WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Home Energy Consumption: Investigating Influencing Factors and Behaviours

Mr. Ashish Abhay Koli[1], Mr. Rushikesh Vikram Toke[2]

[1](B-Tech Civil Engineering), [2](B-Tech Computer Sci & Engineering)
Tatyasaheb Kore College of Engineering, Maharashtra, India

ABSTRACT—

Residential energy consumption is inherently variable and influenced by numerous factors. This paper identifies the critical determinants significantly impacting home energy use, drawing on global survey data conducted by researchers. The continuous depletion of conventional energy resources underscores the importance of energy conservation. Enhancing energy awareness among household members can lead to substantial energy savings. Research at the end-user level is essential to identify these key parameters.

Keywords—Household, Home energy, Energy responsiveness, Energy consumption, Residential energy awareness.

1. RESIDENCE- as an energy consumer

Consumers of primary and secondary energy can be broadly classified into the following categories: 1) Residential, 2) Transport, 3) Service, 4) Industrial, and 5) Agriculture. The residential sector accounts for 25 to 30 percent of primary energy use in developed countries and an even higher share in developing countries.

Surprisingly, the average home emits more pollution than the average car when carbon footprints are calculated under controlled conditions. This environmental impact is often overlooked because home pollution is not as immediately visible as vehicular emissions. Addressing this hidden environmental factor is crucial for understanding residential energy consumption.

Household energy consumption trends differ significantly across regions. In Western countries, household energy consumption is approaching saturation, while in many Asian countries, it continues to rise. For instance, electricity consumption by Chinese residents has been increasing at an annual rate of 10-15 percent, which outpaces the overall electricity consumption growth rate of the country. With over 340 million families, household appliances in China represent a substantial energy load. By 2005, the country had 350 million TV sets, 130 million refrigerators, and 170 million washing machines.

Comparatively, Japanese households consume almost half the energy of their counterparts in the USA or UK. Despite being a developed country, Japan's energy-efficient practices and technologies contribute to this lower consumption.

In rural China, energy consumption per household is notably high. Approximately 80% of this energy comes from wood or agricultural waste, which are inefficient energy sources. Consequently, a rural Chinese household uses more energy than an urban one due to the low efficiency of these traditional fuel sources.

Understanding these diverse patterns of residential energy use across different regions is essential for developing targeted energy conservation strategies and policies. By focusing on both technological advancements and behavioural changes, it is possible to mitigate the environmental impact and improve energy efficiency on a global scale.

2. Universal Picture of Home Energy Awareness

The world is facing an impending energy crisis, making it imperative to promote public understanding and awareness about various forms of energy generation, dissemination, and consumption. Given the finite nature of non-renewable energy sources, conserving current supplies and transitioning to renewable sources are essential to ensure the availability of natural resources for future generations. The adage "one unit saved is equivalent to two units generated" underscores the importance of household energy conservation, a concern of global significance.

Despite the development of numerous policies aimed at energy conservation worldwide, the desired outcomes have not been fully realized. In India, the government, with significant input from the Bureau of Energy Efficiency (BEE), is implementing policies to promote energy-efficient products. Similarly,

European governments are encouraging energy efficiency in homes through incentives and regulations. For instance, the UK's "28-day rule" implemented in 2003 facilitated consumer investment in domestic-scale energy-efficient systems, and the Netherlands is promoting the adoption of green energy products.

The following snapshots highlight findings from various research studies on home energy awareness across the globe:

a. Energy Responsiveness in Rented Apartments of Sweden

A questionnaire survey in Sweden, focusing on residents' characteristics, appliance usage, and attitudes toward energy consumption, revealed that household income is a significant factor influencing electricity consumption. The study recommended that energy companies and municipal corporations consider individual behavioural approaches when developing energy-saving strategies. Additionally, it suggested employing energy advisors to work with households individually.

b. Energy STAR Label Awareness in the USA

Research in the USA examined factors influencing consumer awareness of the Energy Star label on major appliances. The study found that household characteristics strongly correlate with label awareness but less so with the choice of Energy Star appliances. Factors such as renting, Hispanic ethnicity, and lower income levels were identified as significant barriers, leading to an annual economic loss of $164 million and associated carbon emissions of 1.1 million metric tons.

c. Energy Awareness in Japan and Norway

A survey in Japan and Norway assessed knowledge and awareness regarding energy usage. Both populations were aware of seasonal energy cost fluctuations, with size and capacity being key considerations when purchasing refrigerators. In Norway, energy-intensive space heating and lighting are culturally significant, whereas Japanese households exhibit more disciplined energy habits .

d. Household Energy Behaviour in Sweden

In June 2009, a survey in Sweden analysed households' willingness to increase efforts to save electricity, considering both economic and norm-based motivations. The study highlighted the importance of information about behavioural changes at the household level, identifying cost, environmental attitudes, and social interactions as key determinants of electricity-saving activities .

e. Household Energy Awareness in Liaoning Province, China

A 2009 questionnaire survey in Liaoning Province aimed to identify barriers to energy efficiency in China. Despite pre-paid electricity systems requiring direct consumer involvement, general knowledge about energy efficiency was low. Only 2% of respondents reported reducing energy consumption after reading informational brochures on energy saving.

f. Energy Conservation Tools in Saudi Arabia

Research in Saudi Arabia suggested three supportive tools for energy conservation and management: Energy and Public Awareness, Energy Regulations, and Energy Information & Programming. The study recommended using methods such as video films, radio and TV, posters, and advertisements in public facilities like cultural centres to promote energy conservation .

These studies underscore the importance of tailored strategies and increased public awareness to enhance energy conservation efforts globally.

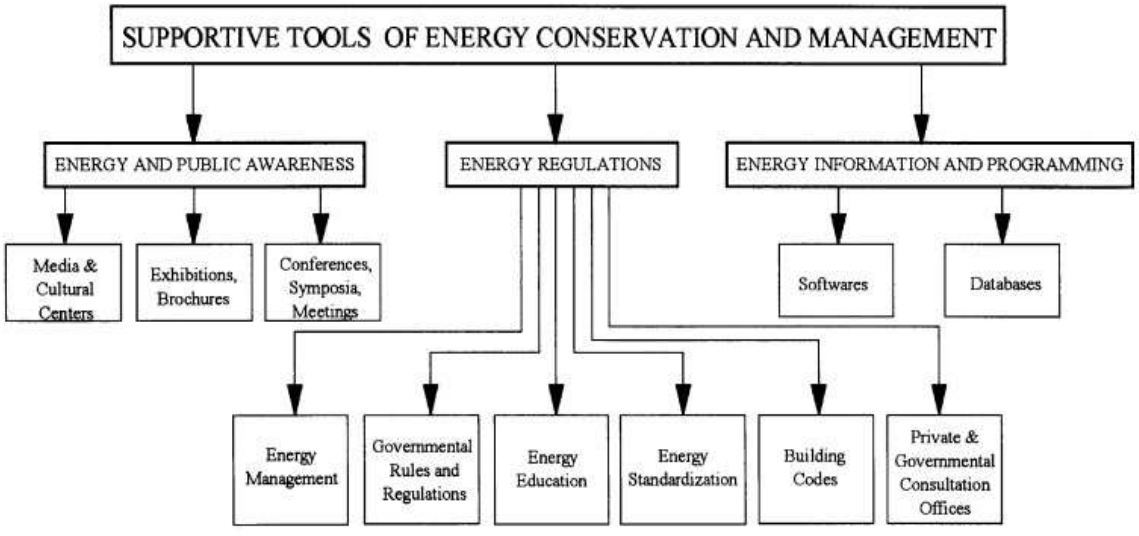

Fig.1 Supportive tools and methods for EC and EM

It was also suggested to use available methods and techniques, like video films, radio and TV, communication and networking, posters and advertisements in public facilities, i.e. cultural centres, for energy conservation [EC] and energy management [EM].

3. Evaluation of Critical Factors

We have identified and summarized the critical factors governing the responsiveness of residential energy use as follows:

a. Interest in Energy Consumption

It is crucial to assess whether households are genuinely interested in understanding their energy consumption. Often, residents pay their electricity bills without knowing the number of units consumed, focusing solely on the monetary aspect. However, crises like the one in Juneau, Alaska, which led to a 25% reduction in electricity demand, can significantly boost energy awareness among the populace.

b. Basic Energy Literacy

Every household member, regardless of their educational background, should be familiar with the unit of electricity (kWh), which integrates both time and power. Enhancing energy literacy—comprising content knowledge and behavioural characteristics—empowers individuals to make informed energy-related decisions and adopt sustainable energy practices.

c. Operation and Maintenance of Appliances

Household appliances such as refrigerators and air conditioners account for approximately 50% of monthly electricity bills. Regular maintenance, such as cleaning air conditioner filters and refrigerator condenser coils, is essential. Many households lack awareness of the importance of components like condensers and thermostats. Inefficient operation and neglecting maintenance are significant contributors to increased household energy consumption.

d. Purchasing and Using Energy-Efficient Appliances

Programs like the Energy Star label are vital, but the affordability of energy-efficient appliances for low-income households remains a concern. Subsidies for low-income families to purchase such appliances could address this issue. Additionally, households should produce a report every five years detailing the type, star rating, and purchase year of their appliances to encourage accountability and informed decision-making.

e. Household Behaviour:

While households often take the initiative to switch on appliances as needed, there is frequently a lack of diligence in turning them off. This behaviour is compounded by multiple household members controlling appliances simultaneously or intermittently. Automation systems may offer a solution to manage such inefficiencies by ensuring appliances are used only when necessary.

f. Government Role

Governments can play a significant role in promoting energy awareness through electronic and print media. Broadcasting the past, present, and future energy scenarios on televisions and radios can educate the public. Print media can disseminate information about energy awareness programs and campaigns, targeting specific regions to maximize impact.

g. Energy Pricing Awareness

Households should be aware of the costs associated with the primary and secondary energy sources they use. Many are unfamiliar with the tariff structures designed by electricity suppliers. While increasing energy prices could theoretically curb excess consumption, it is a politically sensitive decision. Such measures could disproportionately affect rural and semi-urban areas, leading to issues like load shedding.

By addressing these critical factors, we can enhance residential energy responsiveness and promote more sustainable energy consumption practices on a global scale.

3.1 Summary of the Critical Factors

The readiness of houses to be energy aware is thus shown to be constrained by a mesh of interconnected barriers as shown below.

TABLE T1

Sr. No.	**Factor governing Energy Responsiveness**	**Solution**	**Barrier**
1	Interest	Motivation, rewards[14]	Attitude
2	Energy	Energy	Interest, Time

	Acquaintance	Education	
3	Behavior with appliances	Training, education	Knowledge
4	Purchase of EEA	Subsidy, incentives	Income
5	House tone	Automation, TPC	Behavior, lifestyle
6	Energy value	Tax credits	Politics
7	Government role	NGO	Initiative, support
8	Public engagement	Fiscal terms	Interest

4. Discussion

Residential energy consumption is growing rapidly due to rising living standards and lifestyle changes. While developed countries have been promoting the production and use of energy-efficient appliances, it is equally important to enhance public awareness about energy usage. Several strategies can help reduce residential energy consumption:

1. Rating of Houses by Energy Usage: Implementing a system that rates houses based on their energy consumption can incentivize homeowners to adopt energy-saving practices. Higher-rated houses, which maintain lower energy usage, can be recognized, fostering a competitive spirit towards energy efficiency.

2. Incentives for Energy-Efficient Houses: Providing incentives, such as discounts on energy bills for energy-efficient houses, can motivate residents to adopt energy-saving measures and invest in energy-efficient appliances.

3. Energy Audits of Houses: Regular energy audits can help identify areas where households can reduce energy consumption. These audits offer actionable insights and recommendations for improving energy efficiency.

4. Environmental Impact Awareness: The environmental impact of energy consumption, particularly carbon footprints, should not be overlooked. Ranking houses based on their carbon emissions can increase awareness and encourage households to adopt practices that reduce their environmental impact.

According to the International Energy Agency, India needs an investment of at least $135 billion to provide universal access to electricity for its population. Enhanced energy awareness in the residential sector can help reduce this investment to some extent. This reduction will be further amplified by the interconnected effects between residential, transport, commercial, and industrial sectors in India.

To optimize residential energy consumption, benchmarks for energy use can be set for different types of homes. These benchmarks can serve as targets for households to aim for, encouraging more efficient energy use.

Disparities in household energy use exist between rural and urban populations, high and low-income groups within a country, and among different countries. The major factors contributing to these differences are levels of urbanization, economic development, and living standards. Other factors are country or region-specific, such as climate or cultural practices. In rural areas, the slow pace of urbanization has left energy infrastructure incomplete, presenting opportunities to encourage the adoption of innovative energy systems.

By implementing these strategies and increasing awareness, we can significantly reduce residential energy consumption and its associated environmental impact, contributing to a more sustainable future.

5. Conclusion

There is significant potential to save energy by improving energy usage awareness across all sectors in developing countries like India. Corporations must strive to educate end users about energy efficiency while promoting their energy-efficient products. However, empirical researchers in India face numerous challenges. To maximize their contributions to energy conservation, energy companies should provide researchers with comprehensive databases.

The Indian electricity sector offers vast opportunities for energy service companies and manufacturers of energy-efficient equipment, gadgets, and devices. Proper implementation of energy efficiency projects in households could lead to savings of up to 20% in primary energy consumption.

In OECD countries such as Sweden, Greece, the UK, the US, Japan, Norway, the Netherlands, and France, as well as in some non-OECD countries like China, governments actively promote research on household energy awareness. Developing countries like India need similar initiatives to foster such research and support energy conservation efforts.

By encouraging collaboration between corporations, researchers, and the government, India can enhance energy literacy, drive the adoption of energy-efficient technologies, and significantly reduce energy consumption across all sectors.

References

Certainly! Here's a shuffled version:

1. Zainuddin Abdul Manan, Lim Jeng Shiun, “Energy Efficiency Award system in Malaysia for energy sustainability”, Renewable and Sustainable Energy Reviews 14 (2010) 2279–2289.

2. Kristina Ek, Patrik Soderholm, “The devil is in the details: Household electricity saving behavior and the role of information”, Energy Policy 38 (2010) 1578–1587.

3. Harold Wilhite, “A cross-cultural analysis of household energy use behaviour in Japan and Norway”, P11:S0301-4215(96)0006 I-4.

4. Wayne Leighty, Alan Meie, “Accelerated electricity conservation in Juneau, Alaska: A study of household activities that reduced demand 25%”, Energy Policy 39 (2011) 2299–2309.

5. Anthony G. Murray, Bradford F. Mills, “Read the label! Energy Star appliance label awareness and uptake among U.S. consumers”, Energy Economics xxx (2011) xxx–xxx .

6. G. Ma, P. Andrews-Speed, J.D. Zhang, “Study on Chinese consumer attitudes on energy-saving household appliances and government policies: based on a questionnaire survey of residents in Chongqing, China”, Energy Procedia, 5 (2011) 445–451.

7. Iana Vassileva, Fredrik Wallin, Erik Dahlquist, “Analytical comparison between electricity consumption and behavioural characteristics of Swedish households in rented apartments”, Applied Energy (2011).

8. Hidetoshi Nakagami, “International comparison of energy consumption, Jyukankyo Research Institute Inc., Kioicho Fukuda BLDG.3F 3-29 Kioicho, Chiyoda-ku, Tokyo, Japan”.

9. B. Sudhakara Reddy, “Overcoming the energy efficiency gap in India’s household sector”, Energy Policy 31 (2003) 1117–1127.

10. Feng Dianshu, Benjamin K. Sovacool, Khuong Minh Vu, “The barriers to energy efficiency in China: Assessing household electricity savings and consumer behavior in Liaoning Province”, Energy Policy 38 (2010) 1202–1209.

11. S. A. ALAJLAN, M. S. SMIAI and U. A. ELANI, “Effective tools towards electrical energy conservation in Saudi Arabia”, Energy Conversation. Mgmt Vol. 39, No. 13, pp. 1337-1349, 1998.

12. Jan E. DeWaters, Susan E. Powers, “Energy literacy of secondary students in New York State (USA): A measure of knowledge, affect, and behaviour”, Energy Policy 39 (2011) 1699–1710.