, as Well as Value and Knowledge

Modifying the energy consumption behaviors and its tools (such as DR) impacts the amount of fuel used to produce energy and, consequently, the environment. Therefore, cultural and social factors affecting DR programs can be identified by examining theories related to the environment. At the beginning of the 21st century, environmental issues received considerably more attention than ever as human societies' damage to the environment became more significant [79]. Some environmental scientists believe that human actions are important reasons for the majority of ecological problems. Human misuse of the environment has been highlighted as the world's most serious long-term hazard. Improper human behavior has a negative and irreversible impact on the environment. If these issues are not addressed, there is no assurance that the planet will be sustainable in the future [80].

Environmental sociologists strive to comprehend and predict individuals' environmental behavior in a community (environmental behavior indicates the individuals' thoughts and treatments regarding the environment). Attitude is one of the factors used to predict environmental actions. According to Dunlop's New Environmental Paradigm (NEP), all behaviors have intention and purpose. The focus of this theory is on how individuals make judgments and choices in certain situations [79]. The environmental approach addresses issues such as protecting wildlife, natural resources, plants, forests, and native animals. This strategy also aims to solve environmental problems on the macro level.

There are a variety of sociological ideas regarding why and how people will change their environmental behavior. One of these crucial paradigms is the new environmental paradigm [79]. The separation logic (human separation from nature) claims that the relationship between humankind and the environment is sociologically insignificant. From this perspective, human beings are separate from nature due to their superior power and civilization. From the industrial revolution through the second half of the 20th century, this technique was applicable. The paradigm of human separation from nature was based on four main assumptions:

1. Humans vary from other animal species due to cultural and genetic traits;
2. Cultural and social elements, are essential determinants of human difference;
3. Human cultural and social relations are complex, and the biophysical environment is vast and ambiguous;
4. Culture is a cumulative notion, meaning technological and social progress may be limitless and cure all societal issues [79].

Some sociologists tried to alter the paradigm in sociological research by criticizing the existing dominant approach that exclude human beings from nature. As a result, some sociologists have reinterpreted the new ecosystem paradigm with respect to the environment's influence on social behavior and the environment's impact on social processes. They concluded that humans' interactions with nature are dependent on the global ecosystem like other species. Thus, a new perspective emerged within social studies that incorporated environmental variables into social research and provided a new sociology perspective. By identifying the human initiative, this approach believed that humans are interdependent with other species in the ecosystem. Social and cultural aspects were also taken into account as essential factors in this strategy. It is worth noting that ecological feedback has an impact on humans as well. According to sociologists, human society is an integral part of life. Some of them were concerned that human societies' dominance over nature might lead to self-destruction [79].

Humans have constructed complex communities and buildings for their exploitation and comfort by overusing natural resources. This has led to the severe destruction of nature. The new ecosystem approach changed previous sociological theories. This new method promoted a more ecological, less human-centered viewpoint. This means that humans are only one of the many species that live on the planet [79]. In addition to the previous research assumptions, this paper investigates this paradigm based on other assumptions, as follows:

- Humans have unique traits. They are one of the species that are reliant on the global ecosystem for survival.
- Human life is not only influenced by cultural and social factors, but also by the complex loop of causes, effects, and feedback. As a result, even purposeful human actions may have unintended consequences.
- Humans are dependent on the biophysical environment, live in it, and are affected by this environment's biological and physical limitations.
- Humans should never violate ecological laws, even if they are able to overcome limitations by relying on their initiatives.

Some other sociologists took an approach (new ecological paradigm) and claimed that the escalating environmental crisis had ramifications not just for nature, but also for human society. This method provides a unique sociological perspective in which the environment is also important for understanding social circumstances, just like political and economic activities. In the following, environmental value and knowledge as the components of the new environmental paradigm are introduced.

- Environmental value

Environmental value includes a people's fundamental opinions about the environment and reflects their worldview. For example, studies indicate that people with more biological values and also who have intrinsic respect for the environment usually pay more attention to the environment than those with technological values who believe that technology can solve environmental problems [81].

- Environmental knowledge

Knowledge is a necessity for achieving success. Therefore, it is used to mitigate psychological barriers, such as ignorance and misinformation. Although knowledge may not always impact behavior directly, it reinforces other characteristics that facilitate behavior modification [82].

Some researchers care a lot about environmental knowledge. They believe it is essential to have a broad and universal understanding of biological and ecological concepts to restore and maintain environmental quality [28]. Another group of researchers defines environmental knowledge as an individual's ability to understand and evaluate society's impact on ecosystems. They emphasized that environmental knowledge means a thorough grasp of environmental concerns, challenges, and repercussions. However, some other sociologists have proposed three types of environmental knowledge: systematic knowledge, action knowledge, and effective knowledge. Systematic knowledge is concerned with the functioning of ecosystems. The relationship between carbon dioxide and global climate change is an example of systematic knowledge. Action knowledge refers to a wide range of behavioral techniques (such as activities concerning reducing carbon dioxide). Effective knowledge is information that aids a person in making behavioral decisions. As a result, it may be argued that having a basic understanding of the environment is a precondition for having an appropriate environmental behavior [83].

3. Customers' Sensitivity to Electricity Price and Electricity Consumption

Customers' reactions to the implementation of various DR programs are different. Many mathematical models have been proposed to predict customer reactions. For instance, DR models can be presented using the concept of demand–price elasticity [84]. Demand–price elasticity is defined as the sensitivity of the customers to adjust their load profile in response to the changes in the electricity prices [85,86]. Changes in demand with respect to prices can be modeled, using linear or nonlinear functions [84,87]. Different customers' attitudes and behaviors lead to variations in the selection and execution of DR programs at different times. As a result, these attitudes and behaviors should be evaluated in addition to the preceding examples. By presenting a flexible model, time can be included in the model [88]. Some DR models are based on optimization methods [89]. Customers' logical

behavior is the fundamental premise in the optimization-based approach. The maximizing of desirability or minimizing the costs might be used as the problem's objective function.

In the psychology and behavioral economics domain, non-financial interventions can be successful, such as money incentives in changing consumers' consumption behaviors [90]. In this regard, special attention can be paid to the energy policy. Rewards and penalties are two strategies that can change the consumption pattern of customers [85]. Although both of these strategies can lead to behavior modification in the short term, research studies have shown that incentives can also contribute to habit formation in the long term [91]. According to this theory, even if the long-term incentive-based DR programs are no longer be implemented in a system, most of their positive effects are anticipated to persist, due to habit formation [92]. Many researchers have also studied the effect of electricity prices on customers' behaviors to reduce energy consumption. The findings reveal a strong relationship between financial incentives and customers' behavioral traits [93,94].

Based on human behavior studies, it can be concluded that the customers' responses to penalties and rewards are not the same [95]. This is contrary to the classical economics assumption that customer behavior is linear. Additionally, the "loss aversion" concept could be considered, which is one of the most well-known psychological theories of human behavior [96]. The concept of loss aversion implies that people generally prefer to lose less rather than gain more [97]. In other words, in the financial behavioral domain, the fear of losing is a far bigger stimulant than the desire to profit. Most psychological research studies show that the fear of losing is around twice as strong as the desire to earn [98].

According to the behavioral economics research studies, the effect of loss on a person's inner feeling is much stronger than profit [99]. Figure 1 illustrates an example of the desirability function. As a result of the introduced concepts, the curve slope is greater in the loss area than the profit area. In micro and classical economic theories, it is always assumed that an equal amount of profit or loss produces the same participation level. However, such an assumption is incorrect, considering human behavior characteristics [96]. In high-risk and low-risk situations, the level of loss aversion is different. It is worth noting that in high-risk circumstances, the slope of the desirability function curve is larger.

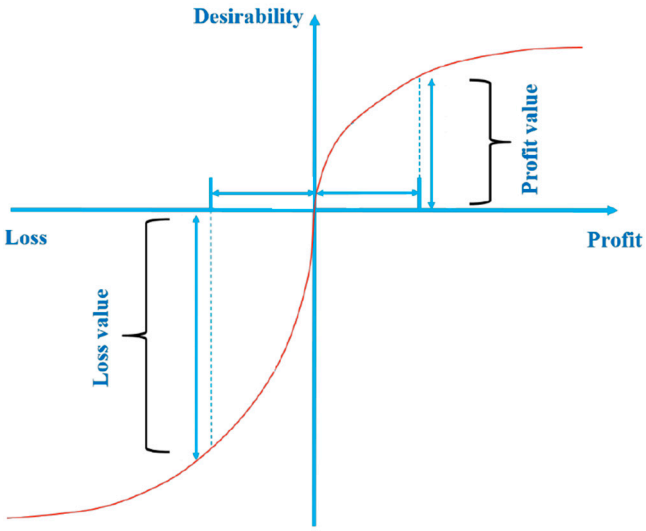

Figure 1. Outline of the desirability function [96].

4. Enhancement of DR Programs' Participation Rate

From a long-term viewpoint, the success of a DR program is determined by the extent of ongoing consumer involvement. Unfortunately, it is found that complex programs make users less likely to participate. In addition, there is evidence that consumers gradually lose their interest in programs that they do not fully comprehend [100]. This phenomenon is known as "Response Fatigue" [11]. It can be extremely harmful in practice since it can

gradually wash away the benefits of the significant efforts required to gain demand flexibility. Generally, the information presented should allow for gradual learning. Consumers enjoy exploring and learning from their previous experiences. Therefore, data should be provided in a variety of formats and should allow for social comparisons. The most crucial factor in eliciting a large consumer response is not price; instead, users and behaviors are more influenced by social interactions [101].

Moreover, utilities and power system operators could benefit from "Gamification" as an interesting way to raise people's participation in DR programs [102]. Gamification fosters participation and inspires people to learn more quickly or to attain specific objectives. Furthermore, the gamification platform provides immediate feedback on performance as well as recommendations for improving the results. Gamification is also an effective method for behavioral changes [103]. For example, users can earn points for their activities and receive virtual (e.g., badges) or real-world (e.g., discounts, and gadgets) prizes by embedding a behavioral modification application in a gamified scenario. A game is created to take the player on a trip that includes discovering the product or concept, learning the rules, earning rewards, and progressing through regular use [104]. The final concept is to reach the point where there is nothing more to learn, explore, or gain. The desired level of social prestige or contentment is attained at this point. Gamification can motivate consumers to become more energy efficient by creating goals and tracking usage behaviors [105].

Moreover, DR cannot indefinitely rely on direct or indirect subsidies [106]. Instead, a successful DR program depends on users' self-interest, which can be cultivated through knowledge and incentives. Subsidies are problematic, not because of the immediate financial distortions they cause, but because of their impacts on long-term system equilibrium. This is due to the fact that consumers who are mostly consuming in peak demand periods are cross subsidized by those whose consumption patterns are flat. The primary purpose of dynamic pricing is to reduce cross subsidies and, more precisely, allocate expenses. However, it should be utilized with caution, as it could result in significant payments if consumers cannot respond to price signals.

Furthermore, the psychological impacts of DR participation should not be overlooked. They stem from a variety of problems. Firstly, most societies are accustomed to having power available at all times. By enrolling in a DR program, however, this availability is jeopardized. Because electricity is not always available, proper behaviors should be adapted. Secondly, if it is automated (as most DR programs are), the participant gives up control over their personal life. Appliances in their homes are now controlled by someone or something far away. This may be perceived as an intrusion into their privacy. Finally, DR programs can increase participants' stress levels. The psychological effects could cause a fall-out of participants, especially as it proceeds toward large-scale deployments. As a result, DR stakeholders should pay adequate attention to psychological impacts [22].

5. Capitals and Analytical Model

In the last two decades of the 20th century, human activities and the resulting environmental damage became increasingly important. Researchers from a variety of scientific fields have collaborated to describe the problem and provide solutions. However, some scholars also believe that we should look at this issue from the perspective of the lifestyle idea. The energy consumption behaviors of individuals and families in a community depend on the lifestyles of people in that society. The destructive effects of pollutants produced in the atmosphere are also greatly influenced by lifestyle. Lifestyle analyses in energy and environmental studies show the relationship between lifestyle and environmental impacts. It may also assist individuals to develop technologies and social structures, which could reduce environmental degradation.

Explaining the fundamental gaps between values, behaviors, and environmental actions is one of the benefits of utilizing lifestyle analysis in environmental issues. While most individuals with environmental values believe that environmental limits must be

respected, they do not act accordingly in practice. As a result, one of the aims of lifestyle analysis is to explain the gaps between values, behaviors, and environmental sustainability activities [107].

Various factors, such as different capitals in the community, affect the implementation of DR programs and consumption behaviors. Individuals' energy consumption behaviors are influenced by cultural, economic, and social capitals. Each of them contains several variables. For example, cultural capital is influenced by environmental knowledge and education. They cause people to choose between different consumption behaviors (e.g., low, medium, high, and very high). The more capital a person possesses, the better their social standing. These capitals also affect people's behaviors and lifestyles [108].

Capital is inherently linked to power, and they would almost be considered equal in social science [107]. This is because capital allows a person to make a secure profit by participating in a competitive environment. As above-mentioned, capital has three primary forms that are defined as follows [109].

5.1. Economic Capital

Economic capital can be converted into money and institutionalized in the form of property rights. Due to the characteristics of economic capital, it can be considered to be money and material objects used to produce goods and provide services [109].

5.2. Cultural Capital

Cultural capital is sometimes similar to economic capital, and it is institutionalized in the form of educational quality. Cultural capital refers to a person's desires and may be used in a variety of ways. Cultural capital, for example, is utilized as a prerequisite for gaining other capitals. Someone with a high level of cultural capital is better able to express his/her social opinions to others. Moreover, if a person has a high level of cultural capital, he/she can adopt appropriate behaviors with more confidence. Cultural capital could be expressed in two ways.

5.2.1. Embodied Cultural Capital

This type of cultural capital symbolizes the knowledge and potential of a group of people. In other words, embodied cultural capital refers to prospective talents that have progressively become a part of an individual's strength.

5.2.2. Institutionalized Cultural Capital

This form of cultural capital includes academic qualifications and is apparent in the form of degrees. It also gives the legal and social values to the holder of qualifications. Environmental knowledge and energy proper usage can be part of cultural capital. Energy consumption becomes more efficient as this capital grows.

5.3. Social Capital

Social capital is made up of social obligations and can be converted into economic capital under certain conditions. Potential benefits acquired via community membership in social networks are referred to as social capital. The critical components of this capital are social trust, social participation, and social support. Behavioral problems appear to be more closely linked to social trust and social involvement [109]. People with higher levels of social capital have easier access to information, which leads to their higher participation in DR programs. In addition, based on this information, they are more motivated and skilled than others to act properly. Social trust makes other people's actions better interpreted, while social participation provides opportunities to become aware of other consumers' consumption behaviors.

5.3.1. Social Trust

People who have a higher level of trust in others have a greater tendency to participate in the DR programs for two reasons:

1. Trust does not directly enhance people's access to information. However, trust in information sources (such as friends, news resources, and government agencies) increases the likelihood of influencing people's behavior.
2. People with higher levels of social trust are more motivated to save energy because they believe that others will also have responsible behaviors, and thus, this increases their behaviors' effectiveness.

5.3.2. Social Participation

Social participation provides the motivation, information, and skills required to adopt energy consumption methods. Members of social groups usually share the same behaviors and values, which might drive them to practice consumption management. Participation in a variety of social organizations also improves a person's social relationships. Consequently, people's access to information would be improved, which has a beneficial impact on their consumption behavior.

5.4. Analytical Model

The analytical model of the research is expressed in this section based on the theoretical framework and other topics that are discussed above. Based on an analytical model, it would be possible to do the following:

- Study influences of cultural, economic, and social capitals—as concepts derived from Bourdieu's theory (Bourdieu's theory defines lifestyle as a set of systematic activities that arise from the stamina of each individual. According to Bourdieu's theory, lifestyle identifies the individuals personalities and also distinguishes between different social classes [110]) of consumption and lifestyle—on the electricity consumption behavior;
- Find out how people's knowledge of electricity affects electricity consumption behavior;
- Investigate the effects of environmental value on the electricity consumption behavior using the Kaiser value scale (Kaiser value scale: Kaiser et al. introduced environmental attitude as a powerful predictor of ecological behavior. They used a unified concept of attitude and a probabilistic measurement approach to overcome the lack of the consideration of behavior constraints beyond people's control. They confirmed three essential variables for consumption behavior studies: (1) environmental knowledge, (2) environmental values, and (3) ecological behavior intention [83]);
- Evaluate how the environmental attitude derived from NEP influences electricity consumption behavior.

Based on the studies, there is a significant relationship between the electricity consumption behavior and the proposed variables (such as cultural capital, economic capital, social capital, environmental attitude, environmental value, attitudes toward subsidies, age, employment status, marital status, news resources, social trust, social participation, environmental knowledge, and building interior architecture). Therefore, they can be generalized to the statistical population. In addition, there is a statistically significant variation in energy usage behavior based on the employment and marital status. Accordingly, full-time employed people and married people have more proper electricity consumption behavior than other ones [48,64,82].

It is expected that the attitudes and behaviors regarding environmental concerns affect people's electricity consumption behaviors. Positive values and attitudes toward the environment will lead to positive modification of energy consumption behaviors. People will behave more effectively if they are aware of the energy value and understand correct consumption behavior [98].

Additionally, it should be said that age can play a decisive role in behavior, lifestyle, and consumption pattern for several reasons. For instance, people of different ages have

different needs and abilities. In addition, their experiences of the past years would affect their lifestyles and consumption behaviors.

One of the critical variables affecting energy consumption behavior is the knowledge of environmental issues as one of the cultural capital elements. Knowledge is a factor that affects people's environmental behavior. Consumer behavior should be promoted carefully and responsibly by increasing awareness of energy consumption-related environmental problems and DR programs. Therefore, having more cultural capital means having a higher cognitive ability. Moreover, education is another part of the cultural capital. Generally, as education increases, people become more responsible about consuming electricity [23].

Home architecture is also one of the important factors affecting energy consumption behavior. One solution for preserving limited natural resources is the sustainable design of green buildings, which should prevent energy losses and provide energy reuse. Attitude toward subsidy schemes is another variable that can be included in the final model. This variable indicates that the more positive people's attitude toward subsidies would result in the more appropriate and efficient behaviors in electricity consumption.

Consequently, a model can be proposed to show the relationship between these factors. This model is shown in Figure 2. The presented model is based on the existing studies that qualitatively have examined the impacts of the cultural, social, and behavioral factors on each other, and also on the electricity consumption behaviors [46,75,79,81]. The main difference between the proposed model and previous models is in considering cultural and social capitals, as well as the environmental value. In addition, some modifications are also made when applying subsidies, accommodation details, and demographic factors.

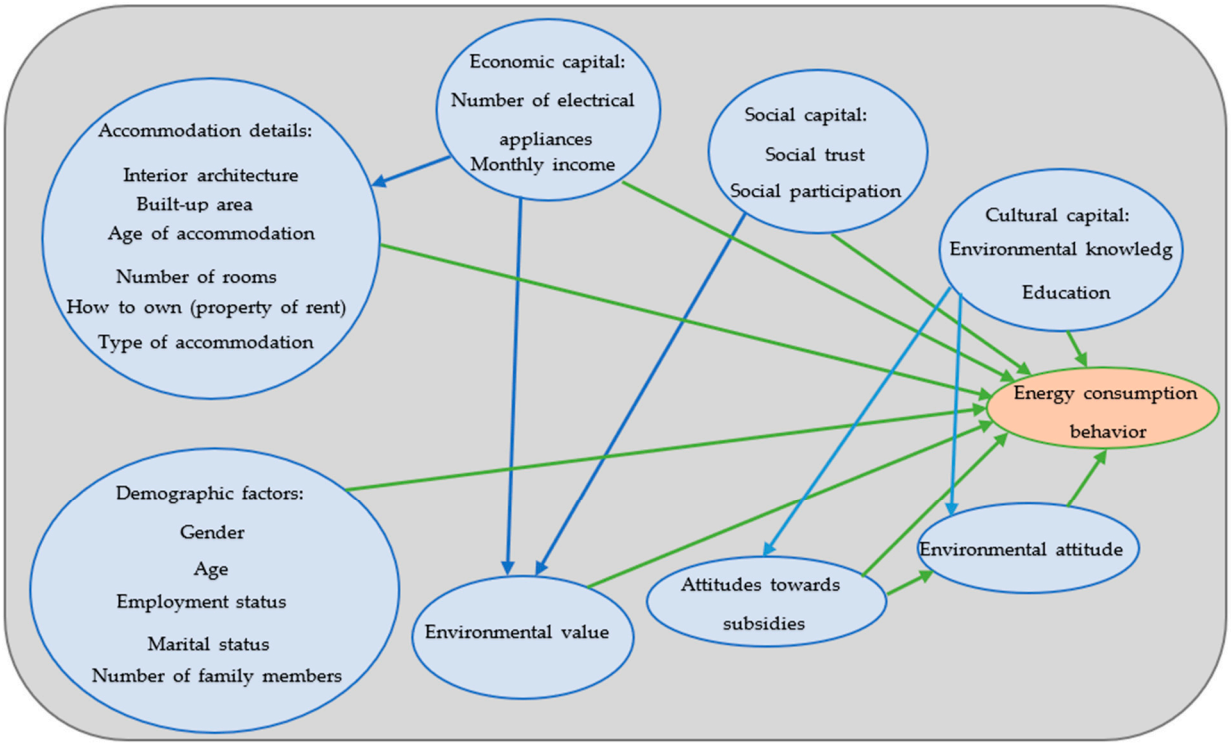

Figure 2. Analytical model.

In this paper, several hypotheses are considered based on the literature review and interviews with experts. Figure 3 shows the relationship between electricity consumption and various cultural, social, and economic factors. Ten of these factors are directly related to electricity consumption. Moving toward the right of this figure, the significance of these factors' impact on improving electricity consumption, compared to the previous factors, increases. Improving electricity consumption means consuming less electricity during peak time and/or using electricity more rationally. For example, if people follow

electricity-related news (such as electricity prices) from more reputable news resources, they can manage to use electricity in less expensive periods. As another instance, if people's employment statuses are better or go toward full-time employment, their electricity consumption might be adjusted in the lower states, because they are at home for fewer hours. Nevertheless, for example, if the influences of these three factors are compared with each other, it could be observed that the effect of the age factor is more significant than the news resources. Additionally, the impacts of both of these factors are much less than the impact of the employment status on the modification of the electricity consumption behavior.

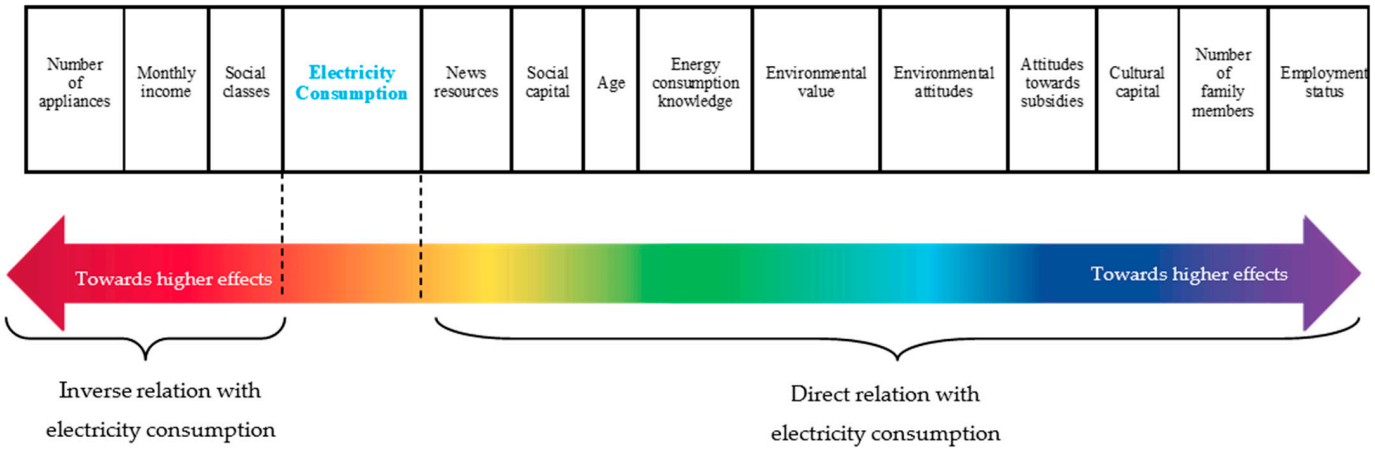

Figure 3. Relation between electricity consumption and different factors.

The same is true for factors that are inversely related to electricity consumption. This means that as the amount of these factors increases, the electricity consumption status would be more inappropriate. So, by moving toward the left side of Figure 3, the factors' impacts on causing inappropriate electricity consumption behaviors become more potent than the previous elements. Inappropriate electricity consumption behaviors mean consuming more electricity during peak time and/or using electricity without considering negative impacts.

6. Discussion, Solutions, and Outlook

In this section, the most important points of the paper are discussed first. Then, the limitations for this work, as well as the general limitations of running DR programs, are discussed. In the following, solutions and roadmaps for designing DR programs are proposed. Finally, future research directions are also briefly introduced.

6.1. Discussion

It is vital to identify the factors that influence energy consumption behaviors to make adjustments. Considering humans' role in the energy consumption, this paper investigated the factors affecting electricity consumption behaviors. Moreover, non-technical needs for DR implementation were identified.

In a smart grid context, fundamental barriers related to intrinsic human nature (cultural, social, and behavioral obstacles) were introduced. Industrial and residential participants in DR programs suffer from some of these barriers. The conceptual framework offered by the extensive cultural, social, and behavioral classifications and analyses, addressed the core features of DR. In addition to theoretical barriers, special attention was also given to practical aspects for implementing DR programs. This comprehensive classification could serve as a foundation for future research and the integration of DR, making it a noteworthy contribution to the power system research area.

The main contribution of this paper was to fill a research gap in the present literature on DR challenges, issues, and barriers by providing cultural, social, and behavioral analyses of the fundamental barriers of DR. In addition, an analytical model was proposed, and

the relationships between numerous factors and electricity consumption behaviors were also discussed.

Some limitations, barriers, and research gaps were also observed, while conducting this research. Information barriers and lack of understanding of DR programs have impeded DSM programs. End-user's lack of trust and DR awareness allows a third party to control their processes and equipment. Behavioral and informational barriers and lack of understanding are also some of other challenges. Moreover, the lack of DR experts for designing and implementing the appropriate programs may be a barrier within power utilities. For example, power system planners stated that they currently do not have enough information about DR needs in their planning models. In addition, many people worldwide have little to no knowledge about the procedure of the electricity markets. Indeed, on average, people are not aware of the technical issues of DR programs.

In order to be motivated to participate in DR programs, and change the habits of people, information needs to be supplied to increase their knowledge levels. Even during a DR event, the participation levels may be decreased, due to the lack of information on how the system works, e.g., inadequate information or knowledge about real-time pricing, using of the interfaces, and the contracts. The lack of awareness of grid issues and DR impacts also reduces the likelihood of customers' behavioral changes. Because large investments mostly indirectly impact the customer, they might not realize that their behavior affects the energy system.

Collecting data on what proportion of consumers continue to use DR programs is just as crucial as analyzing the acceptance rates. There are also some concerns about continuing to participate in DR programs once a customer's energy consumption behavior has been changed. Some analysts believe that customers will eventually return to their old behaviors. Therefore, examining the continuous usage of DR technologies is a critical task.

Furthermore, the combination of small electrical loads and complex internal decision-making procedures can hinder the adoption of DR by major commercial and public sector companies. Moreover, the firm's ability to participate in DR is further limited by hidden costs of involvement and the amount of energy usage within different organizations.

6.2. Solutions

It might be difficult to assess customer awareness and knowledge of customers regarding DR technologies. In fact, power utilities are either not measuring or not disclosing this information to the public. Even more challenging is determining the success of utilities' DR marketing programs; since DR technology marketing is often a part of the larger marketing effort centered on the smart grid program. Therefore, prior to implementing DR programs and throughout its initial stages, power utilities should undertake extensive marketing to promote their DR technologies, including public events, mailings, and a door-to-door campaign.

Several DR stakeholders suggested establishing an appropriate mechanism for power utilities to provide information and technical assistance to mitigate the lack of staff knowledge and capability, the need for intra-organizational coordination and communication, and the risk associated with DR availability. For example, a regional entity could be determined to establish regional information and technical forum for DR program development and deployment.

Furthermore, with the proper communication, marketing, and program design, customer barriers to DR involvement can be overcome. There is also a lot of information about which clients are the most receptive to DR programs. Power system operators can reduce customer perception barriers by accumulating and sharing insights and lessons learned from DR pilots and research studies.

Participants should be guided into DSM programs with a great care. A robust human–machine interface is essential to assist responsive customers to participate in DR programs. In addition, participants should be guided and informed suitably about the system functions. People will not grasp how the system works if they are not well-informed. This

might be remedied by some activities, such as conducting meetings and describing the DR projects to participants and delivering door-to-door information. However, such actions are not scalable and only work if volunteers are available. For instance, residential DR programs enter people's private life. Thus, they need to be informed before they participate, and the emotional experience of participation should not be overlooked.

Moreover, given the organizations' objectives to be profitable, the dissemination of information demonstrating the monetary value of DR could be a crucial enabler in combating the lack of power and culture inside an organization. It may not be straightforward because companies do not always act rationally. Therefore, broad education on the benefits of DR is necessary to overcome any cultural barriers.

The process of influencing end-user preferences (e.g., attitudes on trading convenience for cash or allowing third-party control of devices) to enable DR is challenging. Preference evolution is a complicated process that involves several feedback loops. As a result, there is no easy enabler. However, actions such as changing social norms through affecting perceptions of energy consumption or modifying laws and regulations to communicate those changed norms may impact user values. However, the critical point is how to deal with the inertia barrier. For example, ensuring that information is transmitted correctly can improve inertia barriers by making sure users are fully aware of the benefits.

Finally, it may be more practicable to enable DR by overcoming trust concerns. While trust in existing energy system actors may be limited, DR may be facilitated by partnering with new third parties. The source of information is the most important factor in motivating DR program usage.

6.3. Outlook

Results obtained in this paper point to numerous pathways for future research works that will help to improve the potential of future DR programs.

Appropriate cost–benefit analysis frameworks should be developed to overcome barriers related to the lack of the understanding of DR. The DR provider's decision making should be accurately represented in such a framework. It is also possible to conduct thorough research on all prospective DR markets. Although there has been some progress in this direction, there is still a long way to go.

The relative costs and advantages of each of DR programs are currently unknown. In different circumstances, an analysis for each DR program will provide power utilities with information on which programs are the most cost-effective in reducing peak demand. Thus, future studies could be conducted to help to determine when and where DR programs should be focused.

The environment and climate changes were introduced in this paper as the motives for customers to participate in DR programs. As a result, power companies should consider whether or not to add marketing on the benefits of smart grid initiatives and DR technologies. Determining the impact of marketing concerning the benefits of DR technologies for the environment and society could be a future market research project. Moreover, developing the mathematical models and conducting quantitative studies in various cultural, social, and behavioral fields, could be one of the future research directions.

Finally, as clarified in this paper, there are various cultural, social, and behavioral aspects, affecting the success level of DR that should be identified based on the characteristics of the system under study. Such studies are completely dependent on the specifications of the system. Indeed, people in different countries may have various habits, beliefs, and values, and DR programs should be designed considering their behaviors, besides the technical aspects. Therefore, different research studies should be conducted to specify the effective factors (including different aspects, such as cultural, social, technical, economic, etc.), determine the barriers, find the solutions, and also propose the most appropriate ways to enable DR.

7. Conclusions

This paper mainly examined the cultural, social, and behavioral factors affecting electricity consumption behaviors and identified the relevant requirements for implementing DR programs. The literature research first gave a complete analysis of existing methods for energy management and DR implementation. The paper's major principles and theoretical framework were then provided, which took into account three key sociological factors: familiarizing clients with DSM programs, lifestyle theories, and the new environmental paradigm. Then, the effects of different electricity prices on customer reactions were explored. Next, taking into account the proposed concepts, the desirability function was presented, as well as the loss aversion concept.

The impacts of concepts such as response fatigue, gamification, and subsidies on DR participation and success were also represented in this paper. Further, economic, cultural, and social capitals, as well as their related components that influence energy consumption behaviors, were discussed. In addition, the mentioned concepts were used to drive an analytical model. The relationships between a variety of factors and power consumption patterns were also explored. Finally, barriers for implementing DR, and the solutions to overcome the barriers were presented, and several future research directions were proposed, taking into account different factors, such as cultural, behavioral, social, economic, and technical aspects.

The main finding of the paper focused on three major aspects of the societies, affecting the success level of DR programs, and could be summarized as follows:

- Cultural aspect: Culture is a determining factor to create long-term human behavior, including values, beliefs, customs, and traditions. Changing sustainable behaviors requires a culture shift. Therefore, from the cultural viewpoint, the most important features are stability and adhesion.
- Social aspect: One of the most significant factors for power system operators in persuading people to participate in DR programs is building trust in the source of information.
- Behavioral aspect: There are numerous barriers for the successful implementation of DR programs that target energy consumption behaviors. One of the most challenging problems is to remain in DR for a long term. Incentives and penalties may have different effects in short/long-term horizon times. However, implementing DR programs necessitates a detailed understanding of the effects of daily living routines and behavioral norms on energy consumption, as well as a complete understanding of the characteristics of the target groups.

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

Funding: This research was funded by Niroo Research Institute (NRI), grant number 179101.

Acknowledgments: Administrative and technical supports granted by Niroo Research Institute (NRI) are gratefully acknowledged.

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

References

1. Moshiri, S.; Shahmoradi, A. Estimation of Natural Gas and Electricity Demand of Households in the Country: A Micro-Study Based on Household Budget. *J. Econ. Res.* **2006**, *41*, 305–335. (In Persian)
2. Hashemi Parinchi, Z.; Darvish Rouhani, B. Smart Energy Consumption in Smart Homes. In Proceedings of the 2nd National Conference on Modifying the Electricity Consumption Pattern, Ahwaz, Iran, 22–23 February 2010; p. 131. (In Persian)
3. Enelx. What Is Demand Side Management? 2021. Available online: https://www.enelx.com/en/questions-and-answers/eindustry/what-is-demand-side-management (accessed on 9 August 2021).
4. RESPOND Project 4 Differences between Demand Side Management & Demand Response. Available online: http://project-respond.eu/4-differences-between-demand-side-management-demand-response/ (accessed on 9 August 2021).
5. Arasteh, H.; Vahidinasab, V.; Sepasian, M.S.; Aghaei, J. Stochastic System of Systems Architecture for Adaptive Expansion of Smart Distribution Grids. *IEEE Trans. Ind. Inform.* **2019**, *15*, 377–389. [CrossRef]
6. Arasteh, H.; Sepasian, M.S.; Vahidinasab, V.; Siano, P. SoS-Based Multiobjective Distribution System Expansion Planning. *Electr. Power Syst. Res.* **2016**, *141*, 392–406. [CrossRef]
7. Arasteh, H.R.; Parsa Moghaddam, M.; Sheikh-El-Eslami, M.K.; Abdollahi, A. Integrating Commercial Demand Response Resources with Unit Commitment. *Int. J. Electr. Power Energy Syst.* **2013**, *51*, 153–161. [CrossRef]
8. Amini, M.H.; Talari, S.; Arasteh, H.; Mahmoudi, N.; Kazemi, M.; Abdollahi, A.; Bhattacharjee, V.; Shafie-Khah, M.; Siano, P.; Catalão, J.P.S. Demand response in future power networks: Panorama and state-of-the-art. In *Sustainable Interdependent Networks II*; Springer: Berlin/Heidelberg, Germany, 2019; Volume 186, pp. 167–191.
9. Felts, A. *Home Energy Conservation: Psychological and Environmental Worldviews*; University of Missouri: Columbia, MO, USA, 2008.
10. Kaheh, Z.; Arasteh, H.; Siano, P. Social and Economic Factors in Demand-Side Flexibility. In *Flexibility in Electric Power Distribution Networks*; CRC Press: Boca Raton, FL, USA, 2021; pp. 1–19. [CrossRef]
11. Latiers, A. Demand Response Perspectives for Belgium. *Reflets Perspect. La Vie Econ.* **2015**, *54*, 185–203. [CrossRef]
12. Steve Sorrell Reducing Energy Demand: A Review of Issues, Challenges and Approaches. *Renew. Sustain. Energy Rev.* **2015**, *47*, 74–82. [CrossRef]
13. What Is Culture? Available online: https://sphweb.bumc.bu.edu/otlt/mph-modules/PH/CulturalAwareness/CulturalAwareness2.html (accessed on 15 April 2021).
14. Akbari, N.; Talebi, H.; Jalaei, A. An Investigation of Socio-Cultural Factors Affecting the Household Energy Consumption after the Implementation of Targeted Subsidies Law. *J. Appl. Sociol.* **2017**, *27*, 1–26. [CrossRef]
15. Dolwick, J.S. "The Social" and beyond: Introducing Actor-Network Theory. *J. Marit. Archaeol.* **2009**, *4*, 21–49. [CrossRef]
16. Cardoso, C.A.; Torriti, J.; Lorincz, M. Making Demand Side Response Happen: A Review of Barriers in Commercial and Public Organisations. *Energy Res. Soc. Sci.* **2020**, *64*, 101443. [CrossRef]
17. Good, N.; Ellis, K.A.; Mancarella, P. Review and Classification of Barriers and Enablers of Demand Response in the Smart Grid. *Renew. Sustain. Energy Rev.* **2017**, *72*, 57–72. [CrossRef]
18. Breukers, S.; Mourik, R.; Heiskanen, E. Changing Energy Demand Behavior: Potential of Demand-Side Management. *Handb. Sustain. Eng.* **2013**, 773–792. [CrossRef]
19. Ruff, L.E. Economic Principles of Demand Response in Electricity. October 2002. Available online: https://hepg.hks.harvard.edu/files/hepg/files/ruff_economic_principles_demand_response_eei_10-02.pdf (accessed on 9 August 2021).
20. Wang, B.; Cai, Q.; Sun, Z. Determinants of Willingness to Participate in Urban Incentive-Based Energy Demand-Side Response: An Empirical Micro-Data Analysis. *Sustainability* **2020**, *12*, 8052. [CrossRef]
21. El Geneidy, R.; Howard, B. Contracted Energy Flexibility Characteristics of Communities: Analysis of a Control Strategy for Demand Response. *Appl. Energy* **2020**, *263*, 114600. [CrossRef]
22. Gheuens, R. Barriers to Residential Demand Response in Belgium and the Netherlands. Master's Thesis, Universitat Politècnica de Catalunya, Barcelona, Spain, 2020.
23. Salehi, S. *Investigating the Role of New Cultural Factors in Improving the Pattern of Electricity Consumption*; Mazandaran Electricity Distribution: Sari, Iran, 2013. (In Persian)
24. Hashemi Asl, D. Expansion of the Residential Customers' Consumption Pattern and the Development of Improvement Strategies. Master's Thesis, Iran University of Science and Technology, Tehran, Iran, 2002. (In Persian)
25. Talebzadeh, M. Management of the Electricity Consumption of the Residential Customers. In Proceedings of the 9th National Conference on Power Distribution Networks, Zanjan, Iran, 28–29 April 2004. (In Persian)
26. Lotfi Poor, M.; Lotfi, A. Investigating and Estimating the Parameters Affecting the Residential Demand in Khorasan Province. *J. Knowl. Dev.* **2005**, *15*, 67-47.
27. Fazeli, M.; Kolahi, M.; Salehabadi, I.; Rahbari, Z. A Comparative Study to Evaluate the Effects of Various Methods of Informing Energy Consumption on Consumers' Persuasion for Energy Saving, First Report: Theoretical and Methodological Foundations. In Proceedings of the Niroo Research Institute (NRI), Tehran, Iran, 11–13 April 2006. (In Persian)
28. Safari Nia, M.; Ahadi, H.; Bakhshi, M. The Effect of Behavioral Methods, Cognitive Methods, and Behavioral-Cognitive (Combined) Methods on Changing Attitudes of Students' Electricity Consumption and Family Electricity Consumption Pattern. In Proceedings of the 6th National Conference on Energy, Tehran, Iran, 12–13 June 2003. (In Persian)
29. Taboli, H.; Khajavi, H. Relationship between Home Energy Consumption and Contextual Variables. *Rahbord-e Yas 20*, 9 February 2010. (In Persian)

30. Moosayi, M. Culture, Consumption and Fundamental Principles. 23 July 2009. Available online: https://www.sid.ir/en/journal/ViewPaper.aspx?ID=178107 (accessed on 15 December 2020). (In Persian)
31. Nahidi, M.; Kiavar, F. Investigation of Causative Relationship between Energy Price and Energy Consumption in Industry Sector in Iran Economic. In Proceedings of the Monthly Magezine Gas and Energy, Tehran, Iran, 24 July 2010; Volume 5. (In Persian)
32. Veysi, R.; Nazoktabar, H. Factors Affecting the Culture of Electricity Consumption in Tehran, Iran. In Proceedings of the 2nd National Conference on Modifying the Electricity Consumption Pattern, Ahwaz, Iran, 22–23 February 2011. (In Persian)
33. Sarmast, B.; Poorhassan, R. Factors Affecting the Change in Electricity Consumption Pattern: A Case Study of Tabriz, Iran. In Proceedings of the 2nd National Conference on Modifying the Electricity Consumption Pattern, Ahwaz, Iran, 22–23 February 2011. (In Persian)
34. Yavari, K.; Ahmadzadeh, K. Investigating the Relationship between Energy Consumption and Population (Case Study: Southwest Asian Countries), July 2010. Available online: https://www.sid.ir/en/journal/ViewPaper.aspx?ID=211193 (accessed on 15 April 2021). (In Persian)
35. Amini, M.; Toolayi, R.; Amini, A. Energy Saving in Iran, Non Price Based Solutions. *Iran. J. Soc. Probl.* **2010**, *1*, 139–153.
36. Mohammadi, A. Survey of Household Electricity Consumption among Residents of Urban Areas (Case Study: Gorgan, Iran). Master's Thesis, Faculty of Humanities and Social Sciences, Mazandran University, Babolsar, Iran, 2011. Available online: https://ganj.irandoc.ac.ir//#/articles/f5cea2250aae8a913e2e74c2d1707267 (accessed on 15 April 2021). (In Persian)
37. Mohammadi, A.; Salehi, S.; Khoshfar, G. Lifestyle and Its Impact on Electricity Consumption. In Proceedings of the 1st International Conference on New Approaches to Energy Conservation; Niroo Research Institute (NRI), Tehran, Iran, 18–19 December 2011. (In Persian)
38. Salehi, S.; Khoshfar, G.; Mehnatfar, Y.; Mohammadi, A. Investigating Social and Cultural Factors Affecting Targeted Energy Subsidies and Energy Consumption (Case Study: Gorgan Electricity Company, Iran). In Proceedings of the International Conference on Economic, Kerman, Iran, 7–8 March 2012. (In Persian)
39. Gholizadeh, A.; Barati, J. Analysis of Factors Influencing Residential Energy and Electricity Consumption of Household in Iran: Focus on Energy Productivity. 2011. Available online: https://www.sid.ir/en/journal/ViewPaper.aspx?ID=325095 (accessed on 10 July 2021). (In Persian)
40. Samsami, H.; Hassanzadeh, E. Measuring the Effect of Daylight Saving Time on Electricity Consumption in Tehran, Yazd, Esfahan and Fars Provinces. 2013. Available online: https://www.sid.ir/en/journal/ViewPaper.aspx?ID=278877 (accessed on 23 February 2021). (In Persian)
41. Salehi, S.; Mahmoodi, H.; Dibayi, N.; Karimzadeh, S. An Analysis of the Relationship between the New Environmental Paradigm AndHousehold Energy Consumption. 2012. Available online: https://envs.sbu.ac.ir/article_96464.html (accessed on 23 February 2021). (In Persian)
42. Rahmani, N. The Effectiveness of TV Commercials (Effects of Electricity Consumption Commercials on School Children's Behavior and Effective Demographic Factors). Master's Thesis, Faculty of Broadcasting, University of Kurdistan, Kurdistan, Iran, 2012. (In Persian)
43. Isazadeh, S.; Mehranfar, J. Investigating the Relationship between Energy Consumption and Urbanization Level in Iran (Application of Vector Error Correction Model and Factor Analysis Method). 2012. Available online: https://www.sid.ir/en/journal/ViewPaper.aspx?ID=324640 (accessed on 2 January 2021). (In Persian)
44. Mohammadi, N. The Effect of Subsidies on the Behavior of Household Electricity Subscribers (Case Study: Household Electricity Subscribers in District 3 of Shiraz, Iran). Master's Thesis, Allameh Tabataba'i University, Tehran, Iran, 2012. (In Persian)
45. Zare Shahabadi, A. Socio-Cultural Factors Affecting Energy Consumption Patterns of Households in Yazd. 2013. Available online: https://www.magiran.com/paper/1903456?lang=en (accessed on 23 November 2021). (In Persian)
46. Beheshti, S.S. Sociological Explanation of Energy Carrier Consumption and Presentation of Optimal Consumption Pattern. Ph.D. Thesis, Isfahan University, Isfahan, Iran, 2013. Available online: https://lib.ui.ac.ir/dL/search/default.aspx?Term=11025&Field=0&DTC=3 (accessed on 23 November 2021). (In Persian)
47. Salehi Sarook, F. Survey of Electricity Consumption Savings and Social Factors Affecting It among Married Women in Yasuj, Iran. Master's Thesis, Yasuj University, Yasuj, Iran, 2013. (In Persian)
48. Mahdian, A. An Investigation of (Socio-Economic & Cultural) Factors Underpinning Household Energy Consumption (Case Study: Malayer City). Master's Thesis, Mazandaran University, Babolsar, Iran, 2013. (In Persian)
49. Dzioubinski, O.; Dzioubinski, O.; Chipman, R.; Chipman, R.; Nations, U.; Nations, U. Trends in Consumption and Production: Household Energy Consumption. In Proceedings of the United Nations DESA Discussion Paper. 1999. p. 21. Available online: https://www.un.org/esa/sustdev/publications/esa99dp6.pdf (accessed on 23 November 2021).
50. Brandon, G.; Lewis, A. Reducing Household Energy Consumption: A Qualitative and Quantitative Field Study. *J. Environ. Psychol.* **1999**, *19*, 75–85. [CrossRef]
51. 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]
52. York, R. Demographic Trends and Energy Consumption in European Union Nations, 1960–2025. *Soc. Sci. Res.* **2007**, *36*, 855–872. [CrossRef]
53. Aune, M. Energy Comes Home. *Energy Policy* **2007**, *35*, 5457–5465. [CrossRef]

54. Reddy, B.S.; Srinivas, T. Energy Use in Indian Household Sector—An Actor-Oriented Approach. *Energy* **2009**, *34*, 992–1002. [CrossRef]
55. Mustapha Harzallah, I. Application of Value Beliefs Norms Theory to the Energy Conservation Behaviour. *J. Sustain. Dev.* **2010**, *3*, 129–139.
56. Moezzi, M.; Lutzenhiser, L. What's Missing in Theories of the Residential Energy User. In Proceedings of the 2010 ACEEE Summer Study Energy Efficiency in Buildings, Pacific Grove, CA, USA, 15–20 August 2010; pp. 207–221.
57. Chao, L.; Qing, S. An Empirical Analysis of the Influence of Urban Form on Household Travel and Energy Consumption. *Comput. Environ. Urban Syst.* **2011**, *35*, 347–357. [CrossRef]
58. Government, U.K. Behaviour Change and Energy Use. *Energy* **2011**, *1*, 35.
59. Pape, J.; Rau, H.; Fahy, F.; Davies, A. Developing Policies and Instruments for Sustainable Household Consumption: Irish Experiences and Futures. *J. Consum. Policy* **2011**, *34*, 25–42. [CrossRef]
60. Hemmes, F. Waste Not, Want Not: How Utilities Can Help Consumers Save Energy. *Energy* **2012**, *7*, 1–16.
61. Shuling Chen Lillemo Measuring the Effect of Procrastination and Environmental Awareness on Households' Energy-Saving Behaviours: An Empirical Approach. *Energy Policy* **2014**, *66*, 249–256. [CrossRef]
62. Yamaguchi, Y.; Chen, C.F.; Shimoda, Y.; Yagita, Y.; Iwafune, Y.; Ishii, H.; Hayashi, Y. An Integrated Approach of Estimating Demand Response Flexibility of Domestic Laundry Appliances Based on Household Heterogeneity and Activities. *Energy Policy* **2020**, *142*, 111467. [CrossRef]
63. Alexander, D.; Leemon, A.; Petkovic, M.; Richards, C. Towards a Two-Sided Market ... the Role for Demand Response in Tomorrow's Grid: Expert Panel | EcoGeneration. Available online: https://www.ecogeneration.com.au/towards-a-two-sided-market-the-role-for-demand-response-in-tomorrows-grid-expert-panel/ (accessed on 15 April 2021).
64. Nicolson, M.; Moon, B. Applying Behavioural Insights to Forward Looking Charging Reform Results from a Literature Review by Ofgem's Behavioural Insights Unit. 2019. Available online: https://www.ofgem.gov.uk/publications/applying-behavioural-insights-forward-looking-charging-reform (accessed on 10 June 2021).
65. Demand Response as a Powerful Flexibility Resource for Value Creation in Regulated Markets. Available online: https://www.energy-pool.eu/en/demand-response-powerful-flexibility-resource-value-creation-regulated-markets/ (accessed on 15 April 2021).
66. IEA Behavioural Insights for Demand-Side Energy Policy and Programmes: An Environment Scan. Available online: https://userstcp.org/news/behavioural-insights-for-demand-side-energy-policy-and-programmes-report-published (accessed on 15 April 2021).
67. European Smart Grids Task Force Expert Group 3 Demand Side Flexibility—Perceived Barriers and Proposed Recommendations. Available online: https://ec.europa.eu/energy/sites/ener/files/documents/eg3_final_report_demand_side_flexiblity_2019.04.15.pdf (accessed on 15 April 2021).
68. Sharma, A.; Sharma, H. Demand Side Response: Drivers, Challenges, and Opportunities. In Proceedings of the International Conference on Advancements in Computing & Management (ICACM), Jaipur, India, 13–14 April 2019. [CrossRef]
69. Nursimulu, A. *Demand-Side Flexibility for Energy Transitions: Ensuring the Competitive Development of Demand Response Options*; SSRN: Rochester, NY, USA, 2016. [CrossRef]
70. Osunmuyiwa, O.O.; Peacock, A.D.; Payne, S.; Vigneswara Ilavarasan, P.; Jenkins, D.P. Divergent Imaginaries? Co-Producing Practitioner and Householder Perspective to Cooling Demand Response in India. *Energy Policy* **2021**, *152*, 112222. [CrossRef]
71. Zhang, G.; Xue, S.; Zhang, X. Evaluation of Social and Economic Benefits of Demand Response. *IOP Conf. Ser. Earth Environ. Sci.* **2020**, *571*, 012098. [CrossRef]
72. Valdes, J.; Poque González, A.B.; Ramirez Camargo, L.; Valin Fenández, M.; Masip Macia, Y.; Dorner, W. Industry, Flexibility, and Demand Response: Applying German Energy Transition Lessons in Chile. *Energy Res. Soc. Sci.* **2019**, *54*, 12–25. [CrossRef]
73. Hashemi Majoumerd, S.M.; Zandieh, M.; Alem-Tabriz, A.; Rabieh, M. Key Success Factors for Demand Response Implementation: A Hybrid Multi-Criteria Decision Making Approach. *J. Ind. Syst. Eng.* **2020**, *13*, 240–261.
74. Khalid, R.; Christensen, T.H.; Gram-Hanssen, K.; Friis, F. Time-Shifting Laundry Practices in a Smart Grid Perspective: A Cross-Cultural Analysis of Pakistani and Danish Middle-Class Households. *Energy Effic.* **2019**, *12*, 1691–1706. [CrossRef]
75. Fröhlich, P.; Esterl, T.; Adams, S.; Kuch, D.; Yilmaz, S.; Katzeff, C.; Winzer, C.; Diamond, L.; Schrammel, J.; Lukszo, Z.; et al. Towards a Social License To Automate in Demand Side Management: Challenges, Perspectives and Regional Aspects. *Geoforum* **2020**, *55*, 43–52.
76. Aalami, H.A.; Parsa Moghadam, M. How to Introduce Consumers to Consumption Management. In Proceedings of the 3rd National Conference on Power Distribution Networks, Shiraz, Iran, 11 May 1993; pp. 15–23. (In Persian)
77. Hendry, J. *Man and the Identity Crisis*; Mohammadian, N., Ed.; Mohammadian, N., Translator; Chapakhsh: Tehran, Iran, 2002.
78. Abazari, Y.; Chavoshian, H. From Social Class to Lifestyle; New Approaches in Sociological Analysis of Social Identity. 2002. Available online: https://www.sid.ir/en/journal/ViewPaper.aspx?ID=21159 (accessed on 15 April 2021). (In Persian)
79. Khosh Kholgh, M. *The Effects of Social, Economical and Cultural Factors on Energy Consumption Behavior (Case Study: Electrical Energy in Tehran)*; Tehran University: Tehran, Iran, 2015.
80. Salehi, S. New Environmental Paradigm and Energy Consumption. 2010. Available online: https://www.sid.ir/en/journal/ViewPaper.aspx?ID=503639 (accessed on 15 April 2021). (In Persian)

81. Karimzadeh, S. A Survey on Social Factors Underpinning Environmental Behaviours (Energy Consumption). Master's Thesis, Iranian Research Institute for Information Science and Technology, Tehran, Iran, 2010. Available online: https://ganj.irandoc.ac.ir//#/articles/95dd632a12a59779e1a2906dfef0cd03 (accessed on 8 April 2021).
82. Ferdousi, S.; Mortazavi, S.; Rezvani, N. The Relation between Bio-Environmental Knowledge and Pro-Environmental Behavior. 2007. Available online: https://www.sid.ir/en/journal/ViewPaper.aspx?ID=110956 (accessed on 10 April 2021). (In Persian)
83. Kaiser, F.G.; Wölfing, S.; Fuhrer, U. Environmental Attitude and Ecological Behaviour. *J. Environ. Psychol.* **1999**, *19*, 1–19. [CrossRef]
84. Aalami, H.A.; Moghaddam, M.P.; Yousefi, G.R. Demand Response Modeling Considering Interruptible/Curtailable Loads and Capacity Market Programs. *Appl. Energy* **2010**, *87*, 243–250. [CrossRef]
85. Luft, J. Bonus and Penalty Incentives Contract Choice by Employees. *J. Account. Econ.* **1994**, *18*, 181–206. [CrossRef]
86. Aghapour, R.; Sepasian, M.S.; Arasteh, H.; Vahidinasab, V.; Catalão, J.P.S. Probabilistic Planning of Electric Vehicles Charging Stations in an Integrated Electricity-Transport System. *Electr. Power Syst. Res.* **2020**, *189*, 106698. [CrossRef]
87. Aalami, H.A.; Moghaddam, M.P.; Yousefi, G.R. Modeling and Prioritizing Demand Response Programs in Power Markets. *Electr. Power Syst. Res.* **2010**, *80*, 426–435. [CrossRef]
88. Moghaddam, M.P.; Abdollahi, A.; Rashidinejad, M. Flexible Demand Response Programs Modeling in Competitive Electricity Markets. *Appl. Energy* **2011**, *88*, 3257–3269. [CrossRef]
89. Conejo, A.J.; Morales, J.M.; Baringo, L. Real-Time Demand Response Model. *IEEE Trans. Smart Grid* **2010**, *1*, 236–242. [CrossRef]
90. Allcott, H.; Mullainathan, S. Behavioral Science and Energy Policy. *Science* **2010**, *327*, 1204–1205. [CrossRef]
91. Dodson, J.D. Relative Values of Reward and Punishment in Habit Formation. *Psychobiology* **1917**, *1*, 231–276. [CrossRef]
92. Baboli, P.T.; Eghbal, M.; Moghaddam, M.P.; Aalami, H. Customer Behavior Based Demand Response Model. In Proceedings of the IEEE Power and Energy Society General Meeting, San Diego, CA, USA, 22–26 July 2012. [CrossRef]
93. Ramos, A.; Gago, A.; Labandeira, X.; Linares, P. The Role of Information for Energy Efficiency in the Residential Sector. *Energy Econ.* **2015**, *52*, S17–S29. [CrossRef]
94. Santarius, T. Energy Efficiency, Human Behavior, and Economic Growth: Challenges to Cutting Energy Demand to Sustainable Levels. *AIP Conf. Proc.* **2015**, *1652*, 70–81. [CrossRef]
95. Carmon, Z.; Ariely, D. Focusing on the Forgone: How Value Can Appear So Different to Buyers and Sellers. *J. Consum. Res.* **2000**, *27*, 360–370. [CrossRef]
96. Baboli, P.T. Demand Response Model Considering Loss Aversion Concept. 2017. Available online: https://www.magiran.com/paper/1661853?lang=en (accessed on 2 August 2021). (In Persian)
97. Tversky, A.; Kahneman, D. Advances in Prospect Theory: Cumulative Representation of Uncertainty. *J. Risk Uncertain.* **1992**, *5*, 297–323. [CrossRef]
98. Kahneman, D.; Tversky, A. Choices, Values, and Frames. *Am. Psychol.* **1984**, *39*, 341–350. [CrossRef]
99. Tversky, A.; Kahneman, D. Loss Aversion in Riskless Choice: A Reference-Dependent Model. *Choices Values Fram.* **2019**, 143–158. [CrossRef]
100. Kim, J.H.; Shcherbakova, A. Common Failures of Demand Response. *Energy* **2011**, *36*, 873–880. [CrossRef]
101. VaasaETT EMPOWER DEMAND 2—Energy Efficiency through Information and Communication Technology—Best Practice Examples and Guidance. 2013. Available online: https://www.esmig.eu/esmig-publications/empower-demand-report-phase-ii/ (accessed on 13 September 2021).
102. Albertarelli, S.; Fraternali, P.; Herrera, S.; Melenhorst, M.; Novak, J.; Pasini, C.; Rizzoli, A.E.; Rottondi, C. A Survey on the Design of Gamified Systems for Energy and Water Sustainability. *Games* **2018**, *9*, 38. [CrossRef]
103. Casals, M.; Gangolells, M.; Macarulla, M.; Forcada, N.; Fuertes, A.; Jones, R.V. Assessing the Effectiveness of Gamification in Reducing Domestic Energy Consumption: Lessons Learned from the EnerGAware Project. *Energy Build.* **2020**, *210*, 109753. [CrossRef]
104. Largue, P. Game On: Gamification in the Energy Sector. 2020. Available online: https://www.smart-energy.com/industry-sectors/digitalisation/game-on-gamification-in-the-energy-sector/ (accessed on 16 September 2021).
105. S3C Guideline: Gamification—Making Energy Fun. 2015. Available online: http://www.smartgrid-engagement-toolkit.eu/fileadmin/s3ctoolkit/user/guidelines/guideline_gamification_-_making_energy_fun.pdf%0Ahttp://www.smartgrid-engagement-toolkit.eu/fileadmin/s3ctoolkit/user/guidelines/GUIDELINE_GAMIFICATION_-_MAKING_ENERGY_FUN.pdf (accessed on 3 March 2021).
106. Joskow, P.L.; Marron, D.B. What Does a Negawatt Really Cost? *Energy J.* **1992**, *13*, 41–74. [CrossRef]
107. Fazeli, M. *Consumption and Lifestyle*; Sobhe Sadeq Publication: Qom, Iran, 2003. (In Persian)
108. Ghasemi, V.; Rabbani, R.; Rabbani Khorasgani, A.; Alizadeh Aqdam, M. Structural and Capital Determinants of A Health-Promoting Lifestyle. *JSPI* **2009**, *1387*, 181–213.
109. Tajbakhsh, K.; Khakbaz, A.; Poyan, H. *Social Capital: Trust, Democracy and Development*; Shiraze Publication: Tehran, Iran, 2005; Volume 1. (In Persian)
110. Mahdavi Kani, M.S. The Concept of Lifestyle and Its Scope in Social Sciences. *Cult. Res. Q.* **2007**, *1*, 199–230. (In Persian)