Iranian Household Electricity Use Compared to Selected Countries

Subjects: Behavioral Sciences

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Buildings account for nearly 40% of energy use in global contexts and climatic conditions tend to contribute to consumption. Human activities are also influential in energy consumption and carbon dioxide (CO_2) emissions that lead to global warming. Residential buildings are responsible for a considerable share. There are countries aggravating this situation by heavily relying on fossil fuels. Oil-rich countries are allocating an energy subsidy to the public, making energy cheaper for their consumers. This may result in negative consequences, including households' inefficient energy use behaviours in countries such as Iran. Beyond the impact of energy subsidy allocation, this study aims to explore the climatic and non-climatic factors that affect the increase in domestic electricity use, particularly in Iran. For this purpose, this study begins with a comparative analysis between countries with and without the energy subsidy to examine the trends in domestic electricity use. Afterwards, the tendency of households' electricity use in Iran will be analysed in consideration of climatic and non-climatic factors among several provinces in Iran. This study exploited published statistical data for the analysis. The results indicate the tendency of increased domestic electricity use due to the country's generous subsidy offered to the public as well as climatic and non-climatic factors in Iran. These results may provide an opportunity for future studies regarding building occupants' inefficient energy use behaviours for policy enactment in Iran and other oil-rich countries.

Keywords: behavioural factors ; developing and developed countries ; domestic sector ; electricity use per capita ; energy subsidy ; Iran

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The significant impact of human activities on climate change and global warming has been highlighted by the Intergovernmental Panel on Climate Change in various reports [1][2]. Although several resources are known to contribute to this issue through CO_2 emissions, energy has a large share of 73% of the overall emissions [3]. The International Energy Agency (IEA) analysis showed that the most critical sectors responsible for CO_2 from energy consumption are industry, transportation, and buildings, amongst which buildings account for 17.5% of total emissions. However, with 19% of contributions, residential buildings have a considerable share among other types of buildings [3][4] (**Figure 1**).

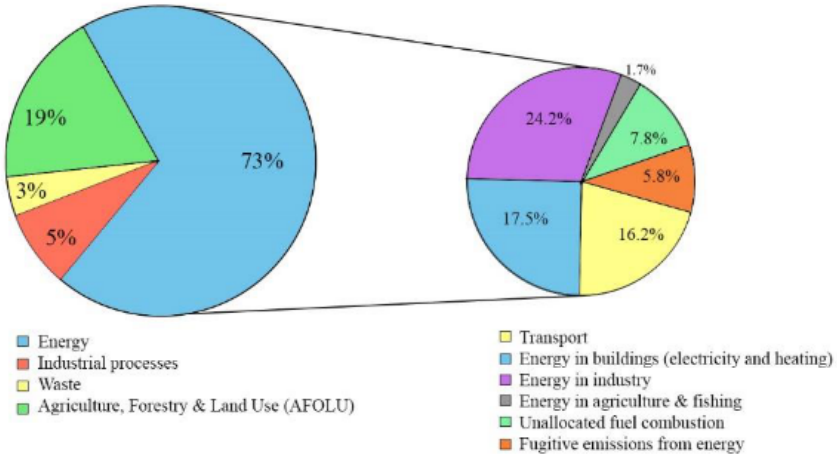

Figure 1. The share of global greenhouse gas emissions (%) from buildings consuming energy worldwide.

In the special report on global warming (SR15) [5], IPCC demonstrated that there is a possibility to achieve the Paris target of 1.5 °C if CO_2 reductions reach 45% by 2030 and a net-zero emission by 2050. However, issues have made net-zero emissions harder to achieve in the future. One of these issues is the energy subsidy allocated to consumers in oil-rich countries to reduce their energy costs. This has negatively encouraged the overconsumption of fossil fuels [6][7][8] while

reducing the incentives for further investments in renewable energies [9][10]. According to the IEA [11], some countries allocate an energy subsidy to reduce costs for energy consumers. However, unfortunately, such an energy subsidy is mainly given to fossil fuels [12][13], in which non-OECD countries form a large portion of the subsidy in the world [14].

As with other oil-rich countries negatively affected by the energy subsidy, Iran is struggling with challenges imposed by the subsidy; through heavily relying on fossil fuels to generate energy for buildings, Iran is facing critical issues in meeting sustainable development goals. Moreover, as a country with a low energy price, the tendency of households towards inefficient energy consumption in the domestic sector is considerably increasing [8]. Therefore, there is a need for oil-rich countries with low energy prices to manage and reduce domestic users' energy demands and habits, which is mainly associated with the energy subsidy policy [15]. The increasing demand for electricity in oil-rich countries has raised concerns regarding blackouts mainly due to this energy subsidy [16].

Several previous studies have highlighted the negative consequences of the energy subsidy on sustainable development goals to be achieved by oil-rich countries. Moreover, these studies pointed out the issue of energy demand growth of occupants in different countries where the energy subsidy was in their energy policies. For instance, Al-Marri (2018) [15] investigated the current energy use of occupants in the domestic sector in Qatar to understand the challenges of consumer behaviour in terms of energy efficiency. They found that occupants were not inclined to alter their energy use behaviour due to the energy subsidy. Moreover, several researchers have pointed out the negative implication of the fossil-fuel subsidy for energy efficiency [17][18][19]. For instance, Sun (2015) and Dube (2003) [20][21] highlighted that higher-income households benefit more than low-income households from energy subsidies, which has further affected their energy use behaviour. Studies conducted by Ouyang and Lin (2014) and Adom and Adams [10][22] pointed out the excessive subsidy for fossil fuels in China, which has led to wasteful energy consumption. Fattouh and El-Katiri (2013) [23] highlighted the inefficiency of domestic energy consumption in the Middle East and North African regions due to a high energy subsidy. According to Oryani et al. (2022) [24], Iran has ranked as the largest consumer of energy among other Middle East and North African countries.

Although there are studies on the energy subsidy and the impact on energy consumption for different countries [25][26][27][28], little research has been conducted to fully understand the effect of a fossil fuel subsidy and prices on the energy consumption trend in the international compared to Iranian context. For instance, in the studies mentioned above, the energy consumption was investigated from the economic perspective rather than climatic or social aspects in the oil-rich countries. Moreover, the important aspect of energy consumption in countries with or without the energy subsidy and its significant effect on the way that occupants consume energy has not been studied comparatively, especially in residential buildings. It is worth mentioning that in the studies which have considered Iran as their case study, most of the researchers have solely highlighted the challenges of removing the energy subsidy and how low-income occupants can be negatively affected. Therefore, there is a need to reconsider the solutions to the subsidy by understanding important factors (climatic and non-climatic) influencing occupants' energy consumption in Iran. Therefore, instead of proposing different solutions regarding the removal of subsidies, occupants' behaviour change might have the potential to be an alternative solution to the removal of the subsidy. This necessitates understanding the effective factors in occupants' energy consumption. Therefore, further investigations are needed to explore the negative consequences of fossil fuel subsidies on households' energy consumption patterns in a global and local context.

Moreover, the tendency of oil-rich countries and the negative consequences of the energy subsidy on occupants' energy use is not clearly understood or well defined in the domestic sector in oil-rich countries, especially Iran, compared to the global context. It is worth mentioning that removing the fossil fuel subsidy alone may not address the issues with which the oil-rich countries are struggling [8]. As indicated by Gangopadhyay et al. [29], energy subsidy reduction in developing countries necessitates further support through other policies to alleviate the adverse effects. However, since the energy subsidy acts as a barrier to not only efficient energy use behaviour but also additional investments in renewable energies [15], raising the awareness of the negative consequences of this issue can globally and locally encourage future studies regarding the consideration of human behaviour for policy enactment as well as possible solutions to be proposed for the reduction of fossil fuel consumption in generating electricity in the domestic sector in Iran and other oil-rich countries.

The research objective is first to investigate the driving factors affecting fossil fuel reliance of oil-rich countries compared to other developed countries without an energy subsidy. To achieve this objective, different countries were compared in terms of their reliance on fossil fuels and its impact on their increasing/decreasing trend in energy consumption to generate electricity. Afterwards, Iran, Australia, and Germany were compared and analysed in terms of electricity costs and demands per capita to understand further consequences of the energy subsidy on households' behaviour in electricity use. The data for this purpose were collected from different statistical data centres worldwide. The data for the global context were obtained from the IEA [3][30][31][32][33], the World Bank [34][35], World Data [36], Our world in data [37][38], the World Economic Outlook Database [39], Global Carbon Project [40], Australian Bureau of Statistics [41], Australia Institute of

Family Studies [42], Statistisches Bundesamt [43], and World Resources Institute [4]. In addition, the tendency of electricity use in the domestic sector was analysed in detail by comparing different provinces in Iran to have insights into the consumption behaviour of provinces known for their high amount of electricity use in Iran. For instance, to understand the significant share of the Tehran province in electricity use in Iran, this study gathered raw data from different resources. For the Iranian context, this research exploited data from the National Statistics Centre of Iran [44][45], the Plan and Budget Organisation [46], the Ministry of Energy, and the Tavanir Company [47].

This paper is divided into four parts. The first part focuses on comparing developed and oil-rich countries in terms of their status regarding the fossil fuel subsidy to explore the effect of energy price on households' electricity demand in oil-rich countries compared to developed countries. Then, the crucial factors affecting the increasing or decreasing trend in domestic electricity demand were explored through a comparative analysis between countries with and without energy subsidies. The second part implements a local comparison of domestic electricity use between different provinces of Iran to further discuss and delve into the impacts of behavioural-related factors on the electricity use of Iranian households. The third part highlights the solutions proposed by previous studies to reduce energy use and emphasises the importance of behaviour as an effective solution to be included in the policy enactment process.

Moreover, the limitations of current energy policies in Iran were investigated for the domestic sector. The sequence of the study is illustrated in **Figure 2** below. The conclusions are presented in the final section. One of the contributions of the study is to explore crucial factors affecting the behavioural aspect of domestic electricity demand in oil-rich countries by comparing them with developed countries. Another contribution is examining and comparing one of the highest electricity-consuming provinces, Tehran, with other cities to inform energy practitioners, designer, and policymakers about the critical issues related to behavioural aspects of domestic electricity use in Iran.

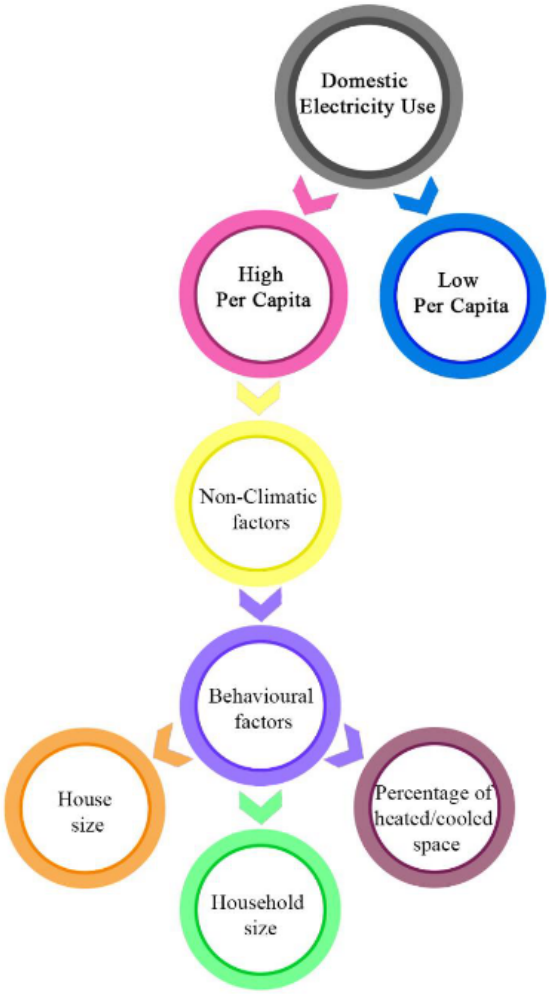

Figure 2. Factors affecting high per capita domestic electricity use in provinces of Iran.

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