Shifting consumer perspectives on energy efficiency and sustainable development

Elena Korneeva[1,2*], *Natalia* Skornichenko[3], *Tatiana* Oruch[3], *Tatiana* Freze[2], and *Aizhan* Omarova[4]

[1] Financial University under the Government of the Russian Federation, 49, Leningradsky Prospekt, Moscow, 125993, Russia
[2] Togliatti State University, 14, Belorusskaya St., Togliatti, 445667, Russia
[3] Volga Region State University of Service, 4, Gagarina str., Togliatti, 445017, Russia
[4] Yessenov University, Microdistrict 32, Aktau, 130000, Kazakhstan

Abstract. The COVID-19 pandemic has undeniably transformed the landscape of people's daily lives, influenced not only their immediate mental and physical health concerns but also reshaped their attitudes and economic behaviour in many profound ways. Among these shifts, one of the most noteworthy is the change in consumer perspectives towards energy efficiency and energy consumption. As the pandemic brought about an era of uncertainty marked with economic upheavals and unpredicted changes, it simultaneously served as a catalyst for a collective re-evaluation of priorities, particularly concerning environmental sustainability and personal consumption habits. This paper focuses on assessing how the consumer perspectives on energy efficiency and energy consumption have altered during and after the recent pandemic into the ongoing post-pandemic era. Our results have some profound implications for stakeholders and policymakers who wish to shape up the acceptance of energy efficiency initiatives leading to tackling global warming and climate change and increasing the energy resilience of the society.

1 Introduction

The unprecedented global response to mitigate the spread of the COVID-19 virus all over the globe in 2020-2022 saw most of the countries implementing lockdowns and movement restrictions, leading to a dramatic change in lifestyle patterns fundamentally shifting consumer perspectives on energy efficiency [1, 2]. Households as well as public facilities became multifunctional space necessitating increased energy consumption for heating, cooling, lighting, and other electronic devices. This surge in domestic energy use brought to light the importance of energy efficiency not just as a cost-saving measure but as a vital component of sustainable living [3, 4]. Moreover, the pandemic's economic fallout prompted a heightened awareness among consumers regarding financial security and resilience. As job losses mounted and economic uncertainties loomed large, individuals began to scrutinize their expenditure more closely than ever before [5]. Energy costs, being a significant part of

* Corresponding author: author@email.org

household expenses, naturally came under inspection arising the interest in how the energy is spent and how it can be conserved and saved [6].

As a result of all those new challenges, consumers started seeking ways to reduce their energy bills through more efficient appliances and home improvements that promised long-term savings [7, 8]. Simultaneously, the clear skies and cleaner air resulting from reduced industrial activity during lockdowns offered a stark visual reminder of human impact on the planet.

With regard to above, the concepts of "energy efficiency" and "energy consumption" found themselves in the focus of many stakeholders. These concepts are quite intertwined, as the following Word Cloud diagram that is based on the definitions of each respective term [9, 10] demonstrates (see Figure 1).

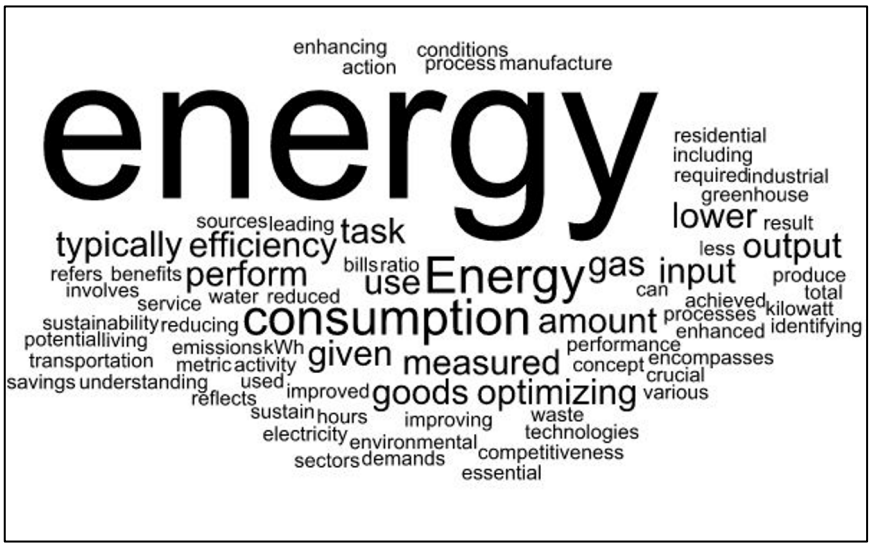

Fig. 1. Word Cloud diagram for energy efficiency and energy consumption definitions

This unexpected glimpse into what could be achieved with lower carbon emissions intensified public concern about climate change and environmental degradation. It reinforced the idea that individual actions do matter and that adopting energy-efficient practices is an accessible way for everyone to contribute towards mitigating environmental harm [11, 12]. As the worlds navigates through this ongoing crisis, it becomes evident that consumer perspectives on energy efficiency are undergoing a significant transformation [13]. The intersection between sustainability concerns and financial prudence catalysed by the COVID-19 pandemic has accelerated public interest in (as well as the adoption of) various energy-efficient solutions. This shift not only reflects an immediate response to current challenges but also signals a broader move towards more sustainable living practices that may well endure beyond this pandemic era [14, 15].

2 Energy efficiency and economic uncertainty

The COVID-19 pandemic has undeniably altered the landscape of human lives all around the planet, reshaping their routines, priorities, and the global economy. One significant shift has been in consumer perspectives regarding energy efficiency [16, 17]. As the pandemic brought about economic uncertainty on an unprecedented scale, the importance of energy savings

came into sharper focus for individuals and businesses alike. This emphasis on energy efficiency is not merely a temporary adjustment but a profound realignment of priorities that could have lasting benefits [18, 19].

Figure 2 that follows represents the results for the search terms “energy efficiency” and “energy consumption” between March 2020 (when the COVID-19 pandemic was declared by the World’s Health Organization) and April 2024 obtained with the help of the Google Trends tool (measuring the so-called “Interest over Time”, i.e. the search interest relative to the highest point on the chart for the given region and time (in this case - worldwide) [20]. One can see that the Google online search of both terms has been quite correlated all throughout the pandemic with some occasional spikes (e.g. in the summer of 2021) which can be explained by the rising concerns over the energy consumption backed up by the mounting evidence and data obtained during the pandemic lockdowns and social distancing.

Fig. 2. Google Trends results for the keywords “energy efficiency” and “energy consumption” (2020-2024)

Economic uncertainty, as experienced during the COVID-19 pandemic, compels consumers to seek ways to reduce expenses and conserve resources. Energy costs, which constitute a considerable portion of monthly expenditures for households and businesses, naturally become a focal point for potential savings [21, 22]. Energy efficiency measures - ranging from simple behavioural adjustments to investing in energy-efficient appliances or retrofitting buildings for better performance all present an opportunity to achieve these savings [23]. During times of economic instability, every dollar saved on energy bills can be redirected towards essential needs such as food, healthcare, or even sustaining small businesses facing unprecedented challenges. Furthermore, by reducing their energy consumption, consumers contribute less to environmental degradation - a concern that has gained increased attention amid growing awareness of climate change and its impacts [24].

Moreover, the push towards energy efficiency during economic downturns can stimulate job creation in sectors related to energy conservation and renewable energies. This not only helps mitigate some economic impacts by providing employment but also accelerates the transition towards a more sustainable and resilient economy [25, 26]. Governments around the world have recognized this potential. In response to the pandemic-induced economic crisis, many have included green initiatives and investments in energy-efficient infrastructure

as part of their recovery plans. Such policies not only aim to support economies but also align with broader environmental goals [27].

It therefore can be stated that the COVID-19 pandemic has underscored the importance of energy savings during times of economic uncertainty by highlighting their immediate financial benefits and contributing to long-term sustainability goals. This shift in consumer perspective towards prioritizing energy efficiency is an essential step toward building more resilient economies and societies capable of withstanding future challenges while fostering environmental stewardship.

3 Consumer demand for renewable energy

The COVID-19 pandemic has not only been a public health crisis but also a catalyst for change across various sectors, including the energy industry. Amidst the upheaval, one of the most notable shifts has been in consumer demand for renewable energy options [28, 29]. This trend is rooted in an increased awareness of environmental issues and a collective reassessment of priorities that the pandemic has precipitated among global populations.

In addition, as individuals spent unprecedented amounts of time at home due to lockdowns and social distancing measures, there was a marked increase in household energy consumption. This surge brought about a heightened awareness of energy costs and sustainability issues among consumers [30]. Many began to scrutinize their energy sources more closely, leading to an increased interest in renewable energy options as alternatives to traditional fossil fuels. This shift is partly driven by a desire to reduce household expenses in the face of economic uncertainties but also by an elevated consciousness about personal health, environmental protection, and climate change [31].

In a way, the pandemic underscored the fragility of human life and our interconnectedness with the natural world, fostering a sense of stewardship towards the planet among many individuals. As news reports highlighted clearer skies and cleaner air resulting from reduced industrial activity during lockdowns, people became more acutely aware of the impact human activities have on the environment. This realization has translated into a consumer demand for cleaner, sustainable energy sources such as solar and wind power [32, 33].

Energy providers have noted this shift in consumer preferences and are increasingly investing in renewable energy infrastructure to meet growing demand. Governments around the world are also supporting this transition through policy measures and incentives aimed at promoting green energy solutions [34, 35]. These developments are indicative of how consumer pressure can influence broader systemic changes towards sustainability. Moreover, advancements in technology have made renewable energy options more accessible and affordable for average consumers. Solar panels, for instance, have become more efficient and less costly over time, making them an attractive option for homeowners looking to reduce their carbon footprint while also saving on electricity bills [36]. The availability of home battery storage systems further enhances this appeal by enabling households to store excess solar power generated during the day for use at night or during periods of high demand [37]. Thence, the COVID-19 pandemic has played a pivotal role in shifting consumer perspectives on energy efficiency towards a strong preference for renewable sources. This trend reflects broader societal values that prioritize sustainability, health, and economic resilience. As this demand continues to grow, it will undoubtedly drive further innovations in green technology while accelerating global efforts toward achieving net-zero emissions targets.

4 Energy-efficient investments

Investing in energy-efficient appliances and upgrades has surged to the forefront of consumer priorities, especially in the wake of the COVID-19 pandemic. This shift in perspective is not only a testament to growing environmental consciousness but also an acknowledgment of the tangible benefits that such investments bring. Among these benefits, cost savings stand out prominently [38]. Energy-efficient appliances consume less electricity or gas, which translates directly into lower utility bills for households.

Over time, the initial higher purchase price of these appliances is offset by the savings on energy costs, making it a financially prudent choice in the long run. Beyond mere cost savings, investing in energy efficiency enhances home comfort and living conditions. For instance, energy-efficient heating and cooling systems operate more quietly and maintain more consistent temperatures than their less efficient counterparts, creating a more comfortable home environment [39].

Furthermore, these systems often come with advanced features like programmable thermostats that allow for greater control over home climate settings. The environmental impact cannot be overstated; by reducing energy consumption, households contribute significantly to decreasing greenhouse gas emission which is a critical step towards mitigating climate change impacts. This aligns with a growing societal trend towards sustainability and responsible consumption. Lastly, as governments around the world incentivize green technologies through rebates and tax credits, consumers find additional financial incentives to make these investments [40]. Thus, what began as a shift driven by necessity during a global health crisis has evolved into a broader movement towards sustainability and efficiency that benefits both individual households and the planet at large.

In general, it is clear that governments and industries play pivotal roles in facilitating this transition towards sustainable energy consumption. Our results emphasize the importance of government incentives in promoting renewable energy solutions. However, beyond incentives, there is a need for comprehensive policies that address the systemic barriers to adopting sustainable practices. For instance, urban planning and infrastructure development can significantly influence energy consumption patterns by making cities more walkable or improving public transit systems. Many industries, particularly those in the energy sector, must adapt to this changing landscape by investing in clean energy technologies and reconsidering their business models to prioritize sustainability. The rise in consumer demand for renewable energy options and energy-efficient products signals a market shift that could drive innovation and competition in green technologies.

5 Conclusions

Overall, it can be stated that the COVID-19 pandemic has served as a mirror, reflecting, and bringing into sharper focus the interconnectedness of human behaviour, energy consumption, and environmental sustainability. The sudden increase in household energy use, prompted by lockdowns and the transition to remote work and schooling, has made consumers acutely aware of their energy consumption patterns. This awareness is a crucial first step towards adopting more sustainable practices. The surge in interest for renewable energy sources and energy-efficient appliances, as the paper outlines, reflects a broader societal shift towards valuing sustainability alongside, or even above, immediate financial savings.

The COVID-19 pandemic has undeniably altered consumer perspectives across a broad spectrum of areas, including energy consumption and sustainability. As the world grapples with the economic and social fallout of the pandemic, there exists a noticeable shift towards renewable energy solutions, not only to mitigate climate change but also to ensure resilience against similar future crises. In this evolving landscape, government incentives play a crucial

role in promoting renewable energy solutions, thereby accelerating the transition towards more sustainable and energy-efficient practices among consumers. Government incentives are pivotal in making renewable energy technologies accessible and affordable to the general public. These incentives can take various forms, including tax credits, rebates for purchasing renewable energy systems like solar panels or wind turbines, and grants for research into innovative green technologies. By reducing the financial burden on consumers who wish to adopt renewable energy sources, these policies encourage more individuals and businesses to make the switch from fossil fuels to cleaner alternatives.

When it comes to the pathways for further research, the intersection of social equity and energy efficiency appear to be an interesting subject worth pursuing further. Our research touches upon the financial motivations behind the shift towards energy efficiency, highlighting how the pandemic-induced economic uncertainty has made consumers more conscious of their spending. However, the benefits of energy efficiency and renewable energy are not evenly distributed. Low-income households often face higher barriers to adopting such technologies, due to upfront costs and lack of access to information and resources. Future research, discussions, and policies need to consider how to make energy-efficient solutions more accessible and affordable for all segments of the population. This could involve targeted subsidies, innovative financing models, or community-based programs that leverage collective purchasing power.

All in all, our paper offers a compelling look at how the COVID-19 pandemic has accelerated a shift towards more sustainable and energy-efficient practices among consumers. It becomes evident that the path to a more sustainable future requires concerted efforts from individuals, governments, and industries. It also necessitates a deeper understanding of the complex web of factors that influence energy consumption and sustainability, including socioeconomic disparities. The ongoing transformation in consumer attitudes towards energy efficiency and sustainability is not just a temporary response to a global crisis but a signal of a broader cultural shift towards recognizing our collective responsibility for the planet. This moment presents an opportunity to reevaluate and redesign our energy systems and consumption patterns for long-term sustainability, resilience, and equity. As the world is moving forward into the post-pandemic era, it will be crucial to keep these broader implications and opportunities in focus, ensuring that the momentum towards sustainability is not only maintained but further fostered and supported by all stakeholders involved.

References

1. G. Cassetti, B. Boitier, A. Elia, P. Le Mouël, M. Gargiulo, P. Zagamé, A. Chiodi, Energy, **263**, 125798 (2023)
2. L. Gorina, E. Korneeva, O, Kovaleva, W. Strielkowski, Energy-saving technologies and energy efficiency in the post-COVID era. Sustainable Development (early view) (2024)
3. M. Solà, A. de Ayala, I. Galarraga, M. Escapa, Energy Efficiency, **14(1)**, 6 (2021)
4. E. Korneeva, N. Olinder, W. Strielkowski, Energies, **14(23)**, 7913 (2021)
5. K. Allanjawi, A. Yazdanparast, Y. Alhenawi, Journal of Consumer Behaviour, **23(2)**, 976-986 (2024)
6. B. Gajdzik, M. Jaciow, R. Wolniak, R. Wolny, W. Grebski, Energies, **16(7)**, 3186 (2023)
7. A. Hansen, M. Jacobsen, K. Gram-Hanssen, Ecological Economics, **193**, 107333 (2022)

8. E. Ruokamo, M. Laukkanen, S. Karhinen, M. Kopsakangas-Savolainen, R. Svento, Energy Research & Social Science, **102**, 103183 (2023)
9. Energy.gov. Energy Efficiency: Buildings and Industry. Available at: https://www.energy.gov/eere/energy-efficiency-buildings-and-industry (accessed on 31.03.2024)
10. Collins Dictionary. Energy consumption. Available at: https://www.collinsdictionary.com/us/dictionary/english/energy-consumption (accessed on 31.03.2024)
11. M. Zulfiqar, S. Tahir, M. Ullah, S. Ghafoor, Environmental Science and Pollution Research, **30(38)**, 88789-88802 (2023)
12. I. Čábelková, L. Smutka, W. Strielkowski, Sustainable Development, **30(1)**, 110-126 (2022)
13. C. Karakosta, Z, Mylona, J. Karásek, A. Papapostolou, E. Geiseler, Energy Strategy Reviews, **38**, 100764 (2021)
14. S. Axon, T. Lent, A. Njoku, Energy Research & Social Science, **102**, 103188 (2023)
15. A. Guliyeva, U. Rzayeva, G. Guliyeva, SHS Web of Conferences, **92**, 01011 (2021)
16. Y. Guo, N. Zhang, T. Hu, Z. Wang, Y. Zhang, Energy and Buildings, **261**, 111954 (2022)
17. W. Strielkowski, S. Zenchenko, A. Tarasova, Y. Radyukova, Sustainability, **14(12),** 7267 (2022)
18. H. El Hafdaoui, A. Khallaayoun, K. Ouazzani, *Long-term low carbon strategy of Morocco: A review of future scenarios and energy measures.* Results in Engineering, 101724 (2023)
19. Y. Teng, B. Lin, Energy Policy, **185**, 113925 (2024)
20. Google Trends. Available at: https://trends.google.com (accessed on 01.04.2024)
21. C. Karakosta, Z. Mylona, J. Karásek, A. Papapostolou, E. Geiseler, Energy Strategy Reviews, **38**, 100764 (2021)
22. W. Strielkowski, I. Firsova, I. Lukashenko, J. Raudeliūnienė, M. Tvaronavičienė, Energies, **14(4)**, 893 (2021)
23. F. Hafez, B. Sa'di, M. Safa-Gamal, Y. Taufiq-Yap, M. Alrifaey, M. Seyedmahmoudian, S. Mekhilef, Energy Strategy Reviews, **45**, 101013 (2023)
24. M. Moslehpour, K. Yin Chau, L. Du, R. Qiu, C. Lin, B. Batbayar, Economic research-Ekonomska istraživanja, **36(2)**, 2121934 (2023)
25. Z. Wang, M. Peng, M. Anser, Z. Chen. Renewable Energy, **205**, 166-173 (2023)
26. F. Nuţă, A. Sharafat, O. Abban, I. Khan, M. Irfan, A. Nuţă, M. Asghar, Gondwana Research, **128**, 325-339 (2024)
27. N. Abdullah, A. Lim, Journal of Sustainable Technologies and Infrastructure Planning, **7(3)**, 17-47 (2023)
28. X. Ye, Z. Zhang, Y. Qiu, Frontiers in Sustainable Energy Policy, **2**, 1171093 (2023)
29. C. Wang, Economic Change and Restructuring, **56(5)**, 3117-3137 (2023)
30. S. Yoo, J. Eom, I. Han, Sustainability, **12(14)**, 5573 (2020)
31. S. Hielscher, J. Wittmayer, A. Dańkowska,. The Extractive Industries and Society, **10**, 101073 (2022)
32. S. Marinello, M. Butturi, R. Gamberini, Environmental progress & sustainable energy, **40(4)**, e13672 (2021)

33. V. Kaftan, W. Kandalov, I. Molodtsov, A. Sherstobitova, W. Strielkowski, Sustainability, **15(4)**, 2876 (2023)
34. K. Hainsch, K. Löffler, T. Burandt, H. Auer, P. del Granado, P. Pisciella, S. Zwickl-Bernhard, Energy, **239**, 122067 (2022)
35. J. Aleluia, P. Tharakan, A. Chikkatur, G. Shrimali, X. Chen, Renewable and Sustainable Energy Reviews, **159**, 112226 (2022)
36. B. Goldstein, D. Gounaridis, J. Newell, Proceedings of the National Academy of Sciences, **117(32)**, 19122-19130 (2020)
37. N. Fox, Nature Energy, **8(1)**, 74-83 (2023)
38. F. Jalil, J. Yang, S. Rehman, M. Khan, Environmental Science and Pollution Research, **30(54)**, 115683-115698 (2023)
39. X. Liu, Y. Wu, H. Wu, Energy and Buildings, **303**, 113770 (2024)
40. A. Osorio, M. Zhang, Journal of Cleaner Production, **380**, 135132 (2022)