Exploring the Benefits of Achieving SDG 7: A Case Study of the Building Sector in South Africa

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Abstract

Achieving the United Nations goal by Sustainable Development Goal (SDG) 7 on affordable and clean energy in the building sector is a multifaceted goal that offers environmental, social, and economic benefits. From reducing operational costs and environmental impact to enhancing occupant comfort and health, the integration of affordable and clean energy solutions in buildings supports sustainable development and contributes to a resilient, equitable, and prosperous future. Focusing on sustainable energy has led to the quest for the industry to reduce its carbon footprint through the achievement of SDG 7. This study explores the multifaceted benefits of achieving SDG 7 on affordable and clean energy within South Africa's building sector. The study explored quantitative techniques and structured questionnaires. Data from the survey was analyzed using descriptive analysis. Out of 150 structured questionnaires distributed, only 110 were returned, representing a 73% response rate. The analysis reveals that reducing the emission of greenhouse gases is the most ranked benefit towards achieving the Sustainable Development Goal (SDG) 7 on affordable and clean energy in the building sector. The study highlights how integrating sustainable energy solutions can drive cost savings, improve energy efficiency, and reduce carbon emissions in the building sector.

Keywords: Sustainable Development Goal 7, Affordable and Clean Energy, Energy Efficiency, Sustainable Development, Building Sector

1. Introduction

Raising awareness of the benefits of achieving SDG 7 is crucial for driving global action towards universal access to affordable, reliable, and sustainable energy. Achieving SDG 7 not only improves energy access and affordability but also fosters economic growth, job creation, and innovation through investments in renewable energy technologies (United Nations, 2015). Furthermore, transitioning to sustainable energy sources mitigates climate change impacts and protects ecosystems, contributing to global efforts for a more sustainable future. Increased awareness can mobilize stakeholders across sectors to adopt energy-efficient practices, invest in renewable energy projects, and advocate for supportive policies, ultimately building resilient and inclusive societies. However, SDG 7 faces several challenges in its implementation, hindering progress toward universal access to affordable, reliable, sustainable, and modern energy (Dalei et al., 2021). Furthermore, these challenges encompass various factors such as inadequate infrastructure, limited financial resources, and policy constraints (International Energy Agency, 2021: United Nations, 2019 & International Renewable Energy Agency, 2020). More so, Hirth and Stepanov (2020) attested that limited access to advanced technologies and inadequate technical expertise can hinder the deployment of sustainable energy solutions. In China, Liu et al. (2020) and Zhang et al. (2020) highlighted that integrating renewable energy sources into existing energy grids can be complex and costly, particularly in regions with outdated infrastructure, which poses challenges to grid integration. Therefore, the transition to clean energy is challenged by the need to balance economic growth with environmental sustainability. In addition, Li and Shi (2019) stressed that inconsistent policy implementation and regulatory frameworks can hinder the effective deployment of renewable energy projects. Furthermore, Blignaut et al. (2020) highlighted that transitioning to renewable energy sources is critical but challenging due to the existing infrastructure and economic dependency on fossil fuel industries. In Nigeria, Aliyu et al. (2013) found that insufficient and outdated, results in frequent power outages and unreliable electricity supply due to its energy infrastructure. As a result, inadequate reliable infrastructure hinders economic growth and development, and meanwhile, Nigeria heavily relies on fossil fuels, particularly oil and gas, for its energy needs. In addition, Al-Maamary et al. (2017) enunciated that dependency not only contributes to environmental degradation but also makes the country vulnerable to fluctuations in global oil prices, affecting economic stability. Nhemachena et al. (2018) highlighted that in Zimbabwe, the high initial costs of renewable energy projects and limited access to financing are significant obstacles, local financial institutions often lack the capacity or willingness to provide loans for renewable energy projects, requiring innovative financing solutions and greater government support. Similarly, Maringa & Mhlanga, (2020) stressed that political instability and governance issues in Zimbabwe can deter investment in the energy sector. Also added that political uncertainty affects policy continuity and the implementation of long-term energy strategies. Yet, developed countries such as the USA have a significant dependency on fossil fuels for energy production, particularly natural gas, coal, and oil (Carley & Konisky, 2020). Despite overcoming economic, political, and social barriers, including resistance from established fossil fuel industries and associated employment sectors through transitioning to renewable energy (Cantarero, 2020). Similarly, Bolinger et al. (2021) added that renewable energy costs have decreased, but significant upfront capital is still required for infrastructure development, and further, outlined that limited access to financing, especially for small and medium-sized enterprises and local governments, can impede the deployment of renewable energy projects. Nevertheless, the persisting challenges in achieving SDG 7 have resulted in demands across various sectors and regions for innovative solutions (Trends, 2017). Moreover, addressing these challenges requires a comprehensive approach that includes policy reforms, technological innovations, and financial mechanisms designed to facilitate the transition to renewable energy ensuring equitable access to clean energy, modernizing grid infrastructure, and fostering public support are critical components for advancing toward a sustainable energy future. Stokes and Breetz (2018) highlighted that there is a need for coherent and stable energy policies and regulatory frameworks that provide clear incentives for renewable energy investments. Including consistent subsidies, tax incentives, and streamlined permitting processes to foster a more predictable investment environment. Denholm et al. (2021) articulate that upgrading and modernizing the energy infrastructure is critical, including investments in grid modernization, energy storage systems, and smart grid technologies to handle the integration of renewable energy sources and ensure grid reliability and stability.

There is a demand for innovative financial solutions to lower the high upfront costs associated with renewable energy projects. This can involve increased government funding, private sector investments, green bonds, and other financing mechanisms to support small and medium-sized enterprises and local governments (Bolinger et al., 2021). According to Luo et al. (2015), continuous advancements in renewable energy technologies are required to improve efficiency, reduce costs, and address intermittent issues. This includes the development of advanced energy storage solutions, enhanced grid management systems, and more efficient solar and wind technologies. However, Reames (2016) efforts must be made to ensure that all communities, particularly low-income and marginalized groups, have access to affordable and reliable energy, and this requires targeted policies and programs that address energy poverty and promote energy justice. As the energy sector transitions from fossil fuels to renewable energy, there is a significant demand for workforce development and retraining programs. These programs are essential to equip workers with the skills needed for jobs in the renewable energy sector and to support those affected by job displacement (Cha, 2020). Hamilton et al. (2018). Enunciated that increasing public awareness and fostering community engagement is crucial for gaining support for renewable energy projects, this involves educating the public about the benefits of renewable energy and involving communities in the planning and decision-making processes. In addition, developing resilience and adaptation strategies to address the impacts of climate change on energy systems is essential, including planning for extreme weather events, enhancing the resilience of energy infrastructure, and ensuring reliable energy supply under changing climatic conditions (Zhang et al., 2020).

Transitioning to SDG 7 is critical for fostering economic growth, social equity, and environmental sustainability, providing universal access to modern energy services, particularly for the 789 million people globally who currently lack electricity and the 2.8 billion who rely on traditional biomass for cooking, including the expansion of infrastructure and upgrading technology to supply modern and sustainable energy services in developing countries, especially in rural areas (IEA, 2021). The efforts explored to achieve SDG 7 involve a multifaceted approach, encompassing policy measures, technological advancements, financial investments, and international cooperation. The development of advanced energy storage technologies, such as lithium-ion batteries and pumped hydro storage, helps address the intermittent of renewable energy sources and ensures a stable energy supply (Bladergroen et al., 2015). Collaborations between governments, private companies, and non-governmental organizations facilitate the development and deployment of clean energy projects, leveraging diverse resources and expertise (Carley & Konisky, 2020). Efforts are being made to transfer renewable energy technologies and knowledge from developed to developing countries, along with capacity-building programs to enhance local expertise and infrastructure (IRENA, 2020). Programs aimed at providing decentralized renewable energy solutions, such as solar home systems and mini-grids, are being implemented in remote and underserved areas to enhance energy access (UN, 2019). Ongoing research and development in emerging technologies, such as hydrogen fuel cells and next-generation solar cells, are crucial for achieving breakthroughs that can further enhance the sustainability and affordability of clean energy (Zhang et al., 2020). These efforts collectively aim to overcome the barriers to achieving SDG 7 ensuring that clean, affordable, and sustainable energy becomes accessible to all, thereby contributing to broader sustainable development goals. The existing traditional literature reviewed, underscores the dual benefits of environmental sustainability and economic resilience, advocating for policy frameworks and investment strategies that support the widespread implementation of clean energy solutions in South Africa's building sector. Moreover, the benefits of achieving SG7 highlight numerous advantages, ranging from economic growth and job creation to environmental sustainability and social development. According to a report by the Council for Scientific and Industrial Research (CSIR) (CSIR, 2021), expanding the use of renewable energy in South Africa can create thousands of jobs in the construction, manufacturing, and maintenance sectors related to the building industry. Furthermore, A study by the University of Cape Town's Energy Research Centre points out that energy-efficient housing can alleviate the adverse health effects caused by inadequate heating and cooling, particularly in low-income communities (University of Cape Town, 2018). Thus, this research seeks to provide a blueprint for other regions aiming to achieve SDG 7 while addressing economic and environmental challenges

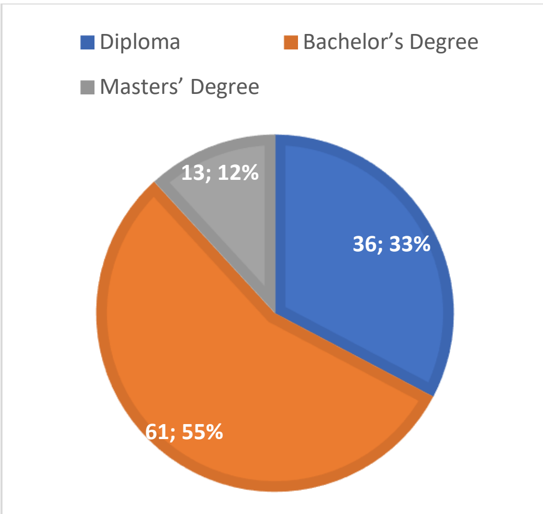
2. Research Methodology

A quantitative cross-sectional approach was implemented in the study to answer the following research question, what are the benefits of achieving the UN SDG on affordable and clean energy in selected building companies in Gauteng Province, South Africa? Scribbr (2023) defines a quantitative cross-sectional as an approach used to provide a snapshot of a population at a single point in time, allowing researchers to analyze and compare various variables simultaneously. Loeb et al. (2017) further affirm that it is efficient, cost-effective, and suitable for descriptive analysis, making it useful for identifying patterns and generating hypotheses. The study utilized a questionnaire survey as a major tool for collecting data administered to building construction specialists and associates mainly, construction managers, project managers, quantity surveyors, builders, electrical engineers, mechanical engineers, civil engineers, and architects. These were selected mainly from the private sector based on the selected building companies in Gauteng Province, South Africa. The location was based on the accessibility of the companies involved in sustainable energy for the researcher. A purposefully censused sampling technique was used with a sample size of 110 construction professionals identified out of 150 structured questionnaires distributed, based on the 10 selected building companies considered in this study, representing a 73% response rate. (Etikan et al., 2018). articulated that purposeful (also known as purposive) sampling is a non-probability sampling technique used in qualitative research where the researcher selects participants based on their knowledge, relationships, or experiences related to the study. It is a deliberate choice of informant due to the qualities the informant possesses. A closed-end questionnaire was prepared and distributed to acquire primary data. Chikwendu, and Amaechi, (2021), highlight that a closed-end questionnaire is a survey tool where respondents are given a set of predetermined answers to choose from. The use of a close-end questionnaire was influenced by the ease of analysis, time efficiency typically taking less time to complete, making them more convenient for respondents, optimizing the subjectivity in responses, and ensuring consistency (Check & Schutt, 2019). A 5-point Likert scale was adopted in assessing the questionnaires with 1 being Strongly Disagree; 2 being Disagree; 3 being Neutral; 4 being Agree; and 5 being Strongly Agree, distributed to 10 selected companies 110 response rate was obtained. In the analysis of the data gathered, the percentage was used in analyzing the data on the background information of the respondents, while the Mean Item score (MIS) was used in ranking the benefits of achieving the UN SDG 7 in selected building companies.

3. Results

3.1. Descriptive Analysis (background information)

Figures 1 to 9 provide background information about the respondents. Figure 1 shows the types of qualifications the respondents hold with the majority holding a bachelor's degree. Figure 2 shows the professional background based on their job title with the highest number of project managers. Figure 3 shows the years of experience in sustainable energy of the respondents with the majority having 0- 3 years of experience, followed by respondents with 4-6 years of experience. Figure 4 shows the type of organization the respondents worked for with the contractor being the majority. Figure 5 shows the company size based on the number of employees in the organization the highest being companies with 6-20 employees. Figure 6 shows the types of projects the organizations specialize in, with the installation of affordable and clean energy In schools, hospitals, etc being the highest. Figure 7 shows the number of projects performed by the respondent's majority being one project followed by two projects. Figure 8 shows the number of projects executed by the respondent's majority more than 13 projects, and lastly, figure 9 shows the project value executed by the respondent’s majority being 6.6 to 20 million rands.



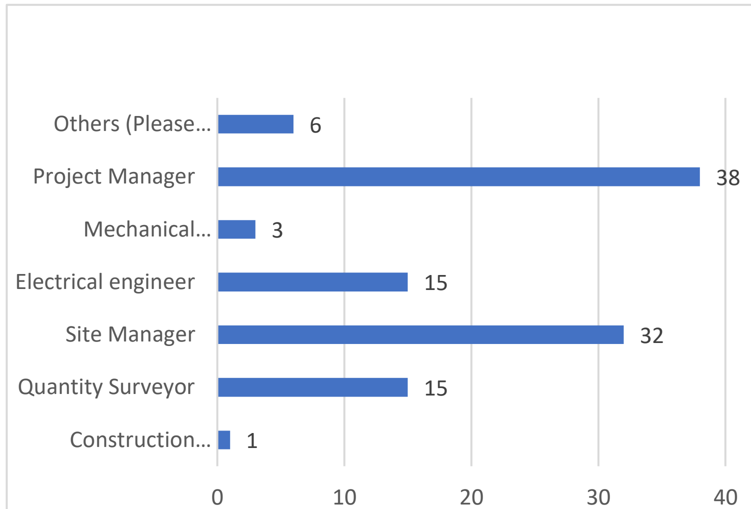
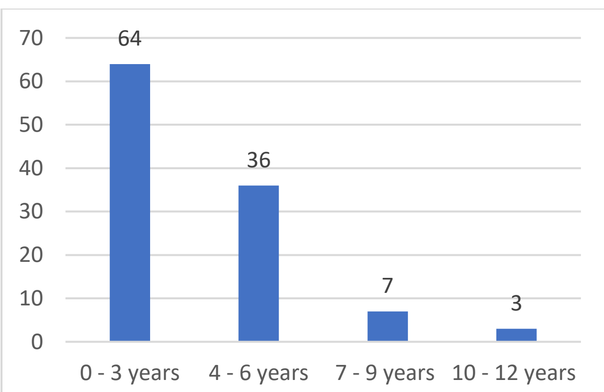


Fig. 1: Type of qualification

Fig. 2: Professional background



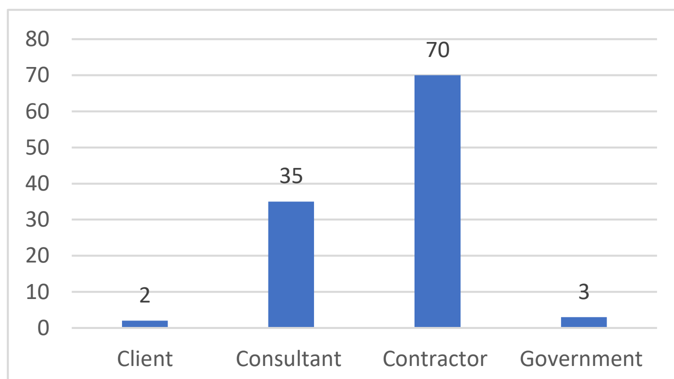


Fig. 3: Years of experience

Fig. 4: Types of organization

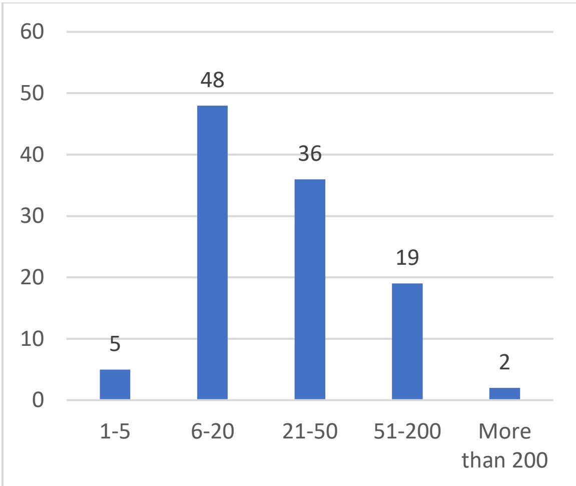


Fig. 5: Company size

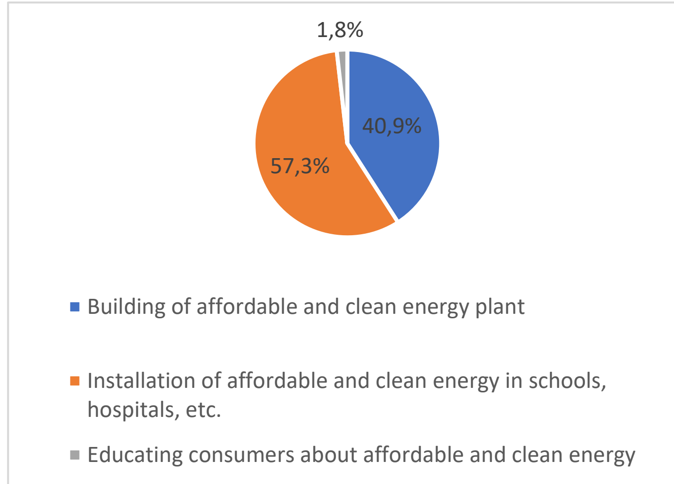


Fig. 6: Types of Projects

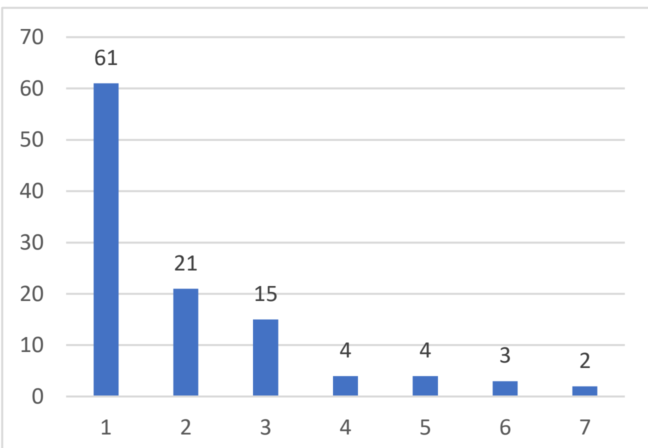


Fig. 7: Number of projects

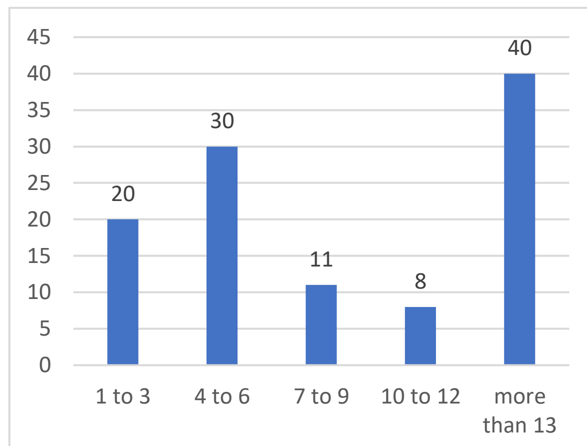


Fig. 8: Number of projects executed

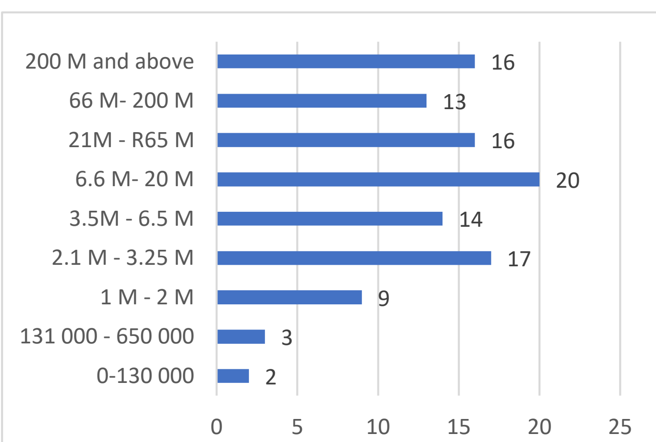


Fig. 9: Project value

3.2. Analysis of benefits of achieving SDG 7

Table 2 below shows the analysis of the benefits of achieving Sustainable Development Goal 7 on affordable and clean energy using mean, standard deviation, and rankings.

Table 1. Benefits of achieving the Sustainable Development Goal 7 (affordable and clean energy)

Benefits	$\bar{x}$	**σX**	**R**
Reduced emission of greenhouse gas	4.83	0.380	1
Reduced waste generation	4.78	0.436	2
Less usage of fossil fuels	4.73	0.487	3
Promotes the use of local sustainable materials	4.55	0.552	4
Increased use of green construction material	4.55	0.536	5
Create job opportunities	4.53	0.570	6
Reduction in the structure's carbon footprint	4.51	0.586	7
Increased protection of the ecosystem	4.47	0.616	8
Energy saving solutions	4.46	0.713	9
Enhances project efficiency	4.40	0.652	10
Boost economic growth	4.36	0.631	11
Protect the environment	4.35	0.658	12
Enhances competitiveness	4.34	0.707	13
Improves building practices	4.33	0.847	14
Reduced operating costs	4.33	0.692	15
Reduce poverty and inequality	4.31	0.714	16
Offers financial benefit	4.30	0.724	17
Improve building performance	4.28	0.814	18
Encourages corporate growth	4.27	0.823	19
Improves the overall quality of life	4.25	0.882	20
Improves building performance	4.20	0.917	21

Notes: $\bar{x}$ = Mean item score; σX = Standard deviation; R = Rank`

4. Discussion

The analysis of the benefits of achieving Sustainable Development Goal 7 reveals a clear prioritization of environmental impacts, with the most highly rated benefits being reduced greenhouse gas emissions. In agreement with the study by (Vakulchuk et al. 2020), concord looking at reduced greenhouse gas emissions, the study reviews the geopolitical implications of the transition to renewable energy and highlights the significant reduction in GHG emissions that can be achieved through the widespread adoption of renewables. It underscores that renewable energy, supported by energy storage systems, contributes to sustainable and modern energy access, benefiting SDG 7, and Hertwich & Roux (2018), conclude that renewable energy systems significantly reduce emissions compared to fossil fuels, supporting the achievement of SDG 7 by providing sustainable energy access. Furthermore, the promotion and increased use of local sustainable materials and green construction materials have significant implications for SDG 7 with the results from the respondents with similar ranks on the mean however, the promotion and increased use of local sustainable materials with a substantial standard deviation, in agreement with the study by Santos et al. (2017), highlighting the role of green construction materials in reducing the energy footprint of buildings. Materials such as recycled steel, bamboo, and rammed earth improve the sustainability of buildings, leading to lower energy consumption over the building's lifecycle. This contributes to SDG 7 by ensuring that energy use in buildings is more sustainable. Moreover, both Improved building practices and Reduced operating costs show significant variability, suggesting their significance is widely recognized but with some differences in perception of the standard deviation. Kylilin et al. (2020) study highlights the impact of building insulation on energy efficiency. Improved insulation practices are shown to significantly reduce heating and cooling energy requirements, leading to lower operating costs and supporting SDG 7 by enhancing energy efficiency. The results are also backed by the findings from Hong et al, (2020) and Zuo & Zhao. (2021). It finds that implementing energy-efficient technologies and optimal energy management significantly reduces operating costs and energy consumption, thereby supporting SDG 7 by promoting sustainable and efficient energy use. Also, emphasizes that sustainable building practices lead to reduced energy consumption and operational costs, contributing to the affordability and sustainability goals of SDG 7. Lastly based on the results from the respondents the improved building performance was shown to be the least favourable benefit the respondents agreed with suggesting more varied opinions among respondents, possibly due to differing perspectives on their feasibility and long-term benefits. According to Hong et al. (2020) findings reveal that energy-efficient technologies and optimal energy management significantly reduce operational costs and energy consumption, supporting SDG 7 and the study by Li et al. (2020) reviewing smart building technologies and their impact on building performance, found that integrating smart technologies enhances energy efficiency and reduces operational costs, supporting SDG 7. Overall, the results indicate a strong consensus on the environmental benefits of achieving SDG 7, while broader economic and social impacts may require more targeted communication and evidence to build wider agreement.

5. Conclusions

The analysis shows a clear prioritization of environmental benefits, with reduced emissions and waste generation being top priorities. There is general agreement on the importance of sustainable practices, but opinions vary more on benefits related to economic and social impacts, as well as specific improvements in building practices. This suggests a strong consensus on the environmental impact of achieving SDG 7, while the broader economic and social benefits may require more targeted communication and evidence to build wider consensus. Also, While existing literature highlights numerous benefits of achieving SDG 7, such as economic growth, environmental sustainability, and social development, several gaps remain that need further exploration. Most studies focus on immediate or short-term economic benefits, such as job creation and cost savings from energy-efficient buildings. However, there is a lack of comprehensive data on the long-term economic impacts of achieving SDG 7 in the building sector. This includes understanding how sustained investments in sustainable energy practices can influence the broader economy over decades. The study also recommends that essential to the success of meeting SDGs it is significant to raise awareness of SDG 7 and close the gaps that remain, particularly in developing countries. Public education campaigns and targeted outreach are crucial to close the gap and meet the global goal for 2023. High upfront costs of affordable and clean energy technologies, lack of infrastructure, and fossil fuel subsidies are major hurdles. Policy changes and innovative financing are needed with collaboration at a global scale. Technological advancements are essential for bringing down the costs of renewable energy technologies and improving their efficiency. Increased research and development (R&D) funding can accelerate progress. Developed countries can share clean energy technologies and expertise with developing countries to bridge the technological gap. SDG 7 requires significant financial resources. Governments can create incentives like feed-in tariffs and tax breaks for sustainable energy projects. Government-private partnerships can also play a key role in mobilizing capital. Moreover, Subsidies for fossil fuels hinder the transition to clean energy. Governments should phase out these subsidies and redirect those funds towards affordable and clean energy development. Complex regulations can impede clean energy projects. Governments can streamline permitting processes and provide clear guidelines for project development.

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