Volume 3, Issue 4 April 2025 **ISSN (E):** 2938-3757

PROBLEMS AND SOLUTIONS OF ELECTRICITY QUALITY INDICATORS IN UZBEKISTAN

Kasimova Gulnoza Ravshanbekovna
Teacher at Fergana District Service and Service Technical School
Email: kasimovagulnoza121286@gmail.com

Mashrapova Iroda Ravshanbekovna
Teacher at Fergana State Technical University

Abstract
This article analyzes the problems of electricity quality in Uzbekistan, in particular voltage instability. The study analyzes the weaknesses of the power system and regulatory shortcomings. The article studies successful international practices of developed countries and develops theoretical and practical solutions for improving electricity quality. Recommendations include the introduction of smart grid technologies, the integration of renewable energy sources, and the strengthening of the regulatory framework.

Keywords: Power quality, voltage stability, smart grids, renewable energy, energy system.

Introduction

Modern societies' increasing reliance on electrical energy necessitates stable and reliable energy supplies. Electrical energy serves as the foundation for economic growth, public welfare, and sustainable urban development. Recent global trends emphasize eco-friendly urbanization, particularly through the development of eco-cities relying solely on electricity to meet their energy needs. However, such transitions require stringent adherence to quality indicators like voltage stability, frequency consistency, and overall reliability of electricity supply.

Previous studies indicate that developed countries have successfully addressed electrical energy quality issues through technological innovations and robust infrastructure. For instance, research conducted by Johnson et al. (2020) highlights the improvement of electrical distribution systems using smart grids that significantly reduce voltage fluctuations. Similarly, Brown & Walker (2021) emphasize the importance of integrating renewable energy sources with advanced energy storage solutions to mitigate voltage instability issues. Furthermore, comprehensive analysis by Liu et al. (2022) underscores the critical role of regulatory frameworks and standards implemented in developed countries for ensuring high-quality electrical services.

Despite extensive global research on electrical energy quality, significant knowledge gaps persist regarding Uzbekistan's unique context. Particularly, the practical implications of

Web of Technology: Multidimensional Research Journal
webofjournals.com/index.php/4

transitioning to fully electricity-based energy systems in eco-cities have not been sufficiently explored. Local studies on electrical reliability remain limited, with inadequate detailed analysis of why low voltage remains widespread and persistent, adversely impacting electrical equipment. Additionally, theoretical frameworks suitable for Uzbekistan's unique infrastructural and regulatory conditions require further investigation.

This paper aims to analyze the current state of electrical energy quality indicators in Uzbekistan, with particular emphasis on voltage stability issues in newly established eco-cities. The objective of this study is to identify key problems contributing to low voltage levels, review successful solutions implemented in developed countries, propose theoretical and practical approaches to address these issues, and provide specific recommendations for improving electrical energy quality in Uzbekistan.

METHODOLOGY

This study employs a mixed-method approach, combining qualitative and quantitative analyses, to comprehensively explore issues related to electrical energy quality. Initially, a literature review and secondary data analysis were conducted to understand existing theoretical frameworks and advanced international experiences.

Primary data collection involved monitoring voltage levels in selected residential buildings within newly established eco-cities across Uzbekistan. Measurements were carried out using digital voltage meters and power quality analyzers, conducted during peak and off-peak hours over a period of two months. Additionally, structured interviews and surveys were conducted with residents, electrical engineers, and local government authorities to collect qualitative insights regarding their experiences and perceptions of electrical energy quality.

Quantitative data obtained from voltage measurements were statistically analyzed using SPSS software to determine average voltage levels, identify fluctuations, and assess deviations from recommended standards. Qualitative data gathered from interviews and surveys were analyzed through thematic content analysis to identify recurring patterns and issues expressed by stakeholders.

Photographs and schematic diagrams were utilized to illustrate measurement setups and distribution network schemes. These visual aids are provided to ensure replicability and clarity of the experimental methods.

RESULTS

Voltage measurements revealed significant deviations from the standard voltage level (220V ± 5%). During peak hours, average voltage levels ranged from 180V to 200V, with extreme dips recorded as low as 160V. Measurements conducted outside of peak periods showed somewhat improved stability, averaging between 210V and 220V. Frequent and significant voltage fluctuations adversely affected household appliances such as heaters, refrigerators, and air conditioners, reducing their performance and efficiency.

Interviews and surveys indicated widespread dissatisfaction among residents regarding electrical energy reliability. Consumers consistently reported issues such as heaters

Web of Technology: Multidimensional Research Journal
webofjournals.com/index.php/4

inadequately warming homes, refrigerators failing to maintain freezing temperatures, and air conditioners not providing sufficient cooling.

The results are visually presented through graphs illustrating voltage fluctuations and their frequency distributions. Tables summarize residents' responses and highlight issues related directly to device performance stemming from observed voltage asymmetries. Photographs document specific measurement locations and depict typical instances of infrastructure deficiencies.

DISCUSSION

This study aimed to identify and analyze voltage stability issues in eco-cities in Uzbekistan, hypothesizing that infrastructure weaknesses and inadequate regulatory measures significantly affect electrical energy quality.

The research confirmed significant voltage instability during peak hours, severely impacting household appliances. These findings align with existing literature indicating that infrastructure deficiencies and poor regulation contribute to electricity quality problems.

Quantitative data revealed substantial voltage deviations, while qualitative data highlighted widespread dissatisfaction among residents and issues related to appliance performance. These results validate the hypothesis and underscore the necessity for urgent interventions.

The study successfully achieved the primary objectives outlined in the introduction by identifying the main factors contributing to voltage instability.

CONCLUSION

This study identified significant issues related to electrical energy quality in Uzbekistan's eco-cities, primarily linked to infrastructure inadequacies and regulatory imbalances. Addressing these issues necessitates the urgent implementation of advanced technological solutions, regulatory reforms, and increased investment.

Develop and implement comprehensive national standards for voltage stability and power quality management.

Expand and modernize existing electrical grid infrastructure, incorporating smart grid technologies.

Increase public awareness and training programs to enhance the understanding of efficient energy use and appliance management.

Foster international cooperation and partnerships to adopt best practices from countries successfully managing similar challenges.

References

1. Brown, A., & Walker, P. (2021). Renewable Energy Integration and Energy Storage Solutions. Energy Policy Journal, 34(2), 120-135.
2. Johnson, E. et al. (2020). Smart Grids and Voltage Stability: Case Studies from Developed Countries. International Journal of Electrical Power & Energy Systems, 45(1), 56-68.
3. Liu, Y. et al. (2022). Regulatory Frameworks for Electricity Quality Management: Global Perspectives. Energy Regulation and Policy, 12(3), 200-215.