A Study on Adoption of Renewable Energy Solutions into Modern Supply Chains: Challenges and Prospects

Sophia Rosaline J*[1],

[1]Department of Management Studies, Bharath Institute of Higher Education and Research, Chennai, India.
sophia.mba@bharathuniv.ac.in

Abstract. This study highlights the emerging business models and the challenges faced by technological and operational systems in modern supply chains. It discusses the importance of using the renewable energy sources instead of conventional fossil fuels by taking the sample of 100 respondents from various departmental managers. Due to the application of renewable sources consider the factors such as changes in nature, environment and regulatory factors. The methodology used in this study is quantitative review-based methodology in order to identify the opportunities, barriers, and future prospects for implementing renewable energy across supply chain operations.

Keywords: Renewable Energy, Supply Chain management, Energy Consumption, Green Logistics, Policy Frameworks.

1 Introduction

In recent years, the global emphasis on sustainability, climate action, and responsible business practices has significantly transformed the organizations design and manage their supply chains [2]. The best alternatives to conventional fossil fuels are the renewable energy sources such as solar, wind, biomass, geothermal energy, and green hydrogen [10]. The change towards renewable energy transition improves long-term energy security, reduces dependency on volatile fuel markets, and enhances operational cost efficiency. This is the basic step towards climate change. For energy providers and companies, shifting from fossil fuels to renewable sources is necessary for their business and for the society [3].

S. P. Vijayaragavan et al. (eds.), *Proceedings of the Global Conference on Sustainable Energy Systems, Smart Electronics and Intelligent Computing (GCSESEIC 2025)*, Advances in Engineering Research 297,
https://doi.org/10.2991/978-94-6239-654-8_22

Using renewable energy sources in organizations is a challenging one. Due to the high initial investment costs, inadequate infrastructure, intermittency of renewable sources, regulatory uncertainties, and the skilled workforce it becomes challenging [6]. Even though organizations knowing that adopting renewable energy improve long-term competitiveness and operational stability.The study gives a clear understanding of the changes towards sustainable, energy-efficient supply chain systems and highlights the ways from existing literature and recent industry developments that organizations can adopt to achieve long-term environmental and operational advantages [7].

2 Objectives of the study

- To find out the importance of renewable energy in supply chain operations.
- To perceive the challenges linked with renewable energy solutions.
- To identify the opportunities which drives the future of renewable energy.

3 Review of literature

Khan (2022),Review of Renewable energy challenges and opportunities in supply chain examined the opportunities and difficulties of using renewable energy and it gives suggestion**s [1].** Berg, E., Longoni, A (2019),Technological frontiers: addressing renewable energy supply chain and sustainability challenges gives solutions for the problems which are faced by the Africa's renewable energy sector and theintegration of green supply chain management and industry 4.0 technologies [4]. Alyamani, R., Solangi, Y.A., Magazzino, C (2025), Artificial Intelligence (AI) in Renewable Energy Systems: A Condensed Review of its Applications and Techniques examined to determine the advancement of the AI techniques in the field of Renewable Energy Systems (RES) [5].

4 Research methodology

Research design: The research design used in this study is descriptive research design. It describes the variables accurately.

Target Population : The target population for this study are professionals and managers in manufacturing department, transportation, retail, and other related supply chain functions.

Sampling Size: The sample size of the population used in this study is 100 respondents.

Data Collection Methods

- Through questionnaire, primary data is collected and it contains both closed-ended and Likert-scale questions [8].
- Through articles, government publications, industry reports, and corporate sustainability disclosures secondary data is collected [9].

5 Statistical Tools

The statistical tools used are simple percentage, bar diagram, pie charts, Tables. To represent variety of data the following tools has been used.

Data Analysis

Table 1. Type of the Organization

Category	Variable	Frequency	Percentage
Demographics	**Organization Type**		
	Manufacturing	30	30%
	Logistics/Transportation	20	20%
	Warehousing	25	25%
	Retail	15	15%
	Other	10	10%

Inference: From the above Table 1 the manufacturing organization type gets the highest percentage. The analysis shows that the manufacturing integrates the renewable energy solutions compared to that of the other.Fig.1 shows the Organization Type chart.

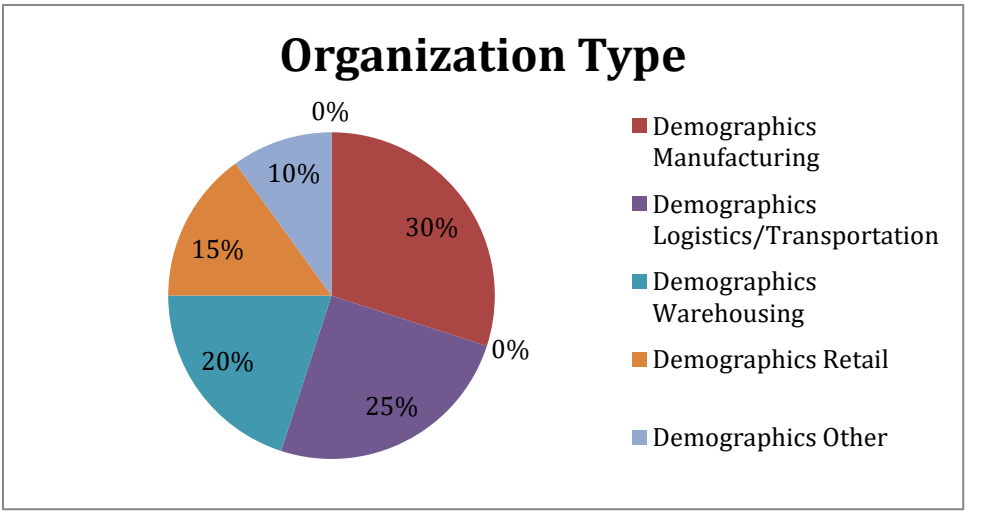

Fig. 1. Organization Type

Table 2. Perceived Benefits of Renewable Energy

Statement	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
Reduction in operational costs	5%	10%	20%	40%	25%
Improvement in supply chain sustainability	3%	7%	15%	45%	30%
Enhances energy security and resilience	4%	8%	18%	42%	28%

Increase in company reputation	2%	5%	20%	43%	30%
Long-term competitiveness	4%	6%	15%	45%	30%

Inference: The Table 2 shows the highest percentage falls under the agree category which tells that the respondents have a positive approach towards renewable energy adoption. The Fig.2 shows the perceived benefits of renewable energy

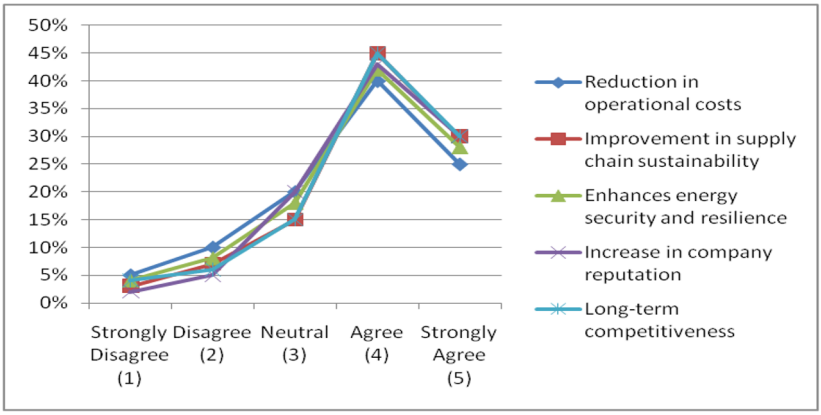

Fig. 2. Perceived Benefits of Renewable Energy

Table 3. Challenges Faced in Adoption

Challenge	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
High initial investment	5%	10%	15%	45%	25%
Lack of technical expertise	6%	12%	20%	38%	24%
Government	7%	14%	25%	34%	20%

policies and regulations					
Technology	8%	12%	22%	38%	20%
Reliable suppliers/service providers are limited	6%	14%	20%	40%	20%

Inference: The Table 3 indicates that the respondents notice significant challenges in the adoption of renewable energy and give the highest responses in the agree category and strongly agree categories. Fig. 3 shows the Challenges Faced in Adoption

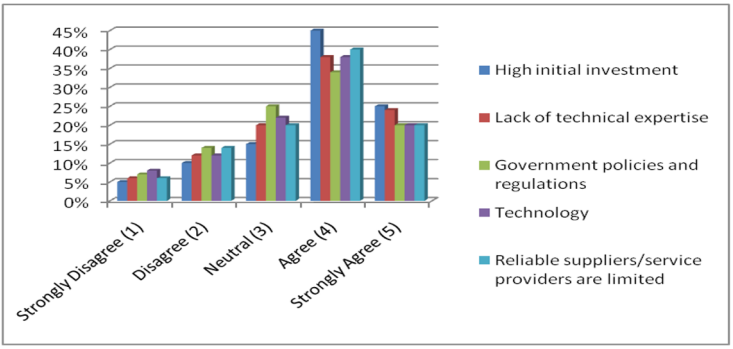

Fig. 3. Challenges Faced in Adoption

Table 4. Prospects & Future Plans

Statement	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
Organization plans to increase renewable energy usage	4%	8%	18%	40%	30%
Adoption will	3%	7%	15%	45%	30%

become essential in supply chains					
Government incentives will encourage adoption	2%	8%	20%	40%	30%
Technology improvements will make renewable viable	3%	7%	15%	45%	30%

Inference: From the Table 4, we know that the government as well as technology helps to adopt the renewable energy to reduce barriers and enhance feasibility.Fig.4. shows Prospects & Future Plans.

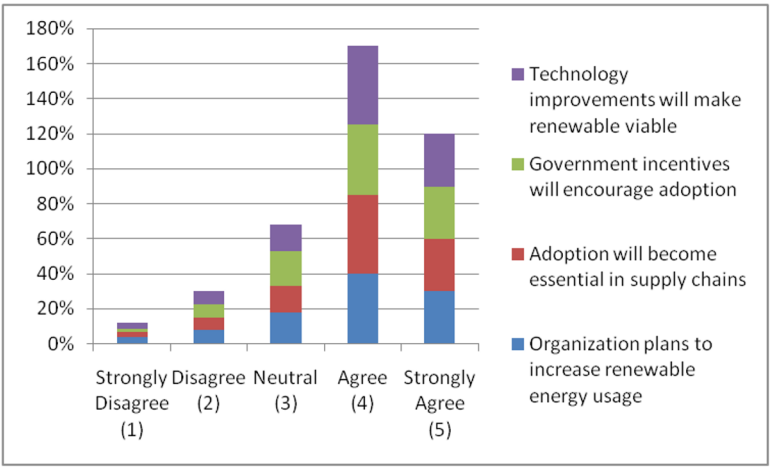

Fig. 4. Prospects & Future Plan

6 Results and Findings

6.1 Organizational Profile and Trends of Adoption

According to the results, manufacturing organizations constitute the biggest sample of the respondents (30%), followed by warehousing (25%), logistics/transportation (20%), retail (15%), and other industries (10%). This implies that manufacturing industries are also on the forefront in embracing renewable energy practices as opposed to other supply chain functions. The increased rate of adoption might have been the result of the high level of energy consumption as well as high sustainability needs in manufacturing processes shown in Fig.5.

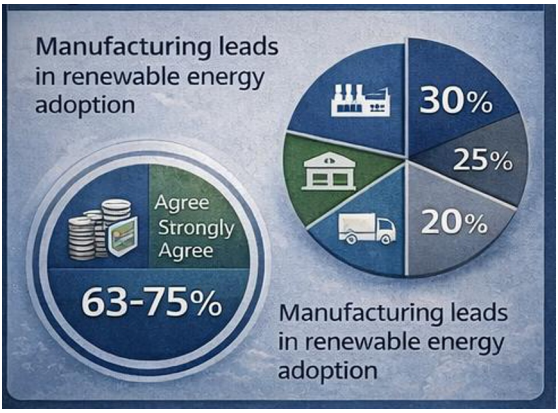

Fig. 5.Organizational Profile and Trends of Adoption

6.2 Perceived Returns of Integrating Renewable Energy

The result shows that there is a good positive attitude towards renewable energy solutions. Quite a considerable number of respondents said they would agree or strongly agree with the statement associated with reduction of operational costs, better sustainability, better energy security, better corporate image, and long-term competitiveness. The greatest positive responses were on improvement in supply chain sustainability and long-term competitiveness, which means that organizations view renewable energy as a strategic investment and not an environmental effort.

6.3 Problems that ISSuAd faces in its adoption

Regardless of the identified advantages, there are some challenges that were perceived as obstacles to adoption. The major challenge that came in was high initial investment cost,

then the absence of technical expertise, technological constraints, uncertainty on regulation, and a scarcity of reliable suppliers or service providers. These findings indicate that economic constraints and unavailability of infrastructure are still significant challenges that limit the ability of organizations to transform to renewable energy initiatives.

6.4 Future Projections and Company Ambitions

The future prognosis shows that the use of renewable energy in supply chains will be positive. Most of the respondents believed that their organizations intend to use renewable power in the future. The respondents also pointed out that the government incentives and technology will be important in speeding up adoption. The findings indicate increased awareness and willingness of the organizations to invest in the sustainable energy practices as technologies become more available and policies more friendly.

6.5 Findings

- Renewable energy solution is adopted by the manufacturing organizations compared to the other organizations.
- Supply chain sustainability provides strongest benefit with most respondents agreeing with respect to reduced operational costs, improved sustainability, enhanced reputation and long-term competitiveness.
- Due to the high initial investment, government policies, lack of technical expertise and technology the organizations struggle to adopt renewable energy solution.
- According to the response, organizations plan to expand their renewable energy usage in the future.
- Government also helps to adopt renewable energy by giving incentives.

7 Conclusion

The study concludes that renewable energy is necessary for the modern supply chains. In the upcoming future, adoption of renewable energy is possible due to the government policies, technologies and organizational commitment on account of the environment. Finally, it concludes that moving to renewable energy improves long-term competitiveness and operational stability.

References

1. Khan, R., Gupta, N.: Digital transformation and renewable energy integration in supply chains. In: Journal of Sustainable Operations (2022)
2. Lee, M., Chen, Y.: Green supply chain management and energy efficiency. In: International Journal of Production Economics (2021)
3. Bag, S., Gupta, S.: Examining the effect of green human capital availability in adoption of reverse logistics and remanufacturing operations performance (2018)
4. Koberg, E., Longoni, A.: A systematic review of sustainable supply chain management in global supply chains. In: Journal of Cleaner Production, vol. 207, pp. 1084–1098 (2019)
5. Yahyazadeha, A.: Review of renewable energy challenges and opportunities in supply chain. In: International Journal of Engineering and Technology Sciences, pp. 1–25 (2022)
6. Alyamani, R., Solangi, Y.A., Magazzino, C.: Strengthening energy security and advancing renewable energy adoption through supply chain digitalization. In: Business Strategy and the Environment (2025)
7. Mishra, R., Raut, R.D., Kumar, M., Naik, B.K.R., Luthra, S.: Renewable energy technology adoption in building a sustainable circular supply chain and managing renewable energy-related risk. In: Annals of Operations Research, pp. 1–26 (2023)
8. Lawal, S.A., Omefe, S., Balogun, A.K., Michael, C., Bello, S.F., Owen, I.T., Ifiora, K.N.: Circular supply chains in the AI era with renewable energy integration and smart transport networks. In: Communication in Physical Sciences, vol. 7, no. 4, pp. 605–629 (2021)
9. Lawal, S.A., Omefe, S., Balogun, A.K., Michael, C., Bello, S.F., Owen, I.T., Ifiora, K.N.: Circular supply chains in the AI era with renewable energy integration and smart transport networks. In: Communication in Physical Sciences, vol. 7, no. 4, pp. 605–629 (2021)
10. Alshahapy, H., Bozeman III, J.F., Carley, S., Nock, D., Matisoff, D.: Modern challenges facing electric vehicle adoption: A review of barriers to adoption, supply chain challenges, and equity. In: Environmental Research Letters, vol. 20, no. 2, article 023002 (2025)