Influence of Rising Costs of Energy on the Energy Consumer Behavior of International Students in Scotland

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Abstract

The rise in energy prices across Scotland and globally has impacted households in several ways including economically, socially and materially. However, little is known on the effects of high energy tariffs on a unique growing segment of the Scottish population – international university students. Therefore, this quantitative study investigates the impact of rising energy costs on consumer behaviour of international university students in Scotland. Hinged on the consumer behaviour theory, this research analyses the effects of energy costs on curtailment and efficiency behaviours evident among international students in Scotland. Factors such as personal, cultural, social, economic and pro-environmental perception were taken into cognizance in the design of the research questionnaire and data collection from220 participants. Descriptive statistics, multivariable linear regression, and ANOVA were used for data analysis. A pivotal revelation was that all participants experienced an elevation in energy costs post-immigration, with 70.5% observing a significant surge. In exploring energy consumption habits, the data underscored a compelling inclination towards energy-saving practices, with 72.73% consistently turning off lights when exiting rooms. Also, the linear regression analysis illuminated the profound implications of rising energy costs on consumption behaviours, revealing an unexpected positive correlation ($p < 0.0001$). "Much" energy-saving changes are linked to significantly lower curtailment in consumption patterns ($p < 0.0001$) compared to "little/nothing" changes ($p = 1$). Furthermore, the ANOVA indicates that households relying solely on gas as an energy source exhibited significantly ($p<0.05$) distinct energy costs compared to those utilising both gas and electricity. Therefore, this research not only underscores the complexities of energy consumption among international students but also offers actionable insights for economically prudent energy decisions. Likewise, the results necessitate the need for enhanced energy conservation education and awareness for this demographic. Hence, these findings contribute to our understanding of the relationship between energy consumption andrising costs among the international student communities.

Keywords: Rising Energy Costs, Energy Consumer Behaviour, International Students, Energy-efficient Investments, Curtailment Behaviour.

1. INTRODUCTION

Energy consumption in Scotland and the United Kingdom has been steadily increasing due to factors such as population growth, development, technological advancements, industrialisation, and household needs. The services powered by energy, such as heating, lighting, electrical appliances, and cooking are critical to daily life (Gyamfi *et al.*, 2013). However, the cost of energy significantly impacts on various sectors of the economy, including logistics, supply chain, maritime, agriculture, production, business operations, and households (Li *et al.*, 2022; Martiskainen *et al.*, 2021; Punzi, 2019). Yet, Babin and Harris (2023) adeptly encapsulate the

sentiment that as these necessities find their foothold in modern existence, the shifting sands of economic challenges pose pressing dilemmas.

As society advances, the intersection of energy and economics becomes increasingly crucial. The trajectory of recent geopolitical events, notably the Russia-Ukraine conflict, alongside intricate policy frameworks (Brexit and Covid recovery measures), exemplifies the volatile landscape of energy economics (Liadze*et al*., 2023; Mbah and Wasum, 2022). In the United Kingdom (inclusive of Scotland), the amplification of this phenomenon is unmistakable, given the government's policy recalibrations, such as the adjustment of the energy price cap (Ofgem, 2022). Researchers have extensively examined the implications of energy pricing on household expenses, encompassing areas like food, transportation, and healthcare (Wehner, 2018; Martiskainen *et al*., 2021). Punzi (2019) underlined the necessity of continuous assessments to comprehend the ripple effects of fluctuating energy prices on macroeconomic variables. Chadwick *et al*. (2022) emphasized the evolving nature of household energy consumption patterns in response to varying periods of energy cost surges.

Moreso, the dynamics of energy consumption and the inherent behaviours it evokes, especially within populations such as international students, offer a unique lens to comprehend the broader socio-economic patterns. As Benoit and Mottet (2023) suggest, rising energy costs may very well usher in a paradigm shift, redefining how we perceive and interact with energy. These changes as highlighted by Akroush *et al*. (2019), could be determinants of purchasing intentions, especially concerning energy-efficient products. Moreover, Mehta, Saxena and Purohit's (2020) exploration of the evolving consumer behaviour in the face of challenges like the COVID-19 pandemic affords a contextual understanding of how external crises mould consumer responses.

However, for international students in Scotland and the broader UK, the constraint of a 20-hour weekly work limit significantly curtails their disposable income (Vu *et al*., 2022). Coupled with escalating living costs, these students, especially those dependent on past living cost estimates for their upkeep allowances, face mounting financial pressures. Recent immigration policy shifts, allowing international students to be accompanied by dependents, could exacerbate these economic challenges, potentially spurring adaptive or even drastic shifts in their energy consumption patterns (Yu *et al*., 2023). So, research focusing specifically on the energy cost implications for international students in Scotland remains sparse. This research addresses the following three questions: (R1) how has changes in energy costs impacted energy consumer behaviour among international students, (R2) what is the effect of energy source on students' attitudes, and (R3) what are the dominant consumption pattern among various demographics of international students in Scotland? Consequently, this study endeavours to delve into the intricate ways in which the mounting costs of energy inexorably shapes the energy consumption behaviours of this unique demographic. Bridging this knowledge gap is paramount not only for unravelling broader patterns of energy consumer behaviour but also for formulating informed policies that can foster a sustainable and equitable environment for international students.

2. THEORETICAL FRAMEWORK

Consumer behaviour theory serves as an invaluable lens for understanding the intricacies inherent in consumers' decision-making processes (Schiffman*et al*., 2013). This theory encompasses the process of selecting, acquiring, using, and disposing of products and services, acknowledging the pervasive influence of cultural, social, personal, economic, and psychological forces on consumer buying behaviour (Kotler and Keller, 2011).Santos and Goncalves (2021) adds depth to our understanding by outlining the various stages in the consumer decision-making process, ranging from need recognition to post-purchase evaluation. Foxall's (2021) exploration of learning and reinforcement further underscores the enduring impact of past experiences on shaping consumer behaviour. In essence, consumer behaviour theory provides a comprehensive framework that aids in deciphering consumer decision-making and laying the foundation for a profound exploration of energy consumer behaviour.

Navigating the complex landscape of energy consumption, especially within the realm of international students in Scotland, provides a unique vantage point into understanding the intricate web of consumer behaviour. This examination becomes even more crucial when set against the backdrop of a rapidly evolving global energy sector, marked by its own set of challenges and opportunities. At the heart of consumer behaviour lies a multidisciplinary confluence. Blythe (2013) posited that consumer behaviour is not solely a marketing construct; instead, it interweaves insights from diverse fields, from economics to psychology. When considered within the context of international students, this multidimensionality is accentuated by a kaleidoscope of cultural influences.

Energy consumption, a focal point of this discourse, is determined by a plethora of factors. Spangenberg and Lorek (2019) highlighted the multifarious determinants of energy consumption, ranging from policy implications and price points to deep-seated personal beliefs. Recent global events, notably the economic reverberations of the Russia-Ukraine conflict, have added layers to this matrix (Liadze*et al*., 2023; Mbah and Wasum, 2022). Nonetheless, scholars admit that broader global shifts towards sustainability and conscious consumption have emerged among consumers and this reflects increased population of informed decision-makers (Vargo and Lusch, 2004). Mehta *et al*. (2020) added weight to this observation, pointing out that these global consumption trends often merge with personal aspirations and ingrained cultural inclinations.

Guan *et al*. (2023) alluded to the influence of dominant factors in the development of consumer behaviour during periods of energy and economic crisis. Cultural underpinnings, for instance, hold profound sway over consumption habits, with distinct cultural philosophies manifesting in varying behaviours (Guan *et al*., 2023; Hofstede and McCrae, 2004). Parallelly, the social fabric, encompassing families, peer groups, and larger societal norms, plays an instrumental role in moulding energy consumption choices (Kotler and Keller, 2015; Mogaji*et al*., 2021). On the other hand, personal factors further compound this complexity. As Solomon *et al*. (2022) elucidated, demographic details, such as age, economic standing, and educational background, profoundly influence an individual's purchasing decisions. In conjunction, psychological underpinnings, from motivations and perceptions to broader worldviews, subtly guide individuals towards specific energy and products consumption patterns (Frederiks *et al*., 2015).

Admittedly, the UK, with its intricate energy narrative, provides an illuminating backdrop for this exploration. With a plethora of energy sources and a web of intertwined policies, the UK's energy story is both rich and intricate (Energy UK, 2023). External challenges, notably the multifaceted implications of Brexit, have added to this intricate energy puzzle, impacting supply chains and influencing consumer behaviours (Kuzemko*et al*., 2022; Acquah-Andoh *et al*., 2019). Economic considerations, underscored by the rising costs of living, have triggered discernible shifts in consumer behaviours, forcing a reconsideration of established energy consumption paradigms (Francis-Devine *et al*., 2022).Zooming in from the macro to the micro, an analysis of household energy consumption presents its own set of insights. Themes of global sustainability dominate this narrative, with households increasingly gravitating towards energy-conserving behaviours (Malinauskaite *et al*., 2019). However, the socio-economic context, particularly property ownership dynamics, introduces layers of complexity, emphasising that consumption patterns are never in isolation from their socio-economic components (Boardman, 2004). Additionally, the onset of the COVID-19 pandemic has further accentuated these dynamics, urging both researchers and consumers to re-evaluate entrenched energy consumption models (Hesselman *et al*., 2021).

However, economic considerations, especially prices, have historically held immense sway over consumer choices. It is well-acknowledged that fluctuations in energy prices lead to significant shifts in consumption patterns. In the context of international students and broader households in the UK, the elasticity of demand becomes apparent in response to these price shifts (Martiskainen, 2007). With global energy dynamics in a state of flux and the pivotal role of consumer behaviour in shaping these dynamics, understanding the nuances of these consumption behaviours becomes paramount.

3. LITERATURE REVIEW

Martiskainen (2022) indicated that household energy consumer behaviour includes actions such as turning off appliances, monitoring energy use through metering, making sustainable purchasing decisions, and adopting energy-saving appliances. However, despite the shift towards energy-saving appliances, poor energy efficiency management behaviours such as leaving appliances on standby and lighting unoccupied rooms contribute to high energy consumption levels in the UK (Atanasiu and Bertoldi, 2010). Energy consumer behaviour is influenced by internal factors such as attitudes, beliefs, norms, lifestyle, and opportunity, as well as external factors including demographic, socio-economic, cultural, technological, and institutional factors (Owens and Driffill, 2008; Darby, 2006; DTI, 2007). Thus, winter heating needs, shorter daylight hours and temperature, also affects energy use. No wonder, the COVID-19 lockdown increased domestic energy costs due to increased home energy consumption (Li *et al*., 2022).

However, scholars argue that quantifying the effectiveness of different energy-saving behaviours is challenging, with curtailment behaviours (e.g., switching off lights and appliances) and efficiency behaviours (e.g., double glazing, energy-saving devices) being prevalent (Abrahamse *et al*., 2005; Geller, 2012). Price-induced behavioural changes are prominent, but a combination of various factors, including demography, technology, institution, culture, education, economic growth, and opportunity, can further influence household energy behaviours (Gärling *et al*., 2002). Despite calls for energy reduction based on climate change concerns, domestic energy use continues to increase, as consumers may not perceive the impacts of their actions on the climate or CO2 emissions (Abrahamse *et al*., 2005). In the UK, consumers may be less concerned about their energy usage, as direct debits and unclear bill presentation can perpetuate unchanged energy consumption behaviour (Darby, 2006; Tuomela *et al*., 2021). Therefore, Roberts and Baker (2003) observed that these trends are likely to have significant impacts on consumer behaviour in the UK.

Researchers generally study household consumer behaviour in relation to energy-saving measures, as the optimal utilisation of resources is a key aspect of consumption. This includes consideration of sources of energy wastage in *the* system. Boudet *et al*. (2016) categorised 261 household energy-saving measures into nine specific characteristics, such as cost, performance, energy savings, skill level required, and household functionality, among others. Based on their analysis, they identified four consumption patterns related to energy-saving behaviour: family style, household management, call an expert, and weekend project.

Nevertheless, there is a consensus among scholars that household energy-saving behaviour can be classified into two broad measures: curtailment actions and efficiency investments. Curtailment actions involve actions *taken* to reduce energy consumption, while efficiency investments focus on investments made to improve energy efficiency (Karlin *et al*., 2014; Boudet *et al*., 2016). Examples of curtailment actions identified by Testa *et al*. (2016) include turning off lights in empty rooms, adjusting heater/AC temperature, avoiding overstuffing the refrigerator, powering off electronics when not in use, ensuring the washing machine is full before use, reducing use of high energy-consuming products, and other adjustments aimed at reducing energy use and associated costs.

Research suggests that the shift in consumption patterns resulting from curtailment measures is crucial in understanding the impact of energy consumer behaviour (Wang *et al*., 2011; Boudet *et al*., 2016). Scholars posit that curtailment actions are among the first observable changes in consumer behaviour in *response* to economic and government policy changes (Wang *et al*., 2011). For instance, Wang *et al*. (2011) investigated the willingness of 816 households in Beijing to save energy and found that economic benefits, government policies, marketing promotions, and perceived inconveniences were key drivers of energy-saving behaviour in China. In contrast, social factors such as education, gender, and perceived changes in the environment had no significant effect on willingness to save energy (Wang *et al*., 2011).

Similarly, Brounen*et al*. (2013) examined curtailment measures, such as room and night temperature settings and controls, in 1,721 Dutch households and found that gender had no impact on these actions. However, age played a significant role, with older citizens setting higher night temperatures and being more relaxed in energy use. In contrast, Hori *et al*. (2013) observed weak positive impacts of income and age on curtailment measures of energy consumption in five Asian cities. Moreover, no significant differences were found in night temperature control between high-income and low-income households (Brounen*et al*., 2013). These findings suggest that personal factors have limitations in influencing consumer behaviour.

Nevertheless, researchers have identified household size, presence of children, and energy-saving awareness as strong determinants of curtailment actions. Mills and Schleich (2012) examined curtailment measures among households in European Union (EU) countries and Norway, using data from 5,000 households across ten countries. Their findings indicated that curtailment actions such as full loading of washing machines, turning off lights in vacated rooms, frequent use of pressure cookers, setting energy-saving features on computers and phones, and regulating heaters were dominant. Furthermore, households with young children and educated households with energy-saving knowledge were more likely to adopt curtailment actions due to the higher demands of household activities in households with children and the increased awareness of energy-saving practices in educated households (Mills and Schleich, 2012). For instance, children's low self-restraint, hyperactivity, and curiosity increase the likelihood of turning on TV, laptops, and lights even when not in use (Fell and Chiu, 2014).

Furthermore, scholars in the UK have found that economic factors, such as income and energy costs, strongly influence household curtailment measures (Traynor *et al*., 2014). High-income households tend to spend more on heating, while households with lower incomes are more motivated to implement curtailment measures (Nakamura, 2013). Rising energy costs also lead to increased adoption of curtailment measures, as households become more conscious of their meter readings and adjust their energy usage (Darby, 2006). Gender plays a role, with women adopting more energy-saving measures than men (Nakamura, 2013), and age shows a 'U-shaped' relationship with heating expenses (Traynor *et al*., 2014). Young people may not fully realise the implications of their energy usage and may be less active in adopting curtailment actions (Lillemo, 2014). Psychological and socioeconomic factors are also important in determining energy-saving measures (Botetzagias *et al*., 2014).

Perhaps the most noticeable household energy consumer behaviour change observed in studies globally is investment in energy-efficient appliances. Manufacturers are constantly innovating to manufacture products with lower energy ratings and modifying existing technologies to conserve energy (Ramos *et al.,* 2016). So, efficiency investment as a type of energy consumer behaviour involves non-routine activities, adjustments and processes that require a measure of financial resource commitment. This includes replacement of home appliances and carrying out housing renovation to optimise energy use. Likewise, the United Kingdom has witnessed a great shift in housing energy efficiency from what was obtainable in the 1970's (Malinauskaite *et al.,* 2019). Malinauskaite *et al.* (2019) in their study of energy efficiency across the EU and the UK noted improvement in buildings in the region as most have: (1) loft insulation in their roofs to ensure heat is trapped, (2) wall insulation to give the building thermal insulation, protective and decorative cladding to ensure efficient reinforcement, and (3) double glazing to reduce heat loss through windows and exclude external noise.

Similarly, Ding *et al.* (2021) observed that the UK and Germany households have one of the most energy-saving appliance efficiencies with increased investment in eco-friendly and low energy rated devices. Most households have replaced high energy rated appliances and replaced these with lower-energy ones. Ding *et al.* (2021) reported the high level of early adoption of energy saving innovations like boilers, heaters, refrigerators, ovens and light bulbs. These changes, while initially incurring a higher cost, yield significant returns on investment in the long run. By saving millions of kilowatts of energy and reducing overall expenses on energy consumption, households can realise substantial benefits over time. Architectural designs are created to

harness illumination of apartments during the day using sunlight reflections. This has reduced the demand for energy for lighting bulbs during the day and influences curtailment measures like turning off the light bulbs during the day (Malinauskaite*et al.,* 2019).

Surprisingly, Boardman (2004) noted that rates of possession of energy efficiency housing (loft insulation, wall insulation and double glazing) were lower in rented apartments than in owner-occupied properties in the UK. They realised that landlords are more concerned about their occupied housing energy efficiency than that of their tenants. Conversely, Maruejols and Young (2011) did not identify any differences in housing efficiency of tenant and landlord-occupied buildings in Canada where landlords include bills as part of the rent. This later study does not deviate much from the former because the landlord will oversee the energy bills payment and will reduce expenses in the tenant apartments by ensuring they are energy efficient (Malinauskaite *et al.,* 2019). Consequently, Maruejols and Young (2011) added that tenants whose bills are integrated into rent display less curtailment measures as they have increased heating and TV watch-times.

However, household energy efficiency investments have been remarked by scholars as being influenced by socioeconomic, psychological and personal factors. In a study of over 9,000 households in 10 out of the 37 OECD countries by Urban and Scasny (2012) revealed that the following socioeconomic factors influence efficiency investments: (1) age, (2) household income, (3) size of household and (4) costs of energy. They reported that education and gender had limited impact on efficiency investments. Also, the studies of Lillemo (2014) in 900 Norwegian households indicated that income has a positive impact on efficiency investments; education has no effect on investments; young people do not have efficiency investment consciousness; and women are less active in efficiency investments than men. Higher energy prices have prompted increased investments in energy-saving efficiency measures (Belaid and Garcia, 2016). Individual households take these proactive efficiency investment decisions to reduce the cost and quantity of energy consumption.

Globally, there is a growing awareness among political and corporate leaders about the need to address climate change through policies and processes aimed at reducing carbon emissions and adapting to its impacts. This universal concern has led to changes in how people consume, shop, travel, and engage in other activities, with an increasing emphasis on making households carbon neutral or even carbon zero. Consequently, several scholars have reported that environmental conservation concerns positively influence both curtailment actions and efficiency investments in energy consumption patterns (Ramos *et al*., 2016). Higher-income individuals, contrary to the expected norm of increased energy consumption, tend to invest more in energy-efficient appliances and housing due to their pro-environmental attitudes (Belaid and Garcia, 2016). Education and awareness about the negative effects of increased energy consumption, such as carbon emissions and climate change, have prompted a shift towards sustainable energy use. For instance, Traynor *et al*. (2014) found that individuals who are determined to keep the environment clean adopt more energy-saving measures. Pro-environmental households tend to consume less energy, invest more in energy-efficient appliances and housing, take curtailment actions more quickly, and are willing to pay in support of environmental protection (Lange, 2022). They also show a higher potential for adopting green energy alternatives and display energy-saving behaviours even with fossil fuel-based energy sources (Ramos *et al*., 2016).

4. METHODOLOGY

This research delved into the energy consumption patterns of international students in Scotland amid rising energy costs. Notably, cross-sectional research design was adopted for its essential roles in examining real-time socio-economic effects (Bryman, 2016; Saunders *et al*., 2019). Also, similar to other scholarly research, this study is rooted in positivism which is aligned to the objective exploration of consumer behaviours (Auf *et al*., 2018). Using Saunders' research model as a guide, structured questionnaires facilitated the acquisition of quantifiable responses from the selected demographic (Saunders *et al*., 2019).

Consequently, convenient probability sampling was chosen, given its efficacy for accessing the dispersed international student community in Scotland. The University of the West of Scotland (UWS) was identified as the study's locus, with 176 of the initial 220 (90% response rate and 22 incomplete data was removed) responses undergoing analysis after data cleaning. Similarly, this study ensured data confidentiality and transparency in achieving optimum data management (Bryman, Bell and Harley, 2019).For data analysis, IBM SPSS Statistical package 24 was employed. Descriptive statistics painted the preliminary landscape, while advanced inferential tools, such as Pearson's correlation and regression, unearthed deeper insights. Validating the research's rigour, the internal consistency of the Likert-type scales yielded a reliability coefficient (α) of 0.86, indicating commendable consistency and thereby reinforcing the study's credibility (Fields, 2013).

5. RESEARCH FINDINGS

5.1 Demographic Profile of Respondents

Table 1 presents descriptive statistics of study participants, revealing that 60% of respondents were under 35 years old and all were international students, with 60.8% from Africa and 33% from Asia. Most participants paid energy bills through direct debit, and 69.9% used both gas and electricity. Notably, all respondents agreed that their current energy bills were higher than their pre-immigration budget, with 70.5% indicating a significant increase.

TABLE 1: Characteristics of the Study Participants.

Variable		Total sample n (%)
Gender	Woman	50.00
	Man	47.73
	Non-binary	2.27
Age range	18-24	18.18
	25-34	42.05
	35-44	30.68
	45-54	9.09
Continent of respondent	Africa	60.80
	Asia	32.95
	Other	6.25
Household Energy Source	Electricity	28.98
	Gas	2.84
	Both gas and electricity	67.61
	Others	0.57
Direct debit bills payment	No	27.84
	Yes	69.89
	Maybe	2.27
Current energy costs comparison pre-immigration	Higher	29.55
	Much higher	70.45

Moreover, according to the findings in Figure 4.1.1, 50% (n=44) of female participants primarily reside in Glasgow, with only 4 females residing in Ayr. On the other hand, the majority of male participants, comprising 39.3% and 38.1% of male respondents, reside in Paisley and Glasgow, respectively.

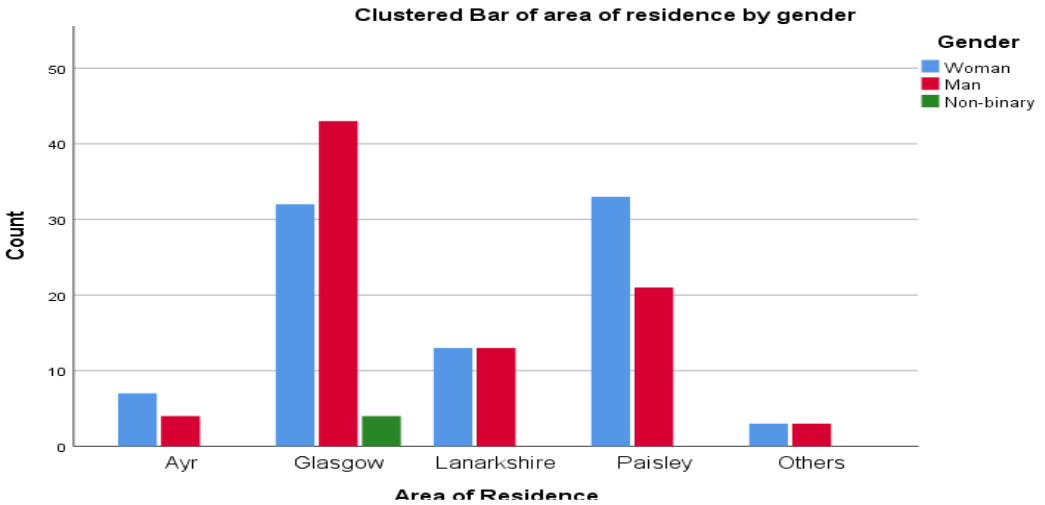

FIGURE 1: Chart Showing Area of Residence by Gender.

TABLE 2: Items Used in Creating Perceived Energy Consumption Pattern Scale.

Item	Never n (%)	Rarely n (%)	Sometimes n (%)	Often n (%)	Always n (%)
How often do you turn off computer monitors or laptops when you are not at your desk?	0.57	1.70	11.93	21.59	64.20
How often do you turn off the lights when leaving a room?	0.00	0.00	9.66	17.61	72.73
How often do you turn off other non-essential electrical equipment?	0.00	1.70	6.25	19.89	72.16
How often do you switch off standby modes of appliances or electronic devices?	1.14	1.71	13.71	21.14	62.29
How often do you turn things off completely, rather than to a "standby" mode?	0.00	2.27	13.64	19.89	64.20
How often do you cut down on heating to limit energy use?	0.00	2.84	8.52	23.30	65.34
How often do you turn off the TV when leaving a room?	0.00	1.70	13.64	15.34	69.32
How often do you limit your time in the shower in order to manage cost of heating water?	2.27	5.11	16.48	23.86	52.27
How often do you wait until you have a full load to use the washing machine or dishwasher?	0.00	0.57	6.82	21.02	71.59
How often do you leave items plugged in, even when they've finished charging?	26.70	39.20	23.86	1.70	8.52
How often do you consider the power/energy efficiency rating of electrical appliances?	1.70	2.84	11.36	26.14	57.95
How often do you discuss energy use in your households?	1.14	13.07	17.61	22.16	46.02
Perceived energy consumption pattern scale (Range: 33 - 60)	Mean = 51.07 (SD = 5.36)				
Perceivedenergy consumption pattern scale categories	n (%)				

Low	34.29%
Medium	41.14%
High	24.57%

Table 2 in response to R1, provides a comprehensive presentation of energy consumption behaviours among international students in Scotland. The data vividly highlights a discernible preference towards energy-saving practices. Specifically, 64.20% of respondents ensure computer monitors or laptops are powered down when not engaged, while 72.73% consistently extinguish lights upon vacating a room. This inclination for energy efficiency is further buttressed by the revelation that 62.29% persistently deactivate standby modes, epitomising a proactive stance against energy wastage. In contrast, a noteworthy 26.70% persist in leaving devices plugged in post-charging, signifying potential lapses in energy consciousness. However, only a small percentage reported using a clothesline instead of a dryer (11.86%) or using a programmable thermostat (10.20%) to regulate heating and cooling.

Furthermore, the data reveals a subtle distinction between practices that directly influence energy consumption and those that exert a more tangential impact. To elucidate, while 65.34% consistently adjust heating to economise on energy, a slightly lower percentage, 52.27%, habitually constrain shower durations to temper heating-related expenditures. This distinction underscores a heightened recognition of immediate energy utilisation contrasted against secondary energy implications. Interestingly, the gravitation towards energy efficiency when procuring appliances is not universal; only 57.95% regularly integrate it into their decision-making matrix. This variance intimates a complex interplay between energy conservation incentives and extraneous determinants like product cost or specialised features (Akroush *et al.*, 2019). Such intricacies magnify the multifaceted nature of economic and environmental considerations shaping these behaviours.Moreover, discussions centred around the challenges of escalating energy costs are prevalent within international students' households, with 68.28% regularly discussing this topic. This suggests an acute sense of apprehension and concern, reaffirming the salience of this investigation into their energy consumption patterns.

Evidently, there exists a moderate level of energy awareness among participants, consistent with prior research endeavours (Frederiks *et al.*, 2015; McMakin *et al.*, 2002). Predominantly, the tendency to adopt straightforward energy conservation behaviours, such as diligent management of lights and computer monitors, aligns with behavioural economic theories (Abrahamse *et al.*, 2005; Steg, 2008). However, areas of divergence are also evident, notably in limited deployment of programmable thermostats and the propensity to leave items plugged in post-charging. This is especially concerning given the potential for 'phantom' energy (standby power) consumption, which can contribute to energy waste without the user being aware (Mehta *et al.*, 2020). So, this pattern is contradictory to the conscious energy-saving actions observed elsewhere in the results. Mills and Schleich (2012) suggested that such inconsistencies might stem from gaps in awareness or perhaps a lack of perceived immediate implications. Given the rising energy costs, such behaviours might inadvertently inflate energy bills, contradicting students' otherwise conservation-oriented actions.

Moreover, international students in Scotland bring a confluence of diverse factors that influence their energy consumption behaviours. Given that many originate from warmer climates, the colder Scottish environment could naturally prompt longer, hotter showers; while perhaps seen as energy indulgence to some, it's a necessary environmental adaptation for others. This perspective is further nuanced when considering the living conditions of these students. Predominantly renting their accommodations, many international students find themselves in homes already outfitted with energy-efficient technologies such as thermostats, insulation, and double glazing. Such environments, implicitly promoting energy efficiency, undoubtedly shape their consumption habits. However, the influence of these external factors is counterbalanced by internal drivers like the pressing financial implications of rising energy costs. While the economic burden might encourage energy conservation actions such as judicious thermostat usage or

waiting for a full washing machine load, these behaviours are also entwined with rental conditions, deep-seated cultural values, and ingrained habits.

Undoubtedly, the prevailing conversations surrounding energy consumption among international students project a diverse spectrum. A noteworthy proportion actively partakes in recurrent discussions pertaining to energy-related matters. This phenomenon mirrors collective financial obligations and an evolving environmental consciousness. Hofstede's cultural constructs (1993, 2011) bear significant influence, particularly in collectivist cultures that predominate among African and Asian nations. These cultures inherently encourage communal deliberations on energy cost challenges, fusing communalism with shared responsibility and providing the backdrop for energy discourse. However, the prevailing economic climate anchors many of the observed behavioural adjustments. Thus, this economic reality, reflected in behaviours such as optimising washing machine usage, encapsulates both environmental stewardship and fiscal prudence among the international students.

5.2 Relationship Between Energy Source and Costs of Household Energy

The conducted ANOVA analysis aimed to examine (R2) the potential association between the energy source used in international students' households and their corresponding energy costs. The null hypothesis (*Ho*) posited that no significant difference exists in energy costs across varying energy sources. The obtained results, with a significance level set at $p<0.05$, led to the rejection of the null hypothesis. This outcome, supported by $p = 0.019$ and an F statistic of 4.043, demonstrates a statistically significant difference in energy costs among international students based on their household energy sources. However, figure 2 shows further analysis through post-hoc LSD testing. This revealed that households relying solely on gas as their energy source exhibited notably distinct energy costs compared to those utilising both electricity and gas sources. However, no significant cost disparity emerged between gas and electricity usage.

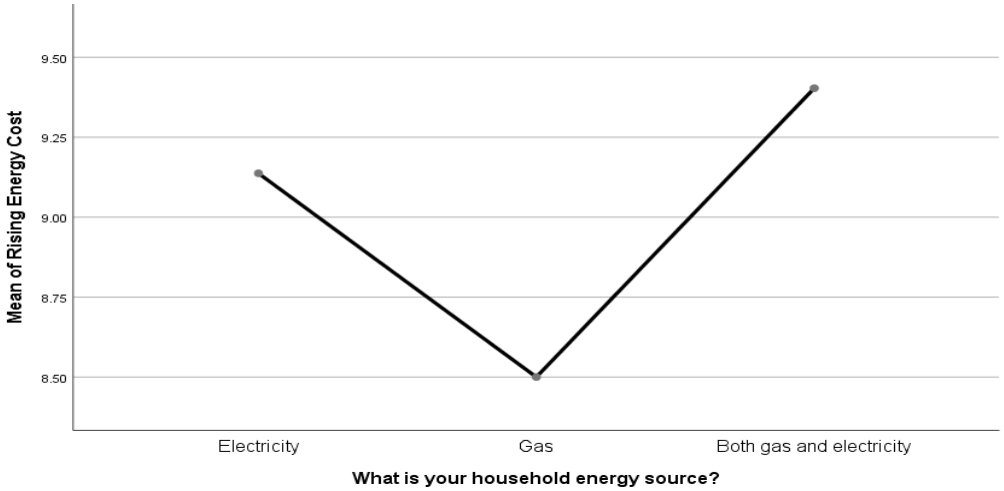

FIGURE 2: Graph showing the specific pairs of household energy sources that differ significantly.

Specifically, households relying solely on gas for energy exhibit notably diminished financial burdens in contrast to those employing a combination of electricity and gas sources. However, this outcome resonates harmoniously with the findings of prevailing scholarship. Building on the assertions of Martiskainen *et al*. (2021) and Testa *et al*. (2016), the intrinsic attributes of gas, coupled with its potential alignment with socio-economic constructs, position it as the frugal alternative. These scholars expound upon the intricate economic dynamics surrounding gas, encompassing aspects such as extraction efficiency, distribution economies of scale, and possibly government incentives, all of which collectively contribute to its role as an economically prudent choice.

Nevertheless, a note of circumspection is imperative. The relationship between household energy sources and financial implications although discernible, is deeply embedded within a complex framework of external and internal factors. Duff *et al*. (2004) opined that the variations extend beyond source selection, encompassing energy-efficient appliance choices and architectural attributes like insulation quality, which yield pronounced influence over energy expenditure. Similarly, Auf *et al*. (2018) found that both the type of energy used in households and the energy efficiency of appliances can significantly affect energy costs.

5.3 Relationship Between Rising Costs and Student Energy Consumption Patterns (R3)

Multivariable linear regression was used to model the relationship between energy consumption pattern and multiple independent variables. Assumptions of normality, homoscedasticity, linearity, and multicollinearity were set and met as illustrated in Appendix 1. Strengths include identifying relationships and making predictions. Limitations include sensitivity to outliers, which was mitigated by visually inspecting the data.

TABLE 3: Multivariable Linear Regression Between Perceived Energy Consumption Pattern Score and Selected Variables.

Variable	Unadjusted Model		Adjusted Model 1		Adjusted Model 2	
	Coef	P-value (95% CI)	Coef	P-value (95% CI)	Coef	P-value (95% CI)
Rising energy cost	**2.10**	**< 0.0001 (1.27, 2.93)**	**1.38**	**0.001 (0.60, 2.15)**	**1.55**	**< 0.0001 (0.75, 2.35)**
Energy saving changes						
Enough			0.53	0.575 (-1.33, 2.40)	1.41	0.15 (-0.52, 3.34)
Much			**3.88**	**< 0.0001 (1.82, 5.94)**	**4.05**	**< 0.0001 (1.97, 6.13)**
Little/ Nothing			1	1	1	1
Stopped or disposed high rated electronics						
Yes			**3.50**	**0.002 (1.28, 5.71)**	**2.94**	**0.011 (0.67, 5.20)**
Maybe			1.89	0.065 (-0.12, 3.91)	1.15	0.269 (-0.90, 3.19)
No			1	1	1	1
Forgone purchase due to energy rating						
Yes			2.46	0.067 (-0.17, 5.10)	**3.42**	**0.012 (0.76, 6.07)**
Maybe			**3.32**	**0.006 (0.96, 5.67)**	**4.13**	**0.001 (1.76, 6.49)**
No			1	1	1	1
Number of persons in the household					0.144	0.717 (-0.64, 0.93)
Gender						
Man					-1.25	0.068 (-2.60, 0.09)
Woman					1	1
Age range						
25-34					2.18	0.061

						(-0.10, 4.46)
35-44					**2.63**	**0.059 (-0.10, 5.35)**
45-54					2.92	0.115 (-0.72, 6.56)
18-24					1	1
Continent						
Africa					0.46	0.544 (-1.03, 1.95)
Asia					1.53	0.352 (-1.70, 4.76)
Other					1	1

The findings from the multivariable linear regression analysis, as summarised in Table 3, reveal a significant relationship between energy consumption patterns and key variables. Rising energy costs demonstrate a substantial positive association with consumption behaviours ($p < 0.0001$), remaining statistically significant even after demographic adjustments ($p < 0.0001$). Notably, individuals who implement "much" energy-saving modifications display notably lower changes in consumption patterns ($p < 0.0001$) compared to those making "enough" or "little/nothing" changes ($p = 0.15$; $p = 1$, respectively).

Undoubtedly, specific energy-saving behaviours yield distinct effects. Individuals who cease or dispose of high-rated electronics experience a marked increase in consumption patterns ($p = 0.002$), a trend consistent even after demographic adjustments ($p = 0.011$). Similarly, those who refrain from purchases due to energy ratings exhibit a corresponding rise in consumption patterns ($p = 0.006$), a trend that remains significant post-adjustment ($p = 0.001$). Furthermore, examining demographic variables, gender, age range, and continent display varied associations. While statistically non-significant, being male is linked to reduced consumption patterns ($p = 0.068$). Specific age groups, notably those aged 25-34, 35-44, and 45-54, show inclinations towards higher consumption patterns ($p = 0.061$; $p = 0.059$; $p = 0.115$, respectively). Geographical origin, as indicated by the continent, appears to exert limited influence on consumption patterns ($p = 0.544$; Asia: $p = 0.352$), even after demographic considerations.

The multivariable linear regression findings underscore the profound implications of rising energy costs on consumption patterns. Rising energy costs were positively associated with energy consumption patterns, suggesting that higher energy costs may not necessarily lead to a decrease in energy consumption. Therefore, this study provides a thought-provoking departure from conventional economic predictions by revealing a nuanced relationship between escalating energy costs and consumption patterns among international students. As expected, the standard economic paradigm suggests that higher energy costs would intuitively lead to reduced consumption which is an application of the principle of price elasticity of demand. Scholars argue that rising energy costs engender heightened consciousness, leading to an increased adoption of curtailment measures (Darby, 2001). However, our findings diverge from this norm, revealing a more intricate interplay of factors that influence energy behaviour. These households, grappling with economic ramifications, are compelled to reshape their consumption patterns. Darby (2001) postulated that individuals tend to invest more in energy efficiency technologies with surging energy costs, offering a plausible mechanism for our observed associations. Moreover, the paradoxical effect of higher energy prices incentivising investments in energy-efficient technologies introduces a dimension not solely dictated by economic logic. This intriguing relationship between energy costs and consumer behaviours skewed towards energy-efficient investment decisions, unveils the intricate dynamics shaping energy behaviours in a distinct manner.

Similarly, Belaid and Garcia (2016) asserts that increased energy prices prompt households to invest in energy-saving efficiency measures. International student households, driven by financial

prudence, strategically adopt proactive measures to curtail both the cost and quantity of energy consumption by investing in energy efficient devices. This dynamic interplay illuminates how economic stimuli intersect with behavioural change, ultimately shaping the intricate patterns of energy consumption observed among international students. Likewise, Traynor *et al*. (2014) had suggested that households with pro-environmental consumption patterns may make minimal or no further changes to their energy consumption behaviours as energy prices rise, as they have already adopted sustainable energy-saving measures. These findings provide possible reasons and support the notion of a positive association between rising energy costs and energy consumption patterns found in the present study. Collectively, understanding energy behaviour requires a holistic approach. Consequently, to truly grasp why students' energy consumer behaviour assumes this relationship, consideration must be given to past habits, current decisions, and reactions to external economic pressures.

6. CONCLUSION

In conclusion, this study has made a significant contribution to the understanding of the impact of rising energy costs on energy consumer behaviour among international students in Scotland. Through the analysis of survey data from the international students' community, this research has successfully achieved its research objectives, shedding light on the prevalence and impact of rising energy costs on international students' living in Scotland.

The findings of this study revealed that while many international students engaged in energy conservation behaviours, such as turning off lights and computer monitors, they lacked awareness and motivation to use energy-efficient technologies. This finding underscores the need for greater education and awareness on energy conservation behaviours among international students, as well as the importance of providing information and resources to help them make energy-efficient choices in their daily lives. Such education and awareness programs could include workshops, information sessions, and campaigns to promote sustainable energy use among international students, helping them reduce their energy consumption and lower their energy costs.

Similarly, the ANOVA revealed that household energy source significantly affects energy costs among international students. This outcome is consistent with existing literature and underscores the importance of considering this factor when assessing household energy costs. Thus, the research contributes to an enriched understanding of the pivotal interplay between the selection of energy sources and financial dimensions, shedding light on one facet of international students' household energy economics. These revelations carry tangible implications, particularly for the demographic of international students, offering insights into avenues for shrewd economic choices. Future research could further investigate the role of energy efficiency measures and types of appliances used in households in influencing energy costs, and how these factors may interact with the household source of energy to impact energy costs.

However, individuals who adopted extensive (much) energy-saving measures showcased consistent consumption behaviours. Akroush *et al*. (2019) underscored this, suggesting that increased energy awareness and the perceived benefits of conservation play pivotal roles in shaping energy consumption. Remarkably, this spectrum of behaviours aligns with Traynor *et al*. (2014)'s findings, suggesting that households already embracing sustainable measures might exhibit inertia in their energy habits, even as energy prices escalate. Such steadfast behaviour, indicating energy conservation efforts, is evident in the study's participants. For instance, while energy-saving inclinations are clear, there is evidence of non-universal practices like unplugging post-charge. Such variations suggest that while turning off lights is practiced, tasks perceived as cumbersome might be eschewed. Moreover, the study's findings highlight the importance of engaging in multiple energy-saving behaviours, as participants who made more energy-saving changes had significantly lower energy consumption patterns, (Abrahamse *et al*., 2007; Frederiks *et al*., 2015). The marked impact of properly disposing of high-rated electronics and making energy-rating-informed purchases underscores the importance of holistic energy conservation strategies.

Therefore, the findings of this study contribute to the understanding of the factors influencing energy consumption patterns and energy conservation behaviours among international students. The results suggest a need for increased education and awareness on standby power consumption and the importance of adopting multiple energy-saving behaviours. The positive association between rising energy costs and energy consumption patterns challenges previous assumptions. It is also supported by prior research for households with increased energy-efficient investments and pro-environmental behaviours (Mills and Schleich, 2012). Further investigation is warranted to better understand the complex relationship between energy costs and energy consumption behaviours.

Invariably, these findings aim to inform the development of policies and programs that can help create a more supportive environment for international students, promote sustainable energy use, and improve academic success among international student communities. Nonetheless, it is crucial to acknowledge some limitations. The exclusive reliance on self-reported data might introduce bias, the study did not explore the reasons behind the lack of awareness and motivation for energy-efficient technology use and the scope was confined to Scotland, potentially limiting generalisability. The study also falls short in investigating the underlying reasons behind the lack of awareness and motivation for the use of energy-efficient technology among international students. Moreover, confining the geographical scope to Scotland raises concerns about the generalisability of the findings to other regions or cultural contexts. To enhance the robustness of future research, it is recommended to employ diverse research methods, including observational and qualitative approaches, and to delve deeper into the cultural and contextual factors influencing energy consumer behaviour. Additionally, expanding the scope beyond Scotland would facilitate a more comprehensive understanding of the global variations in international students' responses to rising energy costs. While the study provides valuable insights, addressing these limitations will contribute to a more balanced and applicable understanding of the unique relationship between energy costs and consumer behaviour among international students. Recommendations arising from the study encompass energy conservation education, student-tailored financial assistance and increasing awareness of international students' unique needs. Implementation of these recommendations can aid international students in managing energy costs and promoting an inclusive campus environment. Conclusively, the rising energy costs has unique influence on international students' energy consumer behaviour in Scotland.

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