



# Sports Industry

## Assessing Decarbonization and Growth Potential



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## Accessing Decarbonization and Industrial Growth

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Alternate Development Services



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## Acronyms and abbreviations

3D	Three dimensional
ADS	Alternate Development Services
CAD	Computer-Aided Design
CO <sub>2</sub>	Carbon dioxide
GDP	Gross Domestic Product
EPA	Environment Protection Agency
EU	European Union
FGDs	Focus Group Discussions
FIFA	French for International Association Football Federation
GIZ	German Government International Aid Agency
KIIs	Key Informant Interviews
kW	Kilo Watt
kWh/kg	Kilo Watt Hour Per Kilogram
kWh/m <sup>2</sup>	Kilo Watt Hour Per Meter <sup>2</sup>
LCA	Life Cycle Assessment
LNG	Liquefied Natural Gas
MW	Megawatt
NAMA	Nationally Appropriate Mitigation Action
NCCP	National Climate Change Policy (Pakistan)
NDCs	Nationally Determined Contributions
NEQS	National Environmental Quality Standards
NUST	National University of Science and Technology
MCSTSI	Multan Chamber of Small Traders and Small Industry
ABPUMA	All Pakistan Bedsheets & Upholstery Manufacturer Association
PRGMEA	Pakistan Readymade Garments Manufacturers and Exporters Association
PSGMEA	Pakistan Sports Goods and Manufacturers Exporters Association
PV	Photovoltaics
R&D	Research and Development
SBP	State Bank of Pakistan
SCCI	Sialkot Chamber of Commerce and Industry
SDGs	Sustainable Development Goals
SDPI	Sustainable Development Policy Institute
SDSC	Sustainable Development Study Centre
SESCO	Sialkot Electric Supply Company

UNDP	United Nations Development Program
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
WAPDA	Water and Power Development Authority
WWF	Worldwide Fund for Nature

## **Chapter 1: Introduction and Methodology Adopted**

### **1. Introduction**

#### **1.1. Background**

**T**he utilization of fossil fuels in industries for energy generation, industrial processes, and transportation lead to a substantial amount of carbon dioxide (CO<sub>2</sub>) emission into the atmosphere (*THE NATIONAL CLIMATE CHANGE CONTEXT NATIONAL VISION FOR CLIMATE ACTION*). These emissions play a pivotal role in global warming and climate change, resulting in various adverse effects such as more frequent and severe extreme weather changes, sea level rise, and loss of biodiversity. Considering these challenges in developing countries, especially Pakistan like many other countries is struggling with environmental challenges.

According to data from the National Greenhouse Gas Inventory spanning from 1994 to 2017, the energy sector is the primary source of greenhouse gas emissions in Pakistan, accounting for 50.8% of the total emissions. Additionally, industrial processes and product usage contribute 8.2% of emissions (*PAKISTAN'S SECOND NATIONAL COMMUNICATION ON CLIMATE CHANGE TO UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE (UNFCCC) 2018 Ministry of Climate Change Government of Pakistan*). The industrial sector in Pakistan consumes a significant portion of the country's energy, with the 2018 Pakistan Energy Yearbook revealing that it consumes 37.5% of total energy. This industrial sector plays a crucial role in Pakistan's economy, contributing 20.42% to the Gross Domestic Product (GDP) (*Developing Pakistan's Economy of Sports - Business - DAWN.COM*). In Pakistan's industrial landscape, it stands as a main pillar supporting economic growth. Particularly, the sports industry has long been a cornerstone, boasting significant contributions to the nation's GDP and employment rates. As the largest manufacturing sector in Pakistan, it holds a substantial share,

approximately 60% of total exports and projected to grow by 9.57% (*Sports - Pakistan | Statista Market Forecast*).

The sports goods manufacturing sector in Pakistan, centered in Sialkot city, holds a distinguished status at the global stage, particularly renowned for its hand-stitched football production. Exporting its products to over 100 countries, this industry accounts for approximately 70% of the world's hand-sewn footballs, manufacturing around 40 to 60 million pieces annually (*Globalization in Pakistan: The Football Stitchers of Sialkot - DER SPIEGEL*). This specialization has led to the widespread use of these footballs in various FIFA World Cups. Beyond its international recognition, the industry directly and indirectly engaging in a carbon emission, with estimates ranging from 30 million tons per annum that is roughly equivalent to the total emissions by Denmark (*Unveiling the Real Carbon Footprint of Football | Earth.Org*).

## **1.2. Literature**

The United Nations Framework Convention on Climate Change (UNFCCC), established in 1992, forms the cornerstone of international endeavors to combat climate change. Pakistan actively participates in the annual Conference of the Parties (COP) meetings convened under the UNFCCC, engaging in negotiations and discussions surrounding climate change issues (*History of the Convention | UNFCCC*). Throughout these sessions, Pakistan consistently articulates its concerns and priorities, emphasizing the unique challenges faced by developing nations in confronting climate change. The Paris Agreement in 2016, builds upon the UNFCCC's framework and sets ambitious targets to limit global temperature rise. It aims to constrain the increase to well below 2 degrees Celsius above pre-industrial levels and strives for a more ambitious goal of 1.5 degrees Celsius (*Key Aspects of the Paris Agreement | UNFCCC*). By becoming a signatory to the Paris Agreement, Pakistan pledges to play its part in the global endeavor to reduce greenhouse gas emissions, sustain climate resilience, and promote sustainable development.

Considering primary data and industrial yearly reports. Pakistan's sports sector is one of the main players in terms of nation's economy, serves both domestic and international markets with sports products. Pakistan exports sports goods over 90 countries including USA, UK, Germany, France, Spain, Netherland, Italy, Canada, Australia, etc. (*Sports Emerging Pakistan*). Football, balls, bats, and other sports related things are globally exported. According to the Pakistan Sports Board, this industry contributes close to \$1 billion in foreign exchange annually, including \$350-\$500 million from footballs alone (*Developing*

*Pakistan's Economy of Sports - Business - DAWN.COM*). In this industry, energy sources commonly used are electricity and fossil fuels such as natural gas and diesel. According to a report from the Pakistan Sports Goods Manufacturers & Exporters Association (PSGMEA) exports of sport goods/apparels contributed approximately \$404.79 million to the economy during July-June of the 2022-2023 fiscal year and \$364.9 million during July-June of the 2021-22 fiscal year, showing the growth of 10.94% (*Pakistan's Sports Goods Exports Surge by over 10 Pct in FY 2022-23-Xinhua*). The production of sports equipment involves various energy-intensive processes such as spinning, weaving, dyeing, sewing, stitching, cutting, printing, embroidery, pressing, assembling, bonding, trimming, labeling, packaging, and testing, with electricity being particularly crucial. Pakistan's energy crisis and inconsistent electricity supply somehow disrupt these processes' productivity and efficiency. To address these energy challenges, sport industries could explore investments in integration of sustainable renewable energy sources, backup power solutions, energy-efficient machinery, enhanced supply chain management, energy audits, waste management initiatives, and policy advocacy (*SUSTAINABILITY ESSENTIALS A SERIES OF PRACTICAL GUIDES FOR THE OLYMPIC MOVEMENT SUSTAINABLE SOURCING IN SPORT*).

Pakistan's National Climate Change Policy of 2012 acknowledges the imperative of adopting and development of cleaner production methods which enhance energy efficiency within the sports industrial (*National Climate Change Policy (2012) | ESCAP Policy Documents Management*). For this, policy's implementation framework outlines several targeted measures, including the encouragement of cleaner fuel adoption like hydrogen or blended fuels, the promotion of energy-efficient technologies, and the establishment of a cleaner production center for R&D. The Pakistan's government take initiatives for sports industrial sector policies. For instance, the Sports Policy to strengthen sports sector output by providing incentives, such as subsidized energy provision and technological modernization. Similarly, the Leather Export Promotion Policy of 2022 aimed to optimize leather exports by tackling issues concerning raw material availability and upgrading manufacturing processes (*Pakistan Export Strategy Leather and Leather Goods*). Nevertheless, these kinds of initiatives promote industries to handle significant challenges. Pakistan's industrial sector struggles with several core challenges, including energy shortages, escalating production expenses, and technological deficiencies.

As Pakistan is actively engaged in global climate change actions, aligning itself with international policies aimed at mitigating climate change effects and fostering adaptation of renewable energy. As a signatory to both the UNFCCC and the Paris Agreement (*Key Aspects of the Paris Agreement | UNFCCC; UNFCCC*), Pakistan commits to collaborative global frameworks designed to control the escalation of global temperatures and reinforce climate resilience efforts especially in sports industry.

### **1.3. Importance of decarbonization**

Transitioning to a low-carbon economy through decarbonization is essential for achieving sustainable long-term industrial growth. As Pakistan's sports industry emerges as a low emission but notable source of carbon emissions in the country. Its decarbonization is crucial to tackle (Fuentes et al.). Therefore, some strategic aspects are required to be employed as our part in environmental responsibility. These strategic aspects are as follows:

#### **1.3.1 Environmental aspect**

Looking at the environmental aspect in Pakistan, the sports sector is recognized for its substantial carbon footprint. This arises from energy consumption during manufacturing, as well as the extraction and treatment of raw materials, along with product utilization and disposal (Xiuhui and Raza). Through decarbonization initiatives within sport industries, Pakistan has the potential to lower its total greenhouse gas emissions, thereby playing a part in the worldwide endeavor to combat climate change (*PAKISTAN'S INTENDED NATIONALLY DETERMINED CONTRIBUTION (PAK-INDC)*).

#### **1.3.2 Economic aspect**

In the sports sector, looking at the economic perspective, decarbonization has the potential to spark innovation, drive the development of new and more efficient technologies, and adoption of renewable energy within sport industries. These efforts are poised to get long-term cost reductions, enhancing the sustainability, and competitiveness of businesses (Xiuhui and Raza). For instance, renewable energy sources like solar and wind power offer cost-effective and environmentally friendly alternatives to the traditional fossil fuels for powering industrial operations. Therefore, this create growing demand and creating an opportunity for sport industries in Pakistan (*Developing Pakistan's Economy of Sports - Business - DAWN.COM*).

By adopting decarbonization strategies in sports industries in Pakistan, sports industries can not only cater to the increasing number of environmentally



conscious consumers but also position themselves for expanded export opportunities and economic growth (Xiuhui and Raza). This shift towards sustainability not only distinguishes companies within the market but also aligns with global trends and addresses Pakistan's pressing environmental challenges. Ultimately, it fosters innovation, creates job opportunities, and establishes resilience against climate risks in the long term<sup>i</sup>.

### **1.3.3 Social aspect**

Considering the societal perspective, decarbonization in sport industry holds an importance in enhancing green solutions. Industrial emissions stand as a major contributor to air pollution, which correlates with various health issues of workers and nearby neighborhoods. By reducing these emissions, air can be cleaned, leading to improved public and workers health. Furthermore, climate change poses a threat to social cohesion, leading to issues like poverty and inequality. For instance, extreme weather events can damage communities, livelihoods, and industries. In Pakistan, past instances of floods in 2008, 2010, and 2022 displaced millions, highlighting the vulnerability of impoverished populations to climate-induced disruptions (*Pakistan's History of Disasters and the Lessons We Fail to Learn - Pakistan - DAWN.COM*). In Pakistan's context, a comprehensive study by the Ministry of Climate Change reveals that the industrial sector significantly contributes to the country's carbon emission, accounting for approximately 24% of the total emissions (Dolan). The Sustainable Development Policy Institute (SDPI) emphasizes that mitigating climate risks through decarbonization is crucial for safeguarding livelihoods, industries, especially in vulnerable rural communities (Dr. Hina Aslam et al.). Therefore, in context of Pakistan sport sector, transitioning to cleaner energy sources like renewables and cleaner fuel like hydrogen becomes imperative to mitigate carbon emissions. Transitioning to cleaner technologies not only reduces emissions but also aligns with Pakistan's "Vision 2030" economic agenda considering Paris agreement (Amin Aslam Khan et al.).

### **1.4. Research objectives**

Our research surveys aim to examine energy consumption, carbon emissions and transitions within the sports sector. This was performed with a comprehensive approach to analyze how the sport sector contributes to the country's industrial emissions. By examining both primary and secondary data, the objectives of this study are as follows:

- To evaluate the environmental impact of current practices in the sports industry of Pakistan, this report comprehensively presents the assessment of the carbon emissions associated with different activities

within the sports industry. This report quantified the GHGs emissions from different activities and identified the primary energy sources emissions in the sports industry.

- To analyze the feasibility and adoption of renewable energy systems in the sports Industries of Pakistan, an investigation of what extent solar PV panels is implemented. This report presents the technical, economic, social, and logistical feasibility of transitioning sports industry to renewable energy sources and evaluates the potential reduction in carbon emissions. The study also explores case studies, KPIs, and carbon emissions assessments of the sports industries. Lastly, the feedback of those industries that have successfully implemented renewable energy initiatives and drive sustainable practices.

## **1.5. Methodology**

**T**he study has employed a rigorous methodology consisting of a literature review, site visits, and interviews with experts and executives to gather the primary data. Initially of sport/apparel sector, the ADS team conducted a thorough desk review, followed by on-site observations and analyses encompassing both qualitative and quantitative assessments of the energy sources and any plans for transitioning to renewable energy. These methods provided valuable insights into the operations, processes, and challenges faced by the sport industries, complementing the broader context provided by secondary sources. Subsequently, an in-depth analysis of the collected data identified patterns, trends, and obstacles encountered by the sport/apparel industries, contributing to a comprehensive understanding of the industrial decarbonization processes and standards in Pakistan. Moreover, special attention was given to observing the processes and mechanisms in the sport industry that can contribute most to emissions.

### **1.5.1. Desk review**

The ADS team initiated the study by gathering and analyzing data from various external and secondary sources regarding the sport/apparel sector. Through comprehensive skimming and literature review, the team developed an important understanding of the energy consumption and carbon emissions within the targeted sports industries. Additionally, ADS team examined energy consumption demand, the capacity of renewable energy adoption, any other relationship between national and international alliances considering commitments, such as the Paris Climate Agreement, Nationally Determined Contributions (NDCs) (*The Paris Agreement* | UNFCCC), and Net-Zero by 2030

targets (*Pakistan | Climate Promise*), and their impact on the sports and apparel industry.

These commitments emphasize the shift towards renewable energy sources and the reduction and mitigation of emissions. This holistic data gathering, and acquisition approach led to a strong foundation for the successive phases of our research, providing essential insights into the current state of environmental sustainability and carbon reduction efforts within the sport industry (*A Shift Towards Environmental Sustainability in Sport | LinkedIn*). Our research offers a detailed overview of the existing situation and explores policy and practical strategies to achieve net-zero emissions within the sports/apparel industry.

Looking at decarbonization in the sports industry, this study highlights the significant role of sports and apparel industries by adopting renewable energy solutions, optimizing energy efficiency, and promoting sustainable practices. Furthermore, this study also addresses the potential for sports venues to serve as models for sustainability, influencing sportsmen and athletes to embrace environmentally friendly practices. This comprehensive examination underscores the critical importance of integrating renewable energy sources into industries for the core operations to meet national and international climate goals.

## **1.5.2. Primary data collection**

### **1.5.2.1. Qualitative survey**

The ADS team conducted Key Informant Interviews (KIIs) with the representatives of 106 sports/apparel industries. The aim was to capture the respective representatives' insights on various aspects, including their energy needs, existing energy mix and energy tariffs, the forms of energy or heat generation sources industries are using, and their energy transition plans and strategies (if any). Industries face numerous challenges when it comes to adopting renewable energy sources. In the sports and apparel industry, these challenges include the cost-benefit analysis, energy consumption costing analysis, and renewable contribution analysis they perform, as well as the specific concerns and priorities of the sports industries. Sports industries are increasingly considerably in Pakistan and are interested in renewable energy adoption that will impact their operations. Most of them have started to implement initiatives aimed at decarbonizing their activities. These initiatives demonstrate their commitment to reducing their carbon emissions. However, they often express criticism regarding government policies, the existing systems

of energy production, and transmission. These comments reflect their views on how these factors either facilitate or hinder the transition from conventional fuels to renewable energy sources. Their role in this transition is significant, as they can either promote or prohibit reducing carbon emissions, depending on their level of engagement and support for renewable energy initiatives.

#### **1.5.2.2. Quantitative survey**

The ADS team also drew a comprehensive quantitative analysis of the sports/apparel industries, primarily focusing on gathering statistical data that was later tabulated and transformed into graphs and schematic illustrations. The team developed a survey questionnaire to assess the current sources of energy used by the select sports industries, their objectives regarding the shift from traditional energy to renewables, and the initiatives they have undertaken or planning to undertake to mitigate carbon emissions within their operations. In total the team filled the questionnaire with 106 pertinent questions to assess the current sources of energy, transition potential, future planning, and obstacles coming in the way. Moreover, a thorough and precise analysis by ADS team, the team was able to collect significant insights/data into the energy consumption patterns in the sports sector. This detailed quantitative analysis enabled the team to map out the current energy profile of these industries. Additionally, it helped them to identify the potential for transitioning towards more sustainable, environmentally friendly, and eco-conscious practices. By understanding these consumption patterns and profiles, the team could better strategize and recommend pathways for industries in the sports sector to adopt renewable energy sources and reduce their overall carbon emissions.

## **Chapter 2:**

### **Contextualizing Energy Challenges in Sports/Apparel Industries**

#### **2. Industrial processes and their environmental impacts**

##### **2.1. Sports industry**

In Pakistan, the sports goods manufacturing industry, centered primarily in Sialkot, encompasses a wide array of categories, including footballs, cricket equipment, hockey sticks, and diverse sports apparel. Within this sector, a range of distinct processes are involved, beginning with Design and Prototype Development, followed by Material Preparation, Forming & Shaping, Joining & Assembling, and culminating in Finishing & Quality Control stages. Each step plays a crucial role in the production of high-quality sports goods.

##### **2.1.1. Processes**

###### **2.1.1.1. Design and prototype development**

During the design phase, advanced software like Computer-Aided Design (CAD) tools are employed to craft detailed and accurate product blueprints, laying the groundwork for prototypes. Prototype development, which includes small-scale manufacturing utilizing technologies such as 3D printers, CNC machines, or manual craftsmanship, serves to evaluate the feasibility of the design. Energy consumption in this stage primarily stems from the operation of these sophisticated devices and systems. The design and prototype of a football is illustrated in Fig. 1.

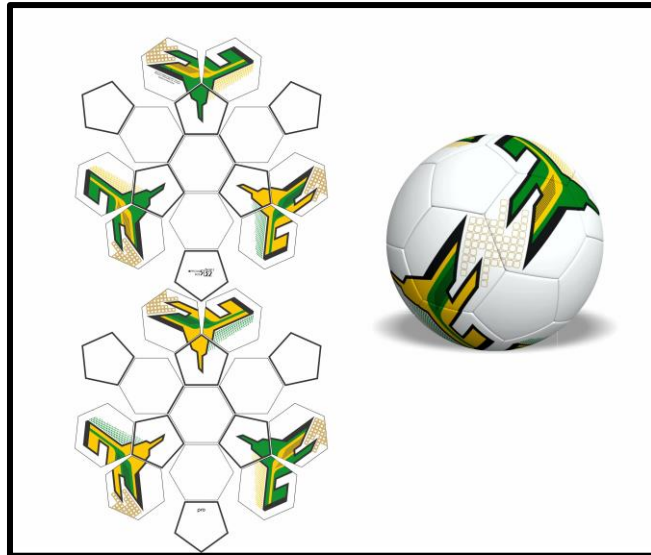


Fig. 1 Design and prototype of football.

#### 2.1.1.2. Material preparation

The procurement and preparation of raw materials, including leather, wood, rubber, and assorted composites, are integral processes. Leather undergoes a series of treatments such as soaking, fleshing, deliming, bating, and tanning. Wood is subjected to cutting, seasoning, and shaping procedures. Sports products are either woven or knitted, while rubber and plastics undergo synthesis or are obtained in pre-made forms. The Fig. 2 illustrates the material preparation process. The energy-intensive machinery utilized for these processes significantly impacts the carbon footprint of the industry.



Fig. 2 Material preparation process.

### 2.1.1.3. Forming and shaping

After the materials have been prepared, they are then shaped into individual components that make up the final product and the machine is illustrated in Fig. 3. For instance, leather intended for footballs is cut into panels, wooden blanks are formed into shapes suitable for cricket bats or hockey sticks, and sports suits are patterned for sportswear. The machinery used in these processes, including hydraulic presses, lathes, and cutting machines, often requires significant energy, especially when heat or high pressure is involved.

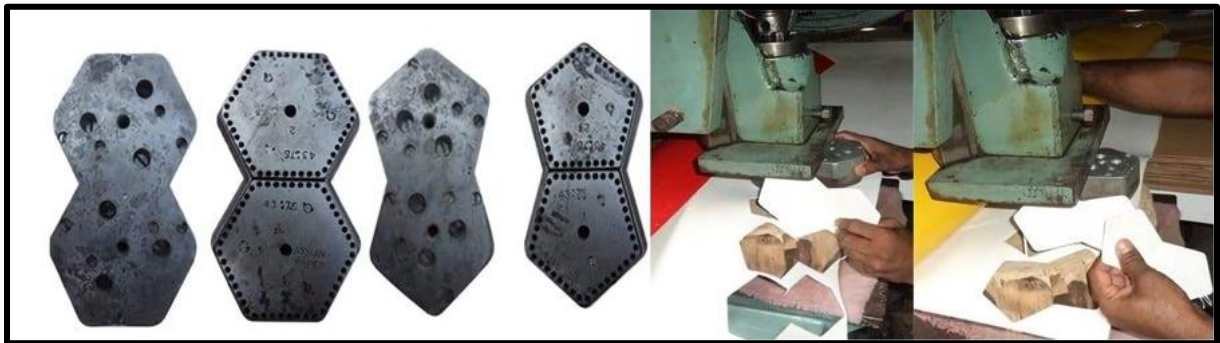


Fig. 3 Forming and shaping process.

### 2.1.1.4. Joining and assembling

The formed components are then assembled to construct the end product. Stitching machines play a vital role in football production, demanding substantial energy. Moreover, hockey sticks may necessitate the use of high-temperature adhesive applicators to bond the handle and blade securely. Crafting sports apparel involves intricate stitching and sewing processes as mentioned in Fig. 4. The energy source in these operations is electricity, predominantly sourced from fossil fuels, thereby resulting in direct CO<sub>2</sub> emissions.



Fig. 4 Football piece joining and assembling.



### 2.1.1.5. Finishing and quality control

The finishing touches encompass branding, typically achieved through methods like heat transfers or printing, as well as varnishing for wooden items, and rigorous quality testing. These procedures commonly require heating or application of pressure, resulting in energy consumption. Quality control measures may also entail the use of automated testing equipment, such as bounce testers for balls or tension testers for apparel, further contributing to electricity usage. In a football industry, the finishing and quality control section is presented in Fig. 5.



Fig. 5 Football finishing and quality control.

### 2.1.2. Analysis of energy-intensive machines and equipment

The detailed analysis of energy intensive machines and equipment are mentioned in the subsections of this section. Therefore, the graphical illustrations are presented in Fig. 6 and Table 1 presents the estimated energy consumption and carbon emissions assessment of different systems and equipment used in the sports industry. Additionally, the graphical illustrations of machines and equipment used in sports apparel industry are presented in Fig. 7 and the estimated energy consumption and carbon emissions of systems and equipment used in the sports apparel industry are presented in Table 2.

#### 2.1.2.1 Lighting Systems

High-intensity lighting systems illuminate nighttime and indoor sports events, requiring a large amount of electricity to ensure visibility for players and spectators.



### **2.1.2.2 Heating and cooling Systems**

The systems provide heating, ventilation, and air conditioning to maintain comfortable temperatures and air quality in large venues, which is crucial for both audience comfort and athlete performance.

### **2.1.2.3 CAD workstations**

CAD software is commonly used and essential for product design, utilizing sophisticated software that demands high-performance computing power. These workstations consume electrical energy during operation. The energy consumption varies based on factors such as workstation specifications and usage patterns, typically ranging between 200 to 500 watts per hour.

### **2.1.2.4 3D printers**

3D printers play a crucial role in prototyping, employing additive manufacturing techniques. They consume electrical energy during the printing process. The energy consumption varies depending on factors like printer type, prototype size, and complexity, with typical rates ranging from 50 to 500 watts per hour.

### **2.1.2.5 Cutting machines**

Cutting machines are employed to shape raw materials like leather, wood, and plastics. These machines consume electrical energy during the cutting process. Energy usage fluctuates based on machine type and size, typically falling between 200 to 800 watts per hour.

### **2.1.2.6 Hydraulic presses**

Hydraulic presses are utilized to shape materials like rubber, plastics, or metals, particularly under high pressure conditions. These presses consume energy during operation. Energy consumption varies based on press size and parameters, typically ranging from 5 to 100 kWh per hour.

### **2.1.2.7 Moulding machines**

Moulding machines, including injection moulding or blow moulding machines, are instrumental in forming plastic components. They consume energy during the moulding process. Energy usage depends on machine size and type, with rates typically ranging from 1 to 50 kWh per hour.

### **2.1.2.8 Stitching machines**

Stitching machines are utilized to join fabric components, vital in sports apparel and equipment production. These machines consume electrical energy during

stitching. Energy consumption varies based on machine type, speed, and efficiency, typically ranging from 50 to 300 watts per hour.

### 2.1.2.9 Adhesive applicators

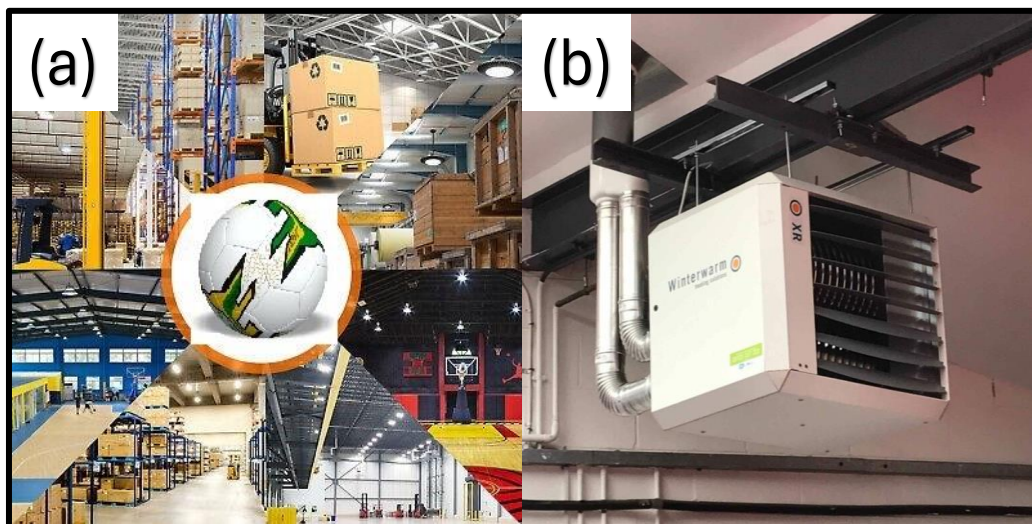
Adhesive applicators, like hot melt glue guns, are employed for bonding components together. These applicators consume electrical energy during use. Energy consumption depends on applicator type and size, typically ranging from 50 to 200 watts per hour.

### 2.1.2.10 Heat transfer machines

Heat transfer machines are utilized for branding or applying graphics to sports goods. They consume electrical energy during heating and pressing operations. Energy consumption varies based on machine size and efficiency, typically ranging from 500 to 2,000 watts per hour.

### 2.1.2.11 Quality testing equipment

Quality testing equipment, such as tension testers or bounce testers, is crucial for evaluating sports goods' performance characteristics. These testers consume electrical energy during testing procedures. Energy consumption varies depending on specific equipment, typically ranging from 50 to 500 watts per hour.



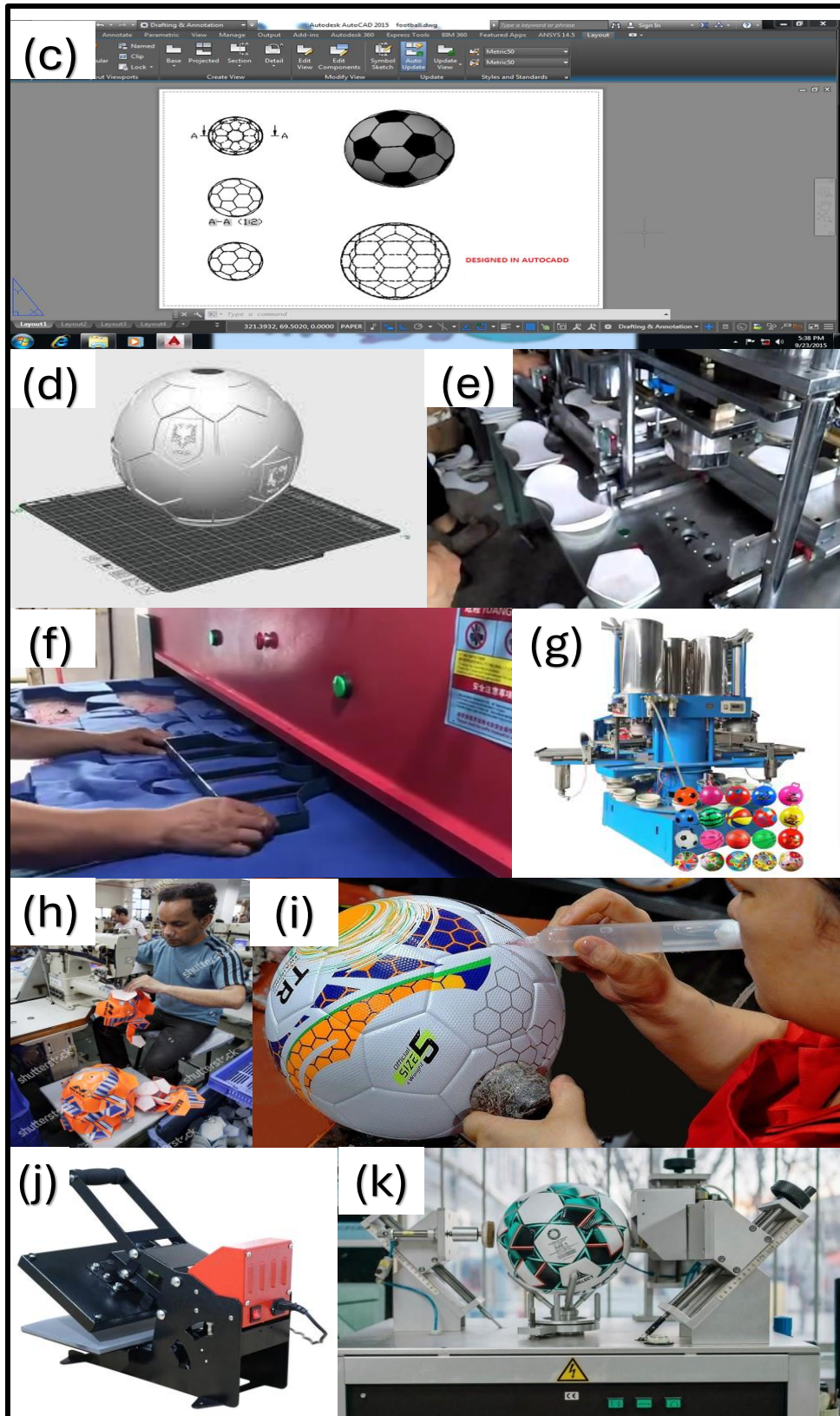


Fig. 6(a) Lighting system in a sports industry, 6(b). Facility heating and cooling system, 6(c) CAD workstations, 6(d) 3D printers, 6(e) Cutting machines, 6(f) Hydraulic presses, 6(g) Moulding machine, 6(h) Stitching machine, 6(i) Adhesive applicator, 6(j) Heat transfer machine, and 6(k) Quality testing equipment.

Table 1 The estimated energy consumption and carbon emissions assessment of different systems and equipment used in the sports industry.

Sr. no.	System/Equipment	Purpose	Typical Energy Consumption	Carbon Emissions (kg CO <sub>2</sub> /hour)
1	Lighting Systems	Illuminate nighttime/indoor sports events	High electricity demand	Varies, typically high
2	Heating and Cooling Systems	Maintain comfortable temperatures and air quality	High electricity demand	Varies, typically high
3	CAD Workstations	Product design using sophisticated software	200-500 watts/hour	0.1-0.25 kg CO <sub>2</sub> /hour
4	3D Printers	Prototyping using additive manufacturing techniques	50-500 watts/hour	0.025-0.25 kg CO <sub>2</sub> /hour
5	Cutting Machines	Shaping raw materials	200-800 watts/hour	0.1-0.4 kg CO <sub>2</sub> /hour
6	Hydraulic Presses	Shaping materials under high pressure	5-100 kWh/hour	2.5-50 kg CO <sub>2</sub> /hour
7	Moulding Machines	Forming plastic components	1-50 kWh/hour	0.5-25 kg CO <sub>2</sub> /hour
8	Stitching Machines	Joining fabric components	50-300 watts/hour	0.025-0.15 kg CO <sub>2</sub> /hour
9	Adhesive Applicators	Bonding components together	50-200 watts/hour	0.025-0.1 kg CO <sub>2</sub> /hour
10	Heat Transfer Machines	Applying graphics/branding to sports goods	500-2,000 watts/hour	0.25-1 kg CO <sub>2</sub> /hour
11	Quality Testing Equipment	Evaluating sports goods' performance	50-500 watts/hour	0.025-0.25 kg CO <sub>2</sub> /hour

#### 2.1.2.12 Fabric Manufacturing Machines in Apparel Sector

Includes looms, knitting machines, and weaving machines that produce fabrics from raw materials, consuming significant energy during the production process.

#### 2.1.2.13 Dyeing and Finishing Equipment in the Apparel Sector

Machines that apply dyes to fabrics and perform finishing processes such as washing, drying, and treating fabrics, require large amounts of water and energy.

#### **2.1.2.14 Sewing Machines in Apparel Sector**

Industrial-grade sewing machines used in garment assembly lines, running continuously to produce clothing on a large scale, consuming electricity throughout their operation.

#### **2.1.2.15 Cutting Machines in Apparel Sector**

Automated equipment designed to cut fabric into patterns before sewing is crucial for efficient and precise apparel manufacturing often requiring substantial power.

#### **2.1.2.16 Pressing and Ironing Equipment in Apparel Sector**

Used to press and iron garments, these machines ensure that clothing is wrinkle-free and properly shaped, operating at high temperatures and consuming significant energy.

#### **2.1.2.17 Embroidery Machines in Apparel Sector**

Machines used to add decorative stitching to garments, often running for long periods to complete detailed designs, demanding consistent electricity.

#### **2.1.2.18 Printing Machines in Apparel Sector**

Equipment such as screen printers and digital printers that apply designs and logos to fabrics, consuming considerable energy during the printing process.

#### **2.1.2.19 Laundry and Dry Cleaning Equipment in Apparel Sector**

Used in the final stages of garment production to wash and finish products, these machines consume large amounts of water and energy to maintain garment quality.

#### **2.1.2.20 Air Conditioning and Ventilation Systems in Factories in Apparel Sector**

Essential for maintaining a safe and comfortable working environment in apparel manufacturing facilities, these systems run continuously and use substantial energy.

#### **2.1.2.21 Energy-Intensive IT Systems in Apparel Sector**

Computers and servers used for designing apparel, managing production, and logistics require constant power, contributing significantly to the overall energy consumption in the apparel sector.



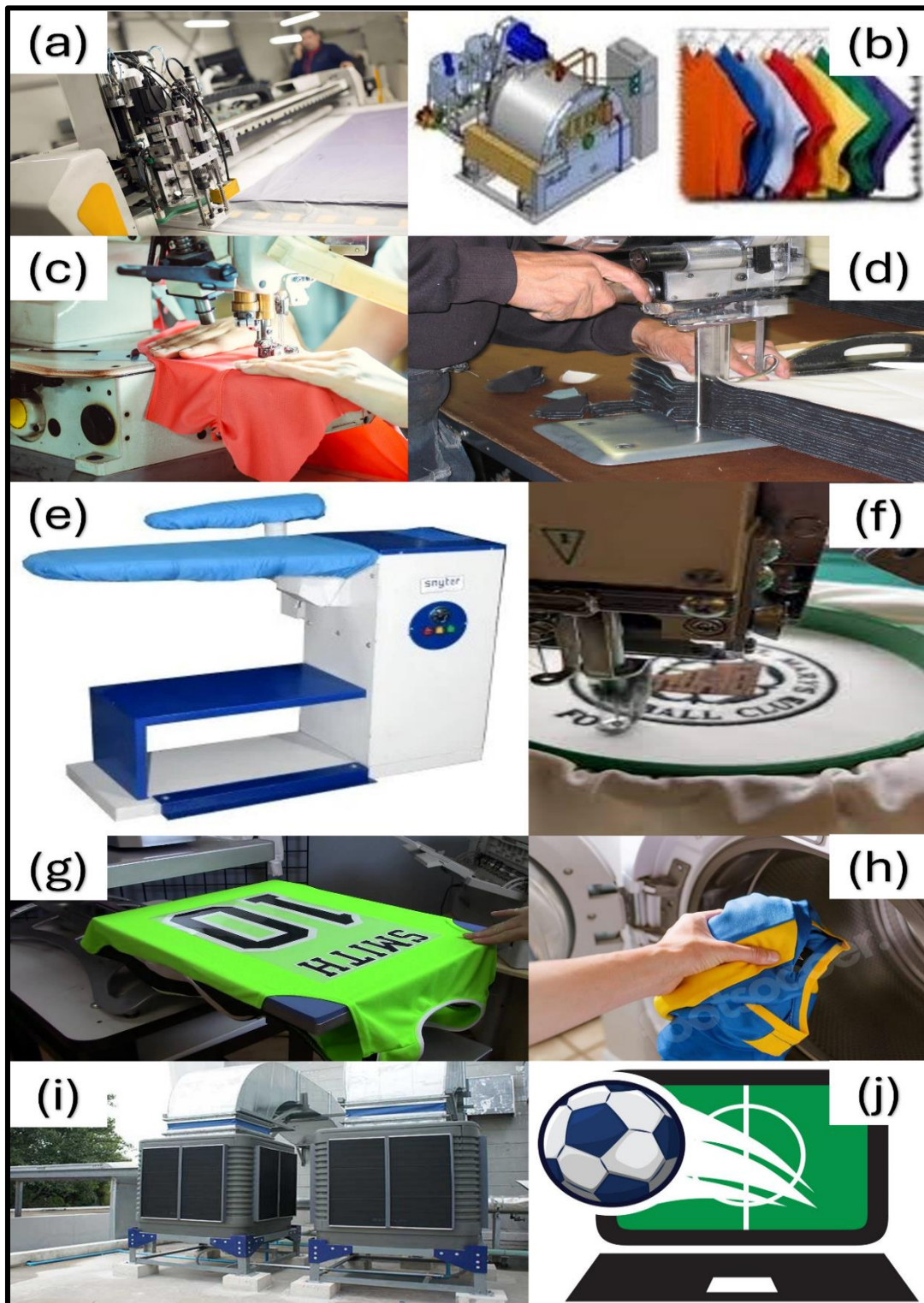


Fig. 7 Process in apparel sector 7(a) Fabric manufacturing machines, 7(b) Dyeing and finishing equipment, 7(c) Sewing machines, 7(d) Cutting Machines, 7(e) Pressing and ironing equipment, 7(f) Embroidery machines, 7(g) Printing machines, 7(h) Laundry and dry-cleaning equipment, 7(i) Air conditioning and ventilation systems in factories, and 7(j) Energy-intensive IT systems.

Table 2 The estimated energy consumption and carbon emissions assessment of different systems and equipment used in the sports apparel industry.

Sr. no.	System/Equipment	Purpose	Typical Energy Consumption	Carbon emissions (kg CO <sub>2</sub> /hour)
1	Fabric Manufacturing Machines	Producing fabrics/kits from raw materials	High electricity demand	Varies, typically high
2	Dyeing and Finishing Equipment	Applying dyes and finishing processes to fabrics	High water and energy demand	Varies, typically high
3	Sewing Machines	Assembling garments in large-scale production lines	Continuous operation, moderate electricity demand	0.1-0.5 kg CO <sub>2</sub> /hour
4	Cutting Machines	Cutting fabric into patterns before sewing	Substantial power requirements	0.2-0.8 kg CO <sub>2</sub> /hour
5	Pressing and Ironing Equipment	Pressing and ironing to ensure proper shape	High temperature operation, significant energy demand	0.5-1.5 kg CO <sub>2</sub> /hour
6	Embroidery Machines	Adding decorative stitching to garments	Continuous operation, consistent electricity demand	0.2-1 kg CO <sub>2</sub> /hour
7	Printing Machines	Applying designs and logos to fabrics	Considerable energy during printing	0.5-2 kg CO <sub>2</sub> /hour
8	Laundry and Dry Cleaning Equipment	Washing and finishing garments	High water and energy demand	Varies, typically high
9	Air Conditioning and Ventilation Systems	Maintaining safe and comfortable working environments	Substantial, continuous energy demand	Varies, typically high
10	Energy-Intensive IT Systems	Designing apparel, managing, and logistics	Constant power requirement	0.1-0.3 kg CO <sub>2</sub> /hour

### **2.2.3. Impact of current practices on CO<sub>2</sub> emissions**

#### **2.2.3.1 Dependence on grid electricity**

As sports manufacturing heavily relies on grid electricity, the emissions factor of the local electricity grid directly influences CO<sub>2</sub> emissions. Transitioning towards renewable sources within the national grid could significantly curb the industry's carbon footprint. For instance, integrating solar or wind power into the grid could offer sustainable alternatives to conventional energy sources.

#### **2.2.3.2 Aging infrastructure**

The presence of aging machinery in sports manufacturing poses dual challenges: increased energy consumption per unit of output and a lack of energy-saving features. By investing in modern, energy-efficient machinery, manufacturers can markedly decrease energy consumption per unit of production. New equipment often comes equipped with energy-saving features like automatic standby modes and operational optimization indicators, which can substantially reduce carbon emissions.

#### **2.2.3.3 Limited implementation of sustainable practices**

Despite growing awareness, the implementation of sustainable practices such as waste recycling, energy recovery from waste heat, and transitioning to renewable energy sources remains restricted in sports manufacturing. Widely adopting these initiatives holds the potential to significantly diminish the industry's carbon footprint. For example, implementing comprehensive recycling programs and installing renewable energy systems within manufacturing facilities could yield substantial environmental benefits.

#### **2.2.3.4 Resource-intensive raw materials**

The procurement and processing of raw materials like leather, wood, and synthetic polymers entail considerable resource usage and contribute significantly to the industry's carbon footprint. Embracing sustainable procurement practices, optimizing material usage, and implementing effective waste management strategies are essential steps to alleviate these environmental impacts. For instance, utilizing recycled materials and investing in sustainable forestry practices can help reduce the environmental footprint of raw material sourcing.

#### **2.2.3.5 Absence of advanced energy management systems**

The absence of advanced energy management systems in sports manufacturing facilities hinders efforts to minimize energy consumption and



carbon emissions. Implementing these systems can optimize energy usage, schedule operations efficiently, and reduce waste. For example, installing smart meters and automated energy control systems can help monitor and regulate energy usage in real-time, leading to significant reductions in carbon emissions.

## **2.3 Policy landscape in Pakistan**

### **2.3.1. Government initiatives and regulations**

Pakistan has implemented various national policies to advance decarbonization efforts and combat climate change. Among these policies is the Pakistan Climate Change Policy, launched in 2012 with a focus on sustainable development and mitigation measures to address climate challenges. Key objectives include reducing greenhouse gas emissions, boosting the share of renewable energy sources, and enhancing climate resilience. Similarly, the National Energy Policy, introduced in 2013, emphasizes diversifying the energy mix by increasing reliance on renewable sources like wind, solar, and hydropower to decrease dependency on fossil fuels and promote cleaner energy technologies. The Green Pakistan Program, initiated in 2017, is another significant initiative aiming to expand forest cover, combat deforestation, and conserve biodiversity, recognizing forests' role in absorbing carbon dioxide and mitigating climate impacts.

To tackle industrial emissions and foster sustainability, Pakistan has enforced the National Environmental Quality Standards (NEQS), setting emission limits for various pollutants, noise levels, and hazardous waste management. Compliance with these standards is mandatory for industries to ensure environmental protection and minimize their contribution to climate change. The implementation of NEQS has led to increased environmental awareness within the industrial sector, driving efforts to meet pollution control benchmarks and reduce hazardous emissions. However, challenges persist, including enforcement issues due to limited resources, corruption, and capacity constraints, resulting in instances of non-compliance by industries. The criticism has arisen regarding the perceived inadequacy of NEQS standards in effectively addressing industrial pollution, prompting calls for more stringent benchmarks. The policy's effectiveness relies on reliable data collection and reporting, with deficiencies in this area potentially undermining enforcement credibility. Additionally, public engagement remains a concern, as greater public participation in decision-making and monitoring processes could enhance NEQS's overall efficacy.

The National Energy Efficiency and Conservation Act, enacted in 2016, provides a framework for promoting energy efficiency in industrial processes, encouraging the adoption of energy-efficient technologies, resource management improvements, and greenhouse gas emissions reduction. This legislation also establishes energy conservation standards and promotes energy audits and awareness programs to enhance energy efficiency practices in industries.

Pakistan's National Climate Change Policy (NCCP) 2012 underscores the importance of promoting cleaner production and energy efficiency in the industrial sector. Specific measures proposed in the Implementation Framework include encouraging the use of cleaner fuels, promoting energy-efficient technologies, and establishing cleaner production centers.

Additionally, the government has introduced policies to incentivize industries to adopt renewable energy, which offered incentives like subsidized energy supply and technological upgrades to enhance output. Despite these efforts, challenges persist in the industrial sector, including energy crises, high production costs, and technological limitations, exacerbated by international competition and changing global trade dynamics like the African Growth and Opportunity Act (AGOA) and the China-Pakistan Economic Corridor (CPEC). While targeted policy interventions for fashion and sports industries remain scarce, indirect support is available through schemes like the Long-Term Financing Facility (LTFF) and the Export Refinance Scheme (ERS), facilitating access to finance for exporters.

### **2.3.2. International commitments and agreements**

International agreements have wielded considerable influence in shaping Pakistan's approaches and policies toward industrial decarbonization. Commitments outlined in the 2016 Paris Agreement, including Nationally Determined Contributions (NDCs), have steered Pakistan's endeavors to curtail greenhouse gas emissions. These accords underscore the imperative of transitioning to low-carbon technologies, advocating for renewable energy adoption, and bolstering energy efficiency across industries.

Pakistan's NDC encompasses tailored targets and actions to mitigate climate change across various sectors, including industry. The NDC delineates precise measures geared toward augmenting energy efficiency, ramping up the proportion of renewable energy sources, and fostering sustainable practices within industries. These initiatives are engineered to trim the carbon footprint of

industrial operations, thereby aligning with both national and global emissions reduction objectives. Moreover, the Paris Agreement accentuates the significance of facilitating technology transfer and capacity-building endeavors to fortify the decarbonization pursuits of developing nations. Moreover, Table 3 presents the government and international commitments of energy transition and decarbonization policies landscape in Pakistan.

Pakistan's domestic policies are harmonized with overarching global sustainability aspirations enshrined in international accords like the Sustainable Development Goals (SDGs) and the Paris Agreement. These policies home in on slashing greenhouse gas emissions, propelling renewable energy integration, fortifying energy efficiency measures, and addressing the impacts of climate change.

Pakistan's initiatives concerning decarbonization and climate change mitigation resonate with numerous SDGs, encompassing Goal 7 (Affordable and Clean Energy), Goal 9 (Industry, Innovation, and Infrastructure), Goal 11 (Sustainable Cities and Communities), Goal 12 (Responsible Consumption and Production), Goal 13 (Climate Action), and Goal 17 (Partnerships for the Goals). By aligning its national policies with the SDGs and the Paris Agreement, Pakistan underscores its dedication to fostering sustainable development while grappling with the multifaceted challenges posed by climate change. These policies prioritize the curtailment of greenhouse gas emissions, the promotion of renewable energy sources, the enhancement of energy efficiency, and the embracement of sustainable practices within industrial realms. Pakistan has charted its own trajectory, setting emission reduction targets and delineating plans to augment the renewable energy share within its energy matrix, all in consonance with global sustainability objectives, thereby attesting to Pakistan's commitment to forging a sustainable and low-carbon future.

Table 3 Government and international commitments of energy transition and decarbonization policies landscape in Pakistan.

Sr. no.	Category	Policy/Initiative	Key Objectives	Challenges/Concerns
1	Government Initiatives and Regulations	Pakistan Climate Change (2012)	Sustainable development, reducing GHG emissions, boosting renewable energy, enhancing climate resilience	Enforcement issues, resource limitations, and capacity constraints leading to non-compliance

2		National Energy Policy (2013)	Diversifying energy mix, increasing reliance on renewables (wind, solar, hydropower)	High production costs, technological limitations, energy crises
3		Green Pakistan Program (2017)	Expanding forest cover, combating deforestation, conserving biodiversity	Resource and capacity constraints in enforcement
4		National Environmental Quality Standards (NEQS)	Setting emission limits, noise control, hazardous waste management	Enforcement issues, criticism over inadequate standards, limited public engagement, and data collection deficiencies
5		National Energy Efficiency and Conservation Act (2016)	Promoting energy efficiency, encouraging adoption of efficient technologies, resource management	Limited implementation and technological adoption due to high costs
6		Incentives for Renewable Energy in Industry	Subsidized energy supply, technological upgrades, facilitating access to finance (e.g., LTFF, ERS)	Limited targeted support for fashion and sports industries, competition from international trade dynamics (AGOA, CPEC)
7		National Climate Change Policy (NCCP) 2012	Cleaner production, energy efficiency in industry, establishment of cleaner production centres	Challenges in implementation and alignment with industry-specific needs
8	International Commitments and Agreements	Paris Agreement (2016)	Reducing GHG emissions, promoting renewable energy, enhancing energy efficiency	Technology transfer and capacity-building needs, aligning domestic policies with international commitments

9	Nationally Determined Contributions (NDCs)	Mitigating climate change in various sectors, including industry, through specific measures and targets	Balancing economic growth with emission reduction targets, ensuring effective implementation
10	Sustainable Development Goals (SDGs)	Achieving global sustainability objectives, including affordable clean energy, climate action, responsible production	Integrating SDGs with national policies, addressing multifaceted climate change challenges, ensuring policy coherence

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## **Chapter 3:**

### **Energy Consumption Landscape: Sports/Apparel Sector**

#### **3.1 Primary data**

**T**he ADS team visited sport/apparel manufacturing industries intending to gather valuable data on their energy consumption and type of energy sources within their industry. Surveyors engaged in-depth discussions with company representatives to document their perspectives on their energy transition strategies, the obstacles they face in implementation of renewable energy adoption, and their recommendations for government policies to encourage this shift. They documented the companies' approaches to moving from conventional fuels to renewable sources, noting challenges such as energy demand, energy mix consumption, financial costs, technical difficulties, and regulatory barriers. Additionally, the representatives provided recommendations for government actions, like offering subsidies, simplifying regulations, and supporting research and development, to encourage the transition. The goal of these discussions is to promote a shift towards renewable energy and reduce carbon emissions while contributing towards environmental sustainability.

#### **3.2 Visits and data collection**

The ADS (Alternate Development Services) team were engaged in multiple surveys to comprehensively understand the decarbonization efforts across different Sports/Apparel industries. In the information-gathering phase, ADS team leverage methodologies such as Key Informant Interviews (KIIs), Focus Group Discussions (FGDs), and a Structured Questionnaire, the ADS team arranged meetings and conducted KIIs with representatives from different sports industries in Faisalabad, which is a hub of sports industry in Pakistan. Those interactions provided a rich information of insights, allowing the ADS team to investigate deeply into the different approaches undertaken by different sports industries towards renewable energy adoption and their overarching

decarbonization goals. Through this diligent documentation, the team was able to conduct the details of these measures, including investment in renewable energy infrastructure to sustainable supply chain practices that aligns industry actions with global decarbonization sustainability goals.

### **3.2.1 Sports/apparel sector**

In Sialkot, the Pakistan Sports Goods Manufacturers and Exporters Association (PSGMEA) is represented by Secretary General Mohsin Masood and Chairman Arshad Latif Butt. Their discussions highlighted the significant challenges faced by the sports industries in adopting sustainable practices. Industries associated with major brands like Nike and Adidas have made substantial progress in transitioning to solar energy, either partially or entirely. However, smaller industries remain largely unaware of the growing international demand for eco-friendly products, despite clients being willing to pay a premium for them.

PSGMEA points out that a lack of outreach and government support exacerbates these challenges. Despite the numerous benefits of solar installations, the absence of incentives is a significant barrier. Consequently, PSGMEA suggests that a portion of the government's fossil fuel investments should be redirected to help industries adopt solar energy solutions. Additionally, the region's geographical constraints limit the feasibility of wind energy, making solar energy the primary viable option. PSGMEA urges the government to provide favorable terms, such as soft loans over 5-7 years, to facilitate the transition to solar energy. The association believes that with proper support, smaller industries can also shift towards sustainable practices, aligning with international standards and meeting the increasing demand for eco-friendly products. In Pakistan, the potential for solar energy is substantial, with an average of about 5-7 kilowatt-hours per square meter per day of solar insolation. Encouraging the sports goods industry in Sialkot to leverage this resource could significantly reduce their carbon footprint and operational costs, promoting a more sustainable future for the sector.

To promote positive change, PSGMEA recommends prioritizing policy research and conducting effective campaigns to raise awareness about the benefits of sustainable practices. However, PSGMEA acknowledges that smaller industries face challenges in obtaining solar loans and green financing from commercial banks, which tend to favor lending to larger corporations. Consequently, PSGMEA advocates linking export performance to the distribution of loans in specific regions.

Additionally, PSGMEA raises concerns about gas distribution, noting that resources are predominantly allocated to large companies rather than being distributed equitably among all industries. PSGMEA is prepared to run awareness campaigns and host seminars to promote sustainable practices. While the association engages in dialogues with the State Bank of Pakistan (SBP), tangible outcomes have been limited thus far.

Despite 90% of small and medium-sized enterprises (SMEs) expressing a willingness to adopt solar energy, the scarcity of available loans significantly impedes their transition. According to the World Bank, SMEs account for 90% of businesses and more than 50% of employment worldwide, highlighting their critical role in sustainable development. PSGMEA underscores the urgency of implementing supportive policies and financial measures to accelerate the widespread adoption of sustainable practices within industries.

Moreover, Pakistan's energy sector faces a significant challenge, with the country experiencing a 4,500 MW energy deficit as of 2023, underscoring the need for renewable energy solutions. PSGMEA emphasizes that equitable resource distribution and accessible financing are essential for the sports goods industry in Sialkot to overcome these hurdles and transition toward a more sustainable future.

The ADS team's visit to Comet Sports Industry in Sialkot, led by Sohail Yaqoob, they discovered a company with a 70-year history specializing in manufacturing footballs, gloves, and apparel. The facility primarily focuses on cutting and stitching finished products, resulting in minimal energy consumption. Currently, they rely on WAPDA electricity and use diesel generators as backup power sources, which helps maintain low greenhouse gas emissions without significant concerns.

Moreover, Sohail Yaqoob mentioned that despite no current plans for solar installation, widespread adoption of solar energy could potentially impact WAPDA's viability, attributing this as a government-imposed hindrance. He suggested that facilitating low-cost solar imports for industries could be a solution to encourage sustainable practices. Additionally, Comet Sports Industry is taking proactive steps towards digitization, aiming to reduce emissions by implementing digital apparel labels. Despite their minimal energy consumption and emissions, Comet Sports Industry remains open to exploring eco-friendly initiatives and fostering collaboration with the ADS team and other relevant stakeholders for the industry's sustainable growth.



The International Energy Agency (IEA) notes that solar energy could meet up to 27% of global electricity needs by 2050, emphasizing the potential impact of widespread solar adoption. Furthermore, digitization in manufacturing can lead to significant energy savings, with studies showing potential reductions in energy use by up to 20% through the adoption of digital technologies. Comet Sports Industry's approach aligns with these global trends, highlighting their commitment to sustainable growth and innovation.

During the ADS team's meeting with Malik Ali, owner of MB Malik in Sialkot, it was revealed that the company currently relies on WAPDA for its electricity needs. While they are contemplating converting to solar energy for their office use, they have not yet taken any concrete steps due to a lack of knowledge about the process and feasibility of such a conversion. Although their industry does not utilize boilers or steamers, resulting in relatively lower energy consumption, they still face significant monthly electricity bills.

To address this, Malik Ali is exploring solar energy as a potential solution to reduce costs and enhance sustainability. The company's interest in solar energy reflects a growing trend among businesses to seek renewable energy sources. According to the International Renewable Energy Agency (IRENA), solar power can significantly cut energy costs and reduce carbon footprints, making it an attractive option for industries with high electricity expenses. By gaining a better understanding of the solar conversion process, MB Malik could lead by example in the local industry, promoting broader adoption of sustainable energy practices.

MB Malik, specializing in cricket bats, balls, and hockey equipment, expressed interest in exploring solar energy as a sustainable option. They voiced disappointment over the lack of government support for transitioning to renewable energy sources but are currently in communication with a solar company. The ADS team discussed potential solutions and offered their expertise to guide MB Malik through the solar adoption process, emphasizing the importance of knowledge-sharing and collaboration with reputable solar providers to ensure a smooth and successful transition.

During the ADS team's visit to Talon Sports in Sialkot, the HR Manager, Nouman, shared valuable insights. Talon Sports utilizes multiple energy sources, including WAPDA electricity, gas, and generators. In winter, when gas availability is limited, they resort to alternative sources like coal, wood, and

agricultural residues such as corn and wheat. However, their shift to solar energy remains constrained due to three primary factors: limited space, the absence of government incentives, and a lack of awareness and commitment to sustainable practices.

Nouman emphasized the need for a government-led campaign to promote solar energy adoption. The facility relies on diesel generators for backup power and uses gas extensively for sewing and processing activities. Talon Sports, known for producing sportswear, activewear, and puffed jackets, faces challenges in embracing modern changes and sustainable practices due to the conventional mindset of some experienced staff members.

The adoption of solar energy in Pakistan could be significantly beneficial, as the country receives ample sunlight, averaging around 5.3 kWh/m<sup>2</sup>/day of solar radiation. Despite this potential, Pakistan's renewable energy share remains low, highlighting the need for increased awareness and government support. Encouraging companies like Talon Sports to transition to solar energy can reduce reliance on fossil fuels and promote sustainability in the industry.

During the ADS team's visit to Awan Sports in Sialkot, the HR Manager informed us that the manager was unavailable, prompting us to explore nearby industries. These industries revealed that they had installed solar panels mainly for office use. According to Ma'am Rehana from Awan Sports, industries collaborating with brands are more conscious of renewable energy and green products. Previously, their primary energy source was WAPDA, supplemented by gas and diesel generators. However, since April 2022, they have successfully converted 50% of their solar energy consumption.

During the ADS team's meeting with Yousaf Nawab Pvt. Ltd in Sialkot, the company's manager revealed that they currently rely on SESCO for electricity and are in the process of obtaining quotes from vendors for solar installation. Operating with two units, the industry uses a 50 kVA unit, and gas is exclusively utilized for the boiler. They have received informal energy-saving advice from Allied Energy Consultant and are considering installing solar panels on their roofs this summer, starting with the office areas and later evaluating the feasibility for the entire industry. They acknowledge that sports machines can be adapted for solar power. The company underscores the need for government subsidies on solar installations for export-oriented industries. Additionally, diesel generators are used as backup power sources. While some work is outsourced,

it is noted that other companies in the sector also predominantly rely on WAPDA for their energy needs.

Despite investigating green energy alternatives, solar power is currently not considered feasible for their operations due to shading from neighboring factories. However, building an additional floor could potentially mitigate this issue and prompt a reevaluation of solar energy options. Athlito World International primarily focuses on producing paddle rackets, specializing in leather stitching. It is noteworthy that only 40-60 factories in Pakistan are involved in paddle racket manufacturing.

In a formal meeting between the ADS team and Athlito World International, owned by Fakhar Javed in Sialkot, in-depth discussions were held about their operations and production processes. Athlito World International, with extensive experience in leather manufacturing and a recent expansion into sports products since 2019, specializes in the production of leather goods and sportswear. Their leather stitching processes are efficiently powered by both WAPDA electricity and UPS systems. In the sports sector, they use pre-package machines, press machines (mold), and boost technology.

To support the sports machinery, the company upgraded its transformer capacity from the 25 kVA initially provided by the government to 100 kVA. For backup power, they rely on a 200 kVA generator, though its operating cost is significantly higher, at approximately 1 lakh per hour. The factory is also equipped with a 10,000-watt heater for various processes.

Pakistan's textile and leather industries, which account for a significant portion of the country's exports, face high energy costs. For instance, leather exports contribute nearly \$1 billion annually to Pakistan's economy. Upgrading energy infrastructure and adopting efficient technologies, as demonstrated by Athlito World International, are essential for maintaining competitiveness and ensuring sustainable growth in these sectors.

During an insightful discussion, the ADS team engaged with the Manager of Active Apparel in Lahore. The manager proudly highlighted the company's significant progress in adopting sustainable practices, with 30% of their operations now powered by solar energy. This achievement underscores their strong commitment to reducing environmental impact and embracing renewable energy solutions.

Looking forward, Active Apparel is determined to further increase the share of solar energy in their energy portfolio. They plan to accomplish this through strategic planning, necessary investments, and a continuous effort to incorporate more solar energy into their operations. By progressively expanding their reliance on clean and renewable energy sources, they aim to set an example of environmental responsibility and contribute to a more sustainable future for both their industry and the planet.

The adoption of solar energy is crucial, especially considering Pakistan's significant solar potential, with average solar insolation levels ranging from 5 to 7 kWh/m<sup>2</sup>/day. As the global textile industry is a major energy consumer, with an estimated 1-1.5% of the world's total energy consumption, Active Apparel's initiative to increase their solar energy usage aligns with global efforts to reduce carbon emissions. Their leadership in sustainable practices can inspire other companies in the region to follow suit, promoting a broader shift towards renewable energy in Pakistan's industrial sector.

### **3.2.2 Associations**

During the interaction with Muhammad Shameel, the Additional Secretary General at the Rawalpindi Chamber of Commerce and Industry (RCCI), the ADS team learned about the Green Chamber's notable achievements, including the successful implementation of a rainwater harvesting system and their commendable plantation drives. Discussions also focused on the ADS team's efforts to promote renewable energy options to industries, despite the challenges involved in implementing such practices. The meeting underscored the Green Chamber's steadfast commitment to fostering environmental consciousness among businesses.

Rainwater harvesting is an increasingly vital practice, especially in water-scarce regions like Pakistan, where per capita water availability has declined to around 860 cubic meters annually, well below the water scarcity threshold of 1,000 cubic meters. Additionally, the RCCI's plantation drives contribute to Pakistan's larger reforestation goals, aligning with the country's "10 billion tree tsunami" initiative, which aims to combat deforestation and environmental degradation. The Green Chamber's proactive approach serves as a model for other chambers of commerce, demonstrating how sustainable practices can be integrated into business operations to benefit both the environment and the economy.

In Sialkot, the ADS team engaged with Salman Mir, the Senior R&D Officer at the Sialkot Chamber of Commerce and Industry (SCCI), to discuss the Innovation Centre of NUST (ICON), established 6-8 months ago. Although the center was inaugurated in August 2022 to foster collaboration between academia and industry, it has yet to produce tangible results, and SCCI has not been kept informed about its progress. The Director of ICON, Mr. Farid, has yet to establish the center as a valuable resource for industry-related data. Furthermore, Mr. Salman expressed his willingness to provide support if required.

During a formal meeting between the ADS team and Rana Muhammad Hammad, the Secretary General of the Multan Chamber of Small Traders and Small Industry (MCSTSI), insightful discussions were held regarding the current state of solar adoption within the small industry sector. It was emphasized that although many small industries aspire to transition to solar energy, the high costs associated with solar installation present a significant barrier, deterring businesses from making the shift. Furthermore, solar energy can only feasibly be used for electric power, while small industries often require biogas for their boilers. The availability and logistics of biogas remain problematic, adding to the challenges faced by these industries.

In Pakistan, the cost of solar energy has been decreasing, yet it still poses a financial challenge for small businesses. The average cost of solar installations ranges from PKR 100,000 to PKR 150,000 per kilowatt, which can be prohibitive for small industries. Moreover, Pakistan's biogas potential is considerable, with an estimated 14 million cubic meters per day, but the infrastructure and distribution networks are underdeveloped. Addressing these issues could facilitate the adoption of both solar and biogas technologies, promoting a more sustainable energy landscape for small industries in the region.

Although the food and packaging industries have made strides in adopting solar energy for self-consumption, a notable observation was that the overall use of solar energy for industrial processes in Multan remains relatively limited. Encouragingly, it was revealed that approximately 60% of small industries have successfully transitioned to solar energy, indicating a positive trend towards sustainable practices. The meeting provided valuable insights into the challenges and progress of solar adoption within the small industry sector, highlighting potential avenues for collaboration and further exploration to promote renewable energy solutions in the region.

Pakistan has significant potential for solar energy, with the country's average solar insolation ranging from 5 to 7 kWh/m<sup>2</sup>/day, making it one of the most promising regions for solar power generation. The shift towards renewable energy in the small industry sector could substantially reduce operational costs and carbon footprints. However, the broader adoption of solar energy requires overcoming financial, logistical, and infrastructural challenges. By addressing these issues, the region could harness its solar potential more effectively, fostering a sustainable industrial landscape.

Our ADS team also engaged in discussion with Rao Dilshad Ali, the Secretary-General of ABPUMA (Multan). During this exchange, Mr. Ali emphasized the critical need for transparent and straightforward communication. He underscored the importance of ensuring that information is easily understandable to prevent unnecessary concern and to ensure that our message reaches and resonates with all stakeholders effectively. Effective communication is crucial in fostering understanding and cooperation among stakeholders. According to studies, clear communication can enhance productivity and mitigate misunderstandings in business environments.

While their primary objective is to advocate for clean energy, Mr. Ali highlighted the importance of framing this within a practical cost-benefit analysis. He pointed out that Pakistan's energy demand has decreased significantly due to the closure of numerous industries. Capitalizing on this scenario, he emphasized the government's responsibility in facilitating accessible solar financing options for both commercial and residential sectors. By implementing these measures, he believes we can lower electricity bills and advance toward universal access to clean energy.

In Pakistan, the demand for electricity has fluctuated, with significant impacts on the economy and industrial operations. Initiatives promoting renewable energy adoption could help stabilize energy costs and reduce dependence on fossil fuels. As of recent estimates, renewable energy sources, including solar power, have the potential to significantly contribute to Pakistan's energy mix and economic resilience.

During a recent discussion with the ADS team, Muhammad Ayub, Secretary North Zone of PHMA, Lahore, emphasized significant barriers hindering widespread adoption of renewable energy sources. He pinpointed these challenges as primarily centered around the economic viability and production costs of renewable energy technologies. Mr. Ayub stressed the critical

importance of ensuring that renewable energy solutions are economically feasible and capable of meeting energy demands to integrate effectively into the global energy landscape.

To overcome these obstacles, Mr. Ayub advocated for strategic investments in research and development to drive technological advancements in renewable energy. He also underscored the necessity of establishing supportive policies that incentivize businesses to transition towards cleaner and more sustainable energy solutions. By addressing these challenges comprehensively, he believes that we can pave the way towards a greener and more environmentally conscious energy future.

In Pakistan, renewable energy sources such as solar and wind hold substantial potential. Solar energy alone receives about 5 to 7 kilowatt-hours of solar radiation per square meter per day on average, making it a viable option for energy generation. However, the cost of solar energy installations remains a significant consideration for industries and households alike, necessitating targeted policies and investments to promote their widespread adoption.

### **3.2.3 Academic sector**

In a formal discussion, the ADS team met with Dr. Amir Abbas Shirazi, Principal of the Climate Change and Environmental Energy College at BZU, Multan. During our conversation, Dr. Shirazi emphasized the crucial role of finding effective solutions to the energy crisis in fostering the progressive growth of nations, particularly Pakistan. He expressed concerns about the significant disruptions that have affected Pakistan's energy mix, leading to uncertainties about the optimal utilization of various energy sources such as hydel, nuclear, coal, and furnace oil. Dr. Shirazi also highlighted Pakistan's limited presence in the Australian market, where competitors from Bangladesh and India overshadow the 'Made in Pakistan' label due to the country's constrained purchasing power, hindering its global competitiveness.

Furthermore, Dr. Shirazi pointed out that owners of sports factories predominantly depend on gas-powered plants, highlighting the critical need for a reliable energy supply at affordable rates. The discussion concluded with Dr. Shirazi emphasizing the unanimous demand from industrialists for affordable energy coupled with uninterrupted supply to strengthen Pakistan's industrial sector.

In an enlightening discussion, the ADS team engaged with Dr. Muhammad Dawood, an Assistant Professor specializing in Environmental Science and Toxicology. Dr. Dawood expressed concern about the significant gap between the formulation and implementation of climate change policies in Pakistan.

Pakistan faces substantial energy challenges, including issues with supply reliability and affordability. The country's energy consumption is projected to increase significantly in the coming years, driven by economic growth and industrial expansion. Addressing these challenges effectively requires coordinated efforts in policy formulation and implementation to ensure sustainable and reliable energy access for industries and households alike.

Despite Pakistan's commitment to combating climate change, Dr. Dawood expressed deep concern over the significant gap between policy intentions and practical implementation, which hampers efforts to mitigate climate change impacts effectively. He stressed the urgent need for Pakistani policymakers to prioritize the effective execution of climate change strategies. Dr. Dawood underscored that achieving this goal requires active participation and cooperation from governmental entities, regulatory bodies, research institutions, and the public at large. He advocated for fostering a culture of accountability and responsibility to bridge the existing gap between policy formulation and tangible action.

Furthermore, Dr. Dawood emphasized the importance of policymakers understanding the multifaceted nature of climate change, its implications across various sectors, and the interconnected challenges it presents, including air pollution, water scarcity, and environmental hazards. He highlighted the need for an integrated approach to address these complex issues successfully.

Dr. Malik also highlighted the challenges of water scarcity faced by industry, stressing the urgency of addressing these concerns. With extensive networks and partnerships across industrial centers like Faisalabad, Dr. Malik assured readiness to engage stakeholders in addressing critical energy and water issues affecting the sports sector.

Pakistan faces significant environmental challenges, including water scarcity and pollution, exacerbated by climate change impacts. The country's efforts to address these issues require robust policies and effective implementation strategies to achieve sustainable development goals and mitigate environmental risks. According to recent data, Pakistan's water availability per



capita has dropped significantly over the years, now estimated at around 1,000 cubic meters per person per year, indicating water stress conditions. This underscores the urgency of addressing water management issues in industrial sectors like sports manufacturing to ensure sustainable growth and environmental stewardship.

The main aims were to conduct practical research with collaboration with academic institutes that could influence policymakers in socio-economic development. It also strengthens its work by forming strong partnerships with other respected institutions involved in environmental research. By creating courses that blend different fields of study and conducting thorough research, the center plans to connect policymakers with academic experts. This approach aims to build trust and cooperation between these groups. Ultimately, the center is dedicated to making a meaningful impact by promoting sustainable practices and improving environmental conditions in the area.

### **3.3 Analysis**

A comprehensive analysis was conducted to scrutinize primary data gathered from Faisalabad's sports and apparel sector, focusing on current practices and sustainability initiatives. The data collection utilized a multifaceted approach, including focal group discussions, key informant interviews from industry leaders, and detailed questionnaires distributed among stakeholders. These methods ensured a diverse range of inputs and perspectives, providing a robust dataset to deepen our understanding of the efforts towards decarbonization within sports and apparel industries.

The questionnaire and the entirety of the collected data are accessible in Appendix A, facilitating transparency and accessibility for further study and reference. In the subsequent sections, we meticulously analyze and interpret this primary data to extract key insights and implications. This thorough examination offers a holistic view of the present landscape of Pakistan's sports sector, shedding light on both challenges and opportunities in advancing sustainable practices and environmental stewardship.

The primary energy mix comprises a diverse type of sources. Grid electricity dominates the landscape with 41% symbolizing the backbone of existing power infrastructure. However, natural gas follows closely at 24% enrol as a versatile and widely utilized fuel. Solar energy contributes 13% which reflects a growing trend towards renewable energy transition. Moreover, biogas 1% and diesel 3% as well as crop waste, coal, and firewood contribute 0%. Other sources

contribute 18% which play persistent role and observed as biomass or blended fuel utilization in sports industry. Moreover, the energy landscape is predominantly shaped by grid electricity consisting over 72%. Secondly, natural gas follows with nearly 10%, indicating its significant contribution to the energy mix. Crop waste, solar energy, and other renewables emerge as promising players, collectively making up almost 10%, 9%, and 8%, respectively. Although biogas, coal, diesel and firewood hold no share almost negligible. The detailed assessment of primary energy sources and percentage share of energy sources are illustrated in Fig. 8.

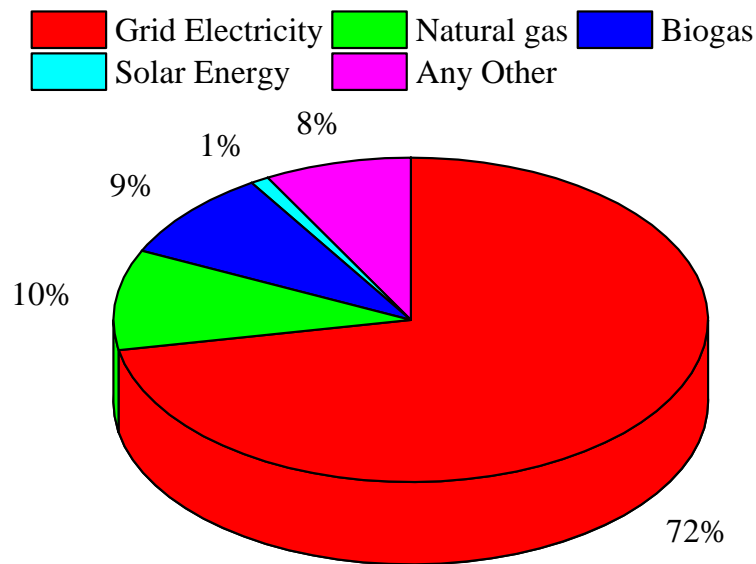


Fig. 8(a) Primary energy sources, (b) Percentage (%) share of energy sources.

The sports industries face severe energy shortfall, ranging up to 50%. Approximately 69% experience a shortfall between 1-25%, while around 29% face a shortfall between 26-50%. A small fraction, about 0.5%, grapple with a shortfall of 51-75%. Fortunately, no respondents report facing an energy shortfall of 76-100%. Moreover, Industries are interested in alternate sources or renewable sources, collectively 39% of existing sport industries are relying partially or specifically on alternate/renewable sources, and 61% are not on any other alternatives energy sources but most of them were interested and shows their willingness if government provide incentives/subsidies. The initiatives taken by production facilities in sports industries to reduce grid-powered electricity consumption. After multiple brief surveys and the representatives' responses, ADS team become to know the big initiative at 50% of industries were agreed by the "Reduce, Reuse, Recycle". However, solar system, biogas, combined and heat and power 0%, while installation of Energy Efficient Systems 25% and other type of initiatives are taken by 25% of the sports

industries. The detailed assessment of percentage of energy shortfall and specific initiatives to reduce grid electricity are presented in Fig. 9.

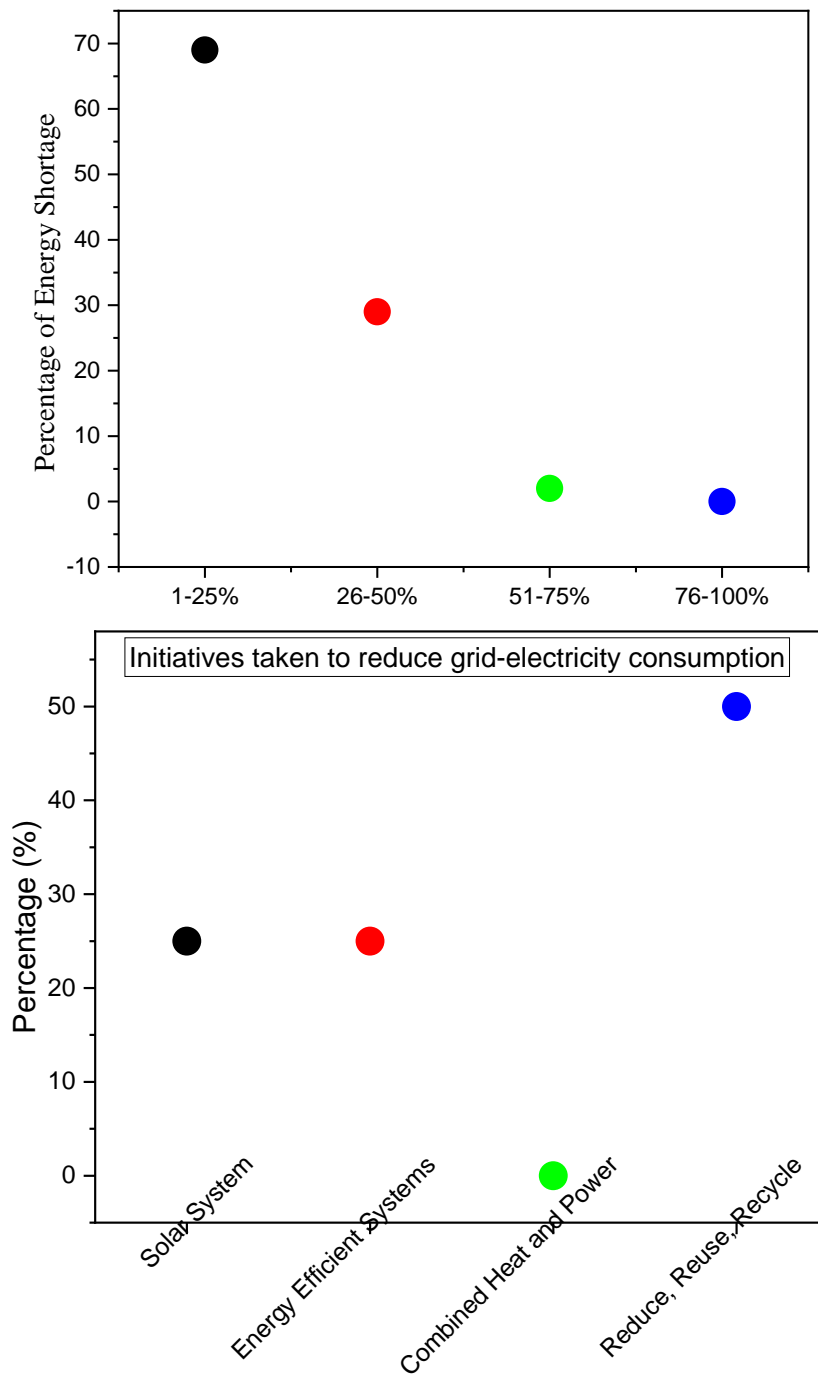


Fig. 9(a) Percentage (%) of energy shortfall, (b) Specific initiatives to reduce grid electricity.

The results indicate that a vast majority about 92% of the respondents have not undertaken an energy audit of their production processes to explore energy-saving opportunities through renewable energy systems. Only 4% of respondents have completed such audits, suggesting a limited proactive

approach to integrating renewable energy solutions into production processes. Another 4% indicated uncertainty or lack of knowledge regarding whether an energy audit has been conducted. These findings are highlighted in the Table 4 that entails the undertaken energy audit processes to identify potential energy savings opportunity. Furthermore, these results present a significant gap in awareness or action towards leveraging renewable energy for efficiency gains in the sports industrial settings as well as indicating no proceedings for cost savings and environmental benefits.

Table 4 Energy audit processes to identify energy savings opportunities.

Yes	No	No idea
4%	92%	4%

The Fig. 10(a) revealed that out of the total respondents, only 1 anonymous person answered "Yes," indicating they have conducted carbon footprint assessment, while all other respondents answered "No" most likely 95% of them and 4% respondents did not provide any information. This data highlights a significant gap in environmental consciousness and actions in sports industry, as the vast majority of respondents have not assessed their carbon footprint. This lack of engagement and negligence entails the need of carbon footprint assessment criteria and greater awareness/education about the importance of measuring and reducing carbon emissions to mitigate environmental impact.

The Fig. 10(b) covered carbon capture and storage role play in individuals' company decarbonization strategy, showed that 91% respondents had "No Idea" about its role, indicating a significant lack of awareness and only 2% representatives reported that it plays a "Major role," reflecting minimal but it existed into company's strategies.

Fig. 10(c) exhibits about the awareness of the Carbon Border Adjustment Mechanism (CBAM). The ADS conduct a brief survey, it revealed that 0% of respondents answered "Yes," this result was shocking no one knew about CBAM. A significant 81% of respondents answered "No," demonstrating a lack of knowledge and indicate no awareness about CBAM, while 19% indicated "No idea," further highlighting a considerable gap in awareness and understanding of this important policy tool among the sports sectors.

Any changes or plans to your supply chain to incorporate renewable energy sources (REs) to reduce carbon emissions are revealed that none of the respondents (0%) have implemented significant changes to their supply chains

to reduce carbon emissions. Additionally, none (0%) have started planning and evaluating potential changes. A substantial majority, 72%, answered "No," indicating they have not made any changes or plans regarding their supply chain to incorporate REs. Meanwhile, 28% responded with "No idea," suggesting a lack of awareness or understanding about integrating renewable energy sources into their supply chain strategies.

The targets to reduce carbon emissions surveyed revealed that 1% of respondents have established targets to reduce carbon emissions, indicating a very low level of proactive engagement. Meanwhile, 60% of respondents answered "No," signifying that the majority have not set any targets for carbon reduction. Additionally, 39% responded with "No idea," reflecting a substantial portion of respondents who are either unaware of the importance of setting such targets or lack the necessary information to do so.

The sustainable packaging materials to reduce your carbon footprint played a significant role and our ADS team revealed that 69% of respondents are using sustainable packaging materials, indicating a strong commitment among the majority to reduce their carbon footprint through packaging choices. However, 14% of respondents answered "No," showing that a smaller segment has yet to adopt sustainable packaging practices. Additionally, 17% of respondents indicated "No idea," suggesting a lack of awareness or understanding of sustainable packaging materials and their impact on carbon emissions. This data underscores a significant majority taking proactive steps toward sustainability, while also highlighting areas for increased education and adoption of eco-friendly packaging solutions. However, the detailed assessment of carbon footprint assessment, carbon capture and storage in company decarbonization strategy, Carbon Border Adjustment Mechanism awareness, Changes or plans to incorporate REs to reduce carbon emissions, targets to reduce carbon emissions, and sustainable packaging materials to reduce lower carbon footprint are presented in Fig. 10.

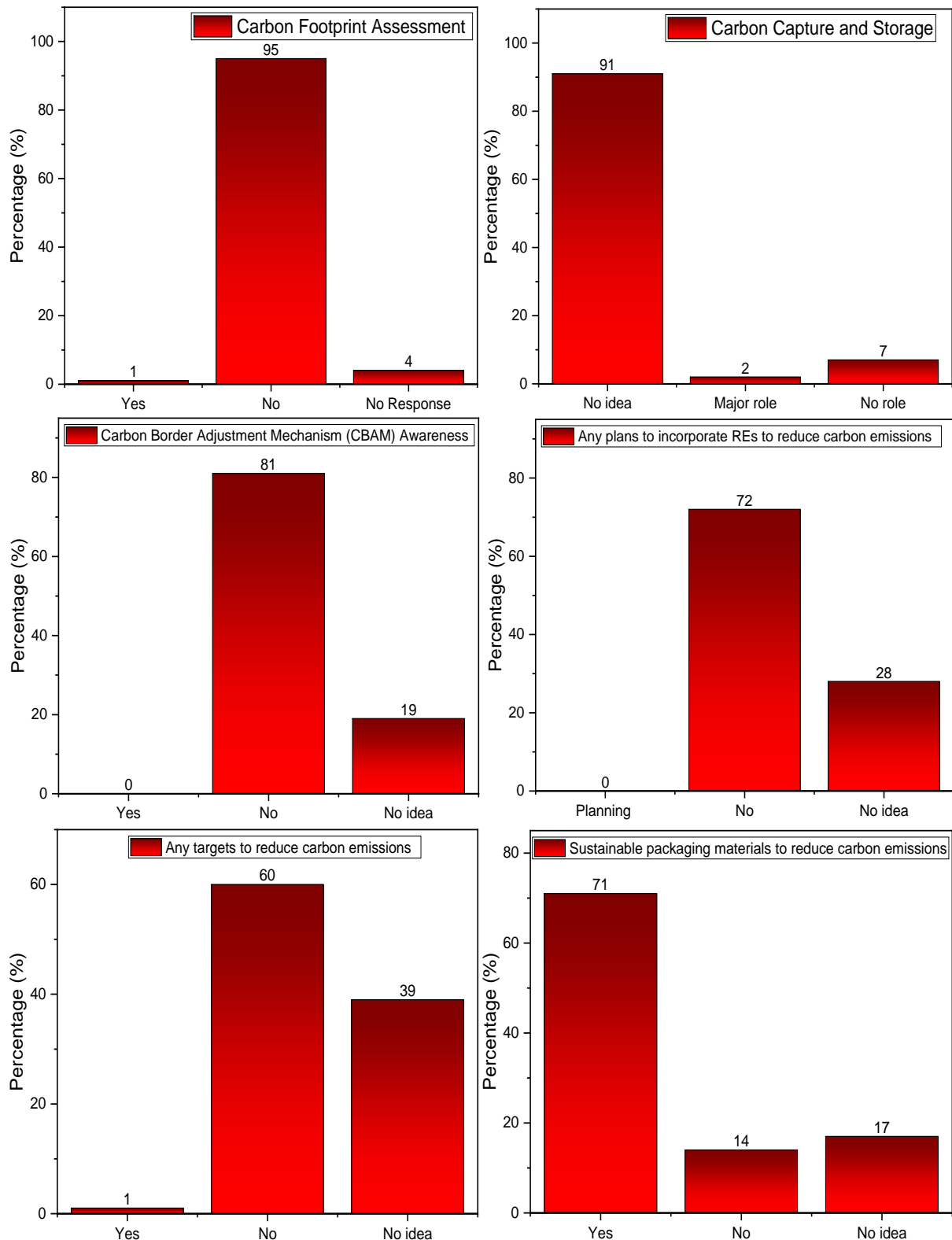


Fig. 10 (a) Carbon footprint assessment, (b) Carbon capture and storage in company decarbonization strategy, (c) Carbon Border Adjustment Mechanism (CBAM) awareness, (d) Changes or plans to incorporate REs to reduce carbon emissions, and (e) Targets to reduce carbon emissions, (f) Sustainable packaging materials to reduce lower carbon footprint.

The ADS team specifically look at the concerns about the familiarity with another international business condition and revealed that the only 2% of respondents answered "Yes," indicating a very small number of individuals who are aware of additional international business conditions. An overwhelming 91% answered "No," demonstrating that the vast majority do not have familiarity with other international business conditions. Additionally, 7% responded with "No idea," showing a small segment of respondents have lack of knowledge.

The international assistance to decarbonize the industry, the respondents (0%) answered "Yes," indicating a complete lack of awareness or knowledge about international assistance programs aimed at helping industries reduce their carbon emissions. All respondents (100%) answered "No," showing the absence of information.

The ADS team's survey about cost reduction in terms of environmental sustainability revealed that only 6% of respondents answered "Yes," indicating a small fraction who have successfully reduced costs through sustainable practices. Meanwhile, 70% answered "No," suggesting that the majority have not realized any cost savings from their environmental sustainability efforts. Additionally, 24% responded with "No idea," reflecting a significant portion of respondents who are uncertain or unaware of whether their sustainability measures have led to cost reductions.

The national/international conditionalities about 6% of respondents answered "Yes," indicating a small fraction who align their cost reduction efforts with national or international conditionalities. In contrast, a significant 70% answered "No," suggesting that the majority do not align their cost reduction strategies with any external guidelines or requirements. Additionally, 24% responded with "No idea," reflecting a notable portion of respondents have lack of knowledge about their cost reduction efforts adhere to national or international conditionalities. Therefore, a detailed illustration of the scenario is presented in Fig. 11. It briefly entails the familiar with any international business condition, any idea of international assistance to decarbonize industry, cost reduction in terms of environmental sustainability and align with national/international conditionalities.

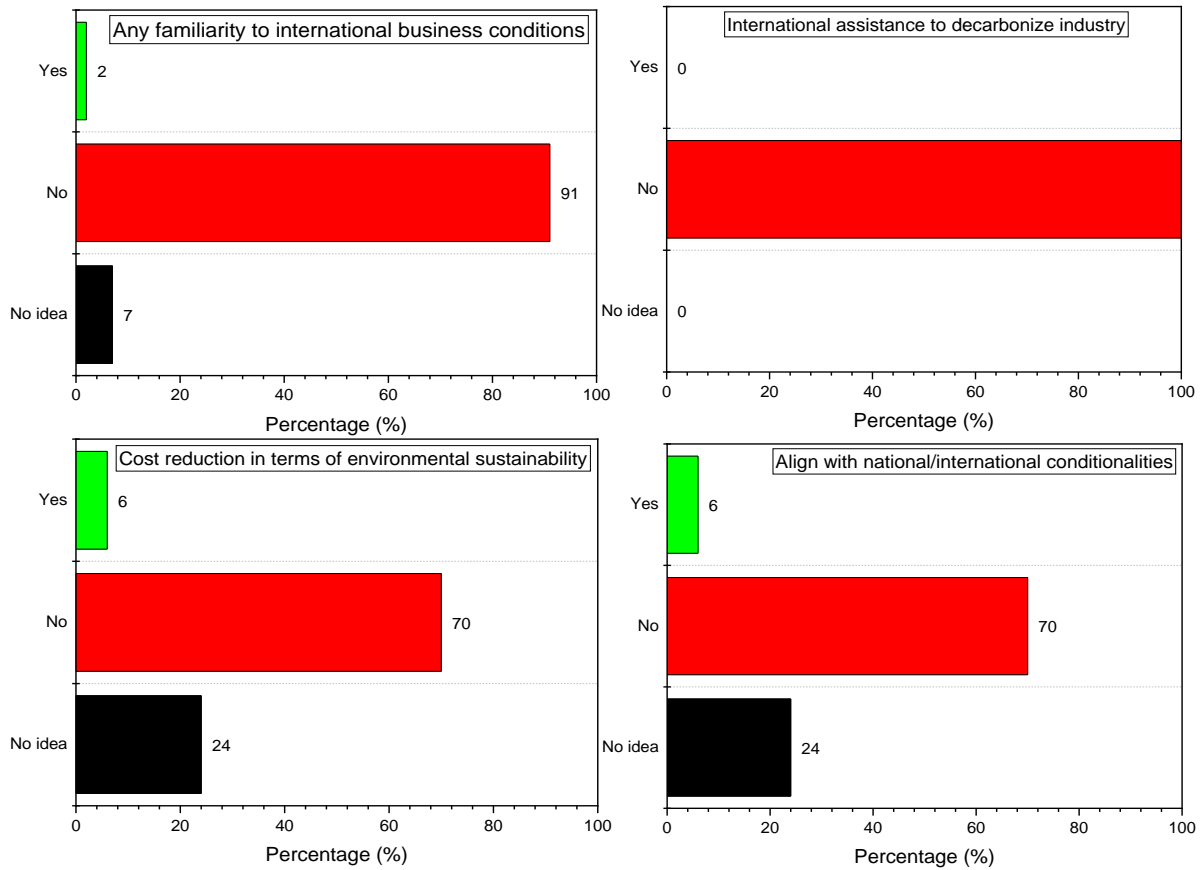


Fig. 11 (a) Familiar international business condition, (b) Any idea of international assistance to decarbonize industry, (c) Cost reduction in terms of environmental sustainability and (d) Align with national/international conditionalities.

An energy audit of your production processes to identify potential energy-saving opportunities through the installation of renewable energy systems discovered 4 respondents (4%) have conducted such an audit, indicating a small minority who have actively pursued energy-saving opportunities through renewable energy installations. Conversely, a substantial 92% of respondents answered "No," suggesting that the majority had not undertaken an energy audit for this purpose. Additionally, 4 respondents (4%) indicated "No idea," reflecting a minor portion of respondents who are uncertain or lack awareness regarding whether an energy audit has been conducted in their production processes.

The survey on roles regarding tariffs in product markets highlighted that 53% of respondents believe tariffs affect export potential, indicating a predominant concern about how tariffs impact the ability to export products. Additionally, 33% of respondents feel tariffs affect market competitiveness, underscoring the significance of tariffs in shaping market dynamics. Only 11% believe tariffs affect growth potential, suggesting a lesser focus on the role of tariffs in driving overall business expansion. Merely 1% of respondents perceive tariffs as affecting



market competitiveness, and 2% attribute other roles to tariffs. Overall, these responses emphasize the multifaceted impact of tariffs on export potential, market dynamics, and competitiveness, signaling the complex considerations businesses must navigate in response to tariff policies. Moreover, Fig 12 exhibits a detailed analysis of Energy audit and the role of tariffs in product markets.

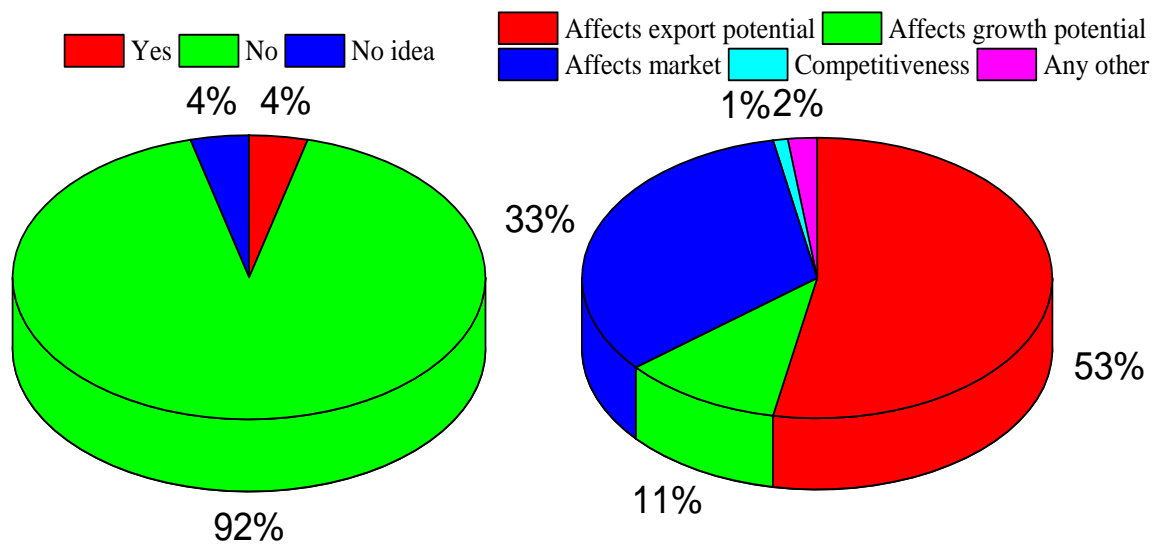


Fig. 12 (a) Energy audit, (b) Role on tariffs in product markets

The survey on waste management initiatives indicates a significant 72% of respondents have opted for collaboration with recycling facilities, indicating a prevailing strategy of outsourcing waste management to specialized entities. Additionally, 13% of respondents have chosen to outsource waste management from another plant, suggesting a reliance on external sources for waste disposal. Only a minimal percentage of respondents, 1% each, have implemented the use of biodegradable or paper-based materials, adopted reduce, reuse, and recycle practices, or installed in-built recycling facilities. Another 10% attribute other methods to their waste management strategies. These findings are highlighted in Fig. 13(a), and these are predominantly reliance on external recycling facilities among respondents, while also indicating a variety of approaches to waste management.

The role of recycling in cost reduction and environmental sustainability strategies exhibited in the survey that a significant majority, 71% of respondents, view recycling as an opportunity to earn income through selling recyclable materials, highlighting its dual benefit of both environmental and financial gain. Surprisingly, no respondents reported using recycling to reduce fines from regulatory bodies like the EPA. However, 27% indicated that they don't focus on recycling, suggesting a notable segment that may not prioritize recycling within their sustainability strategies. Additionally, a small percentage, 1%, stated they are planning to implement a recycling program, while another

1% view waste materials as a value addition component, showcasing alternative perspectives on integrating recycling into their business practices. These findings underscore the diverse ways in which organizations approach recycling within their cost reduction and sustainability and briefly presented in Fig. 13(b).

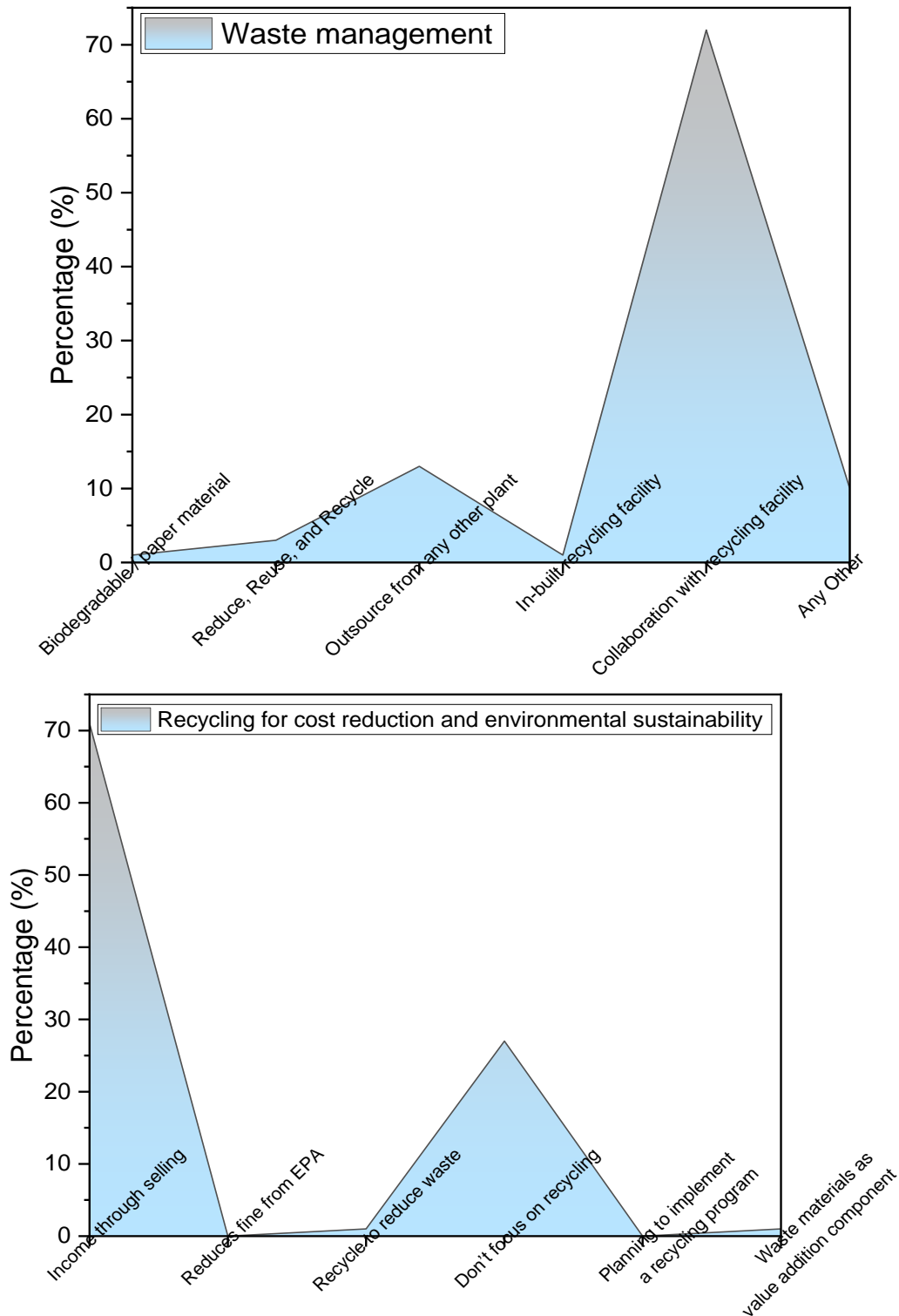


Fig. 13 (a) Waste management (b) Recycling for cost reduction and environmental sustainability.

The ADS team conducted a survey on renewable energy and found that 98% of respondents revealed positive impacts from renewable energy (RE), anticipating benefits such as reduced emissions, lower costs, and enhanced sustainability. Conversely, a mere 2% anticipate negative effects, likely due to concerns about challenges in transitioning to RE. These results show a general consensus on the favorable outcomes of integrating RE, indicating its growing recognition and adoption as 98% are in favour of positive change.

The collaboration with external organizations or partners to implement renewable energy (RE) energy efficiency measures showed that a mere 5% of respondents are engaged in such partnerships. This suggests a limited involvement of organizations in collaborating with external entities to enhance their renewable energy initiatives. Conversely, a significant majority, comprising 93% of respondents, reported no involvement in partnerships for RE energy efficiency measures, indicating a prevailing trend of self-reliance or internal focus on renewable energy initiatives. Additionally, 2% expressed uncertainty or lack of awareness regarding any partnerships for RE energy efficiency measures. These findings highlight a potential area for increased collaboration and knowledge-sharing among organizations to accelerate the adoption of renewable energy and improve energy efficiency measures across various sectors.

The survey results regarding government policies and incentives that facilitate transitions to renewable energy (RE) demonstrate a strong preference for grants and subsidies, with 67% of respondents highlighting their importance. This indicates a belief in the effectiveness of financial support from governments to incentivize RE adoption. Moreover, tax credits and research & development initiatives each received 2% of the responses, suggesting a modest interest in these policies. Net metering, which enables individuals to sell excess renewable energy back to the grid, was noted by 27% of respondents, indicating recognition of its potential benefits. Additionally, 2% of respondents mentioned "any other" policies not specified in the survey, implying a diversity of perspectives on government interventions that could facilitate RE transitions. These findings are indicated briefly in Fig. 14 and these entail the significance of financial incentives and supportive policies in driving the transition to renewable energy sources.

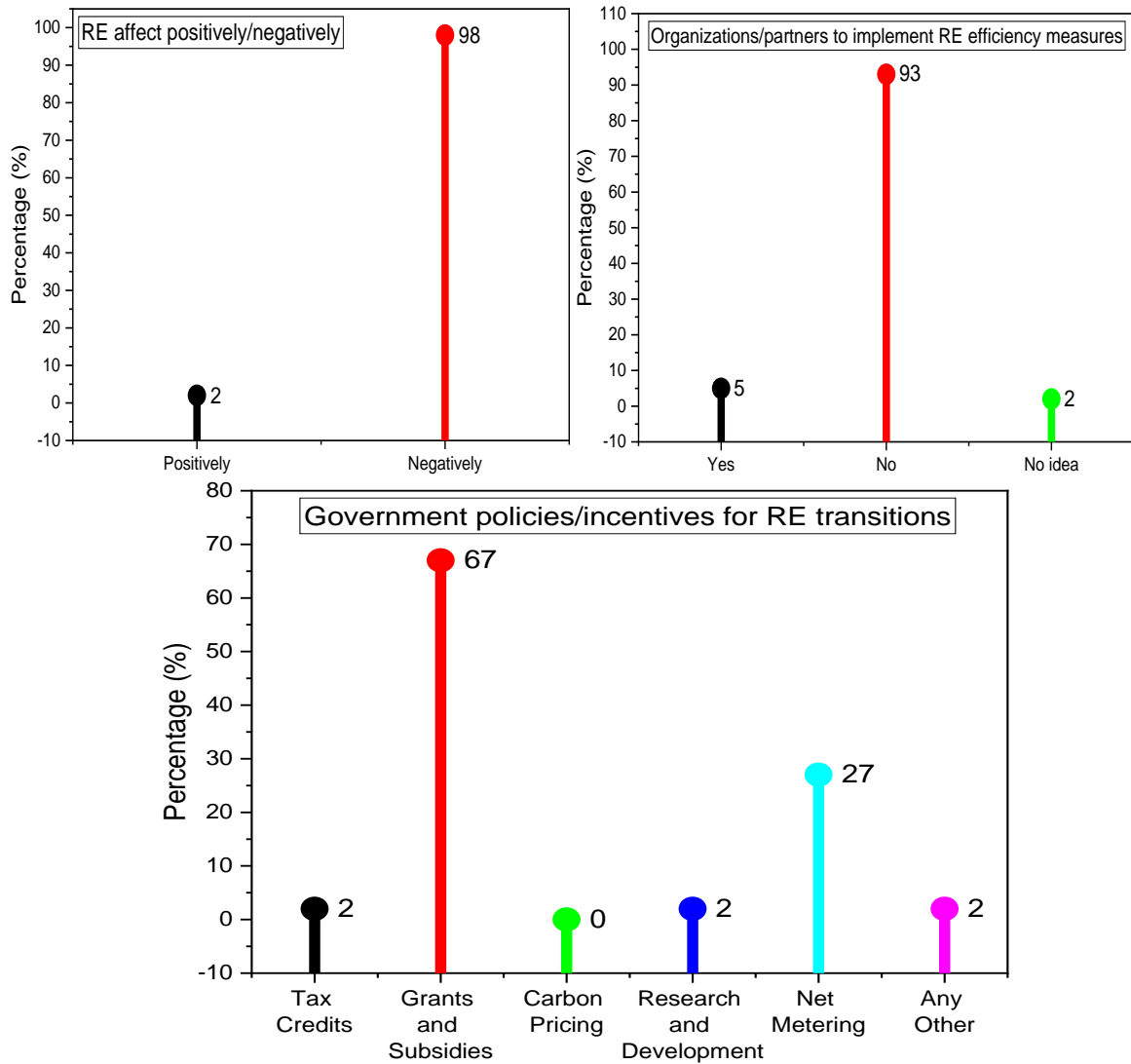


Fig. 14 (a) RE affect positively/negatively, (b) Organizations/partners to implement RE efficiency measures, and (c) Government policies/ incentives helpful for RE transitions.

### 3.4 Kils and Case studies

**Jackal Sports** cooperated in a detailed key informant interview regarding their energy practices and sustainability efforts, several key insights emerge. Firstly, the company currently consumes between 25 to 30 kW of electricity, primarily sourced from the grid with a small percentage (5%) from natural gas. They choose these sources due to their accessibility, despite recognizing the environmental constraints and higher costs associated with grid electricity. During energy shortages, they rely on petrol-powered generators, indicating vulnerability to fluctuations in energy availability.

Regarding renewable energy adoption, Jackal Sports is considering transitioning to solar energy to mitigate costs and environmental impact. However, upfront investment remains a barrier. They have not yet engaged in

partnerships for energy efficiency or renewable integration, nor have they conducted a carbon footprint assessment, citing low emissions from their operations. The company acknowledges the potential benefits of renewable energy, such as cost savings and business development, but faces challenges such as high initial costs and inadequate government support.

Regarding regulatory frameworks, Jackal Sports identifies government responsibility for imposing rules aimed at reducing carbon emissions but notes challenges with policy implementation and regulatory support. They express a need for governmental incentives like subsidies or tax credits to facilitate a more widespread adoption of renewable energy solutions.

In short Jackal Sports recognizes the importance of transitioning towards sustainable practices, including renewable energy adoption and waste management, they currently face barriers such as financial constraints and limited governmental support. They advocate for more accessible renewable energy solutions and supportive policies to enhance their sustainability efforts and mitigate operational costs effectively.

**Alik Sports** is a prominent sports manufacturing company in the sports industry of Sialkot, Pakistan, primarily utilizes grid electricity, natural gas, diesel, and recently installed solar panels for its operations. The company's energy strategy involves using grid electricity for manufacturing, natural gas for boilers, diesel for backup power during grid outages, and solar panels for office and packing units. The recent installation of solar panels, costing approximately 2.22 lakh rupees, aims to reduce dependency on grid electricity and mitigate costs associated with energy consumption.

Regarding energy shortages, Alik Sports relies on diesel generators during power cuts to ensure uninterrupted operations. The company views solar panels as a viable alternative during off-peak hours and power outages, underscoring their commitment to sustainability and cost efficiency.

While Alik Sports has taken steps to reduce grid dependency through solar adoption, they have not engaged in partnerships for energy efficiency or renewable energy projects. The company has not conducted a carbon footprint assessment or set specific carbon reduction targets. Furthermore, they are not currently familiar with international environmental regulations such as the Carbon Border Adjustment Mechanism (CBAM) or other global business conditions impacting their operations.

In terms of future plans, Alik Sports intends to expand solar energy use to their production area once costs decrease further. They believe that enhancing renewable energy adoption could yield substantial cost savings and environmental benefits, aligning with broader national and international sustainability goals.

Furthermore, Alik Sports faces challenges typical of Pakistani industries, including high tariffs and costs associated with energy. They emphasize the need for government support in the form of subsidies, tax incentives, and improved infrastructure to facilitate a smoother transition to renewable energy sources like solar power. This summary summarizes Alik Sports' current energy practices, challenges, and aspirations, highlighting their journey towards greater sustainability amidst operational and economic realities in Pakistan.

**Aries Sports** as a significant player in the sports industry of Sialkot, Pakistan, operates with a peak energy consumption of around 40 kW, primarily relying on grid electricity and natural gas. The company has expressed intentions to transition to solar energy to reduce costs and move towards green energy, although initial high costs delayed their adoption until now. They foresee solar energy as a pivotal solution to enhance energy independence and reduce their carbon footprint. During times of energy shortages, Aries Sports resorts to diesel generators as backup, highlighting their proactive approach to ensure operational continuity despite challenges in the grid supply. However, the company has not yet engaged in partnerships with external organizations to enhance energy efficiency or renewable energy adoption, reflecting their independent approach thus far.

Aries Sports has not conducted a formal carbon footprint assessment or set specific targets for reducing carbon emissions. They are also unfamiliar with international regulatory frameworks like the Carbon Border Adjustment Mechanism (CBAM) and have not explored technologies for carbon capture and storage.

Looking forward, Aries Sports plans to install solar panels on their factory roof to generate clean electricity, aiming to significantly reduce dependence on the grid. They believe this move will positively impact their operational costs and environmental sustainability efforts. However, the company faces challenges typical of Pakistani industries, including high tariffs and limited government support for renewable energy initiatives.

Aries Sports acknowledges the potential benefits of renewable energy adoption but currently faces financial and regulatory barriers. They advocate for government subsidies to facilitate broader adoption of solar systems, suggesting a pivotal role for policy support in accelerating the transition to sustainable energy practices within their industry.

**King 4 Ring Sports** major focused in manufacturing sports uniforms, which involves significant energy usage due to the operation of sublimation machines and heat transfer beds. Their factory operates with an electricity load ranging from 30 to 40 kilowatts, highlighting their reliance on conventional energy sources like natural gas and petrol. The sports industry, broadly tackling, utilizes a variety of materials in its products, ranging from wood and fiber to plastics and leather. Regarding energy sources, King 4 Ring Sports primarily relies on natural gas for electricity and petrol for backup generators. While they have considered transitioning to solar energy by installing solar panels, high initial costs have been a deterrent thus far.

In terms of energy efficiency, King 4 Ring Sports has implemented measures such as using energy-efficient motors with sewing machines and employing steam press systems instead of electric irons. These steps have been taken to reduce their electricity bills and improve operational efficiency. The company has not engaged in partnerships with external organizations to enhance energy efficiency or renewable energy adoption. They have also not conducted a carbon footprint assessment nor set specific targets to reduce carbon emissions. This indicates a lack of focus on environmental sustainability measures within their current operational framework.

Regarding regulatory frameworks, King 4 Ring Sports is unfamiliar with initiatives such as the Carbon Border Adjustment Mechanism (CBAM) and international environmental regulations. They have expressed reservations about the financial viability of renewable energy investments, citing challenges such as high upfront costs and inadequate policy support from the government.

While King 4 Ring Sports admits the potential benefits of renewable energy adoption, including cost savings and environmental sustainability, they currently face significant barriers in terms of cost and policy support. Their stance reflects broader challenges within Pakistani industries, where high tariffs and limited governmental incentives hinder the transition to sustainable energy practices. They recommend that policymakers consider subsidies and more favourable

net metering policies to facilitate a smoother transition to renewable energy sources within the industry.

**Gold Sublimation** has electricity consumption of 40 kW, primarily relies on grid electricity due to the high energy demands of their sublimation printing processes, which require temperatures between 240 to 250 degrees Celsius. The owner, Mr. Mohammed Yousuf, expressed interest in transitioning to solar energy to mitigate high electricity costs, which significantly impact their production expenses. This sports industry, including sublimation printing, predominantly uses grid electricity due to its reliability and consistent voltage, which is crucial for maintaining the operational efficiency of their equipment. Mr. Yousuf highlighted that while solar energy is appealing, the variability of solar power output poses challenges for their specific operational needs, particularly affecting the performance of heat transfer beds.

Regarding environmental impact and carbon footprint assessment, Gold Sublimation has not conducted any formal assessments, citing negligible environmental impact from their operations. They have expressed limited awareness of technologies for carbon capture and storage, indicating a lack of engagement with advanced environmental sustainability measures.

The company faces significant challenges in adopting renewable energy practices, including high initial costs of solar installations, lack of governmental support or incentives, and uncertainty about investment returns. Mr. Yousuf criticized net metering policies, which he perceives as unfavourable to businesses investing in solar energy due to high unit prices charged by the government for electricity.

Gold Sublimation has not set specific targets for carbon emissions reduction nor implemented comprehensive waste management practices beyond basic recycling efforts. They lack partnerships with external organizations or collaborations aimed at enhancing energy efficiency or adopting renewable energy solutions within their operations.

Furthermore, Mr. Yousuf sees potential benefits in transitioning to renewable energy, such as cost savings and environmental benefits, the practical challenges and financial barriers currently limit their ability to make significant changes. He recommends that the government standardize solar panel prices to facilitate broader adoption among businesses, suggesting this could



stimulate economic growth and enhance global competitiveness for Pakistani industries.

**Micah Corp** operates with an energy consumption of 30 kW to 35 kW, primarily sourced from grid electricity (about 95%), with the remainder from LPG (Liquefied Petroleum Gas) and petrol. These alternative sources are used to run specific equipment such as boilers and generators, particularly during periods of energy shortages.

The sports industry, including Micah Corp, is beginning to explore renewable energy solutions like solar power as a response to high electricity prices and intermittent supply issues in Pakistan. However, the high initial costs of solar installations remain a significant barrier, delaying their adoption of alternative energy sources. They have no current partnerships with external organizations focused on enhancing energy efficiency or promoting renewable energy within Micah Corp. The company has not conducted a formal carbon footprint assessment, citing minimal environmental impact from their operations and a lack of industry-wide awareness or regulatory pressure.

Despite recognizing the importance of environmental sustainability and carbon footprint reduction, Micah Corp has not set specific targets or implemented comprehensive waste management practices beyond basic recycling efforts. They face challenges in implementing renewable energy practices due to high costs, limited financing options, and inadequate government support or policy frameworks.

Micah Corp acknowledges the benefits of transitioning to renewable energy for cost savings and environmental sustainability, practical barriers such as high initial investment costs and regulatory challenges hinder their progress. They recommend government initiatives such as tax incentives and public awareness campaigns to facilitate a smoother transition to renewable energy within the industry, potentially fostering economic growth and environmental stewardship in Pakistan.

**John Soni Sports** operates with a relatively modest energy consumption of approximately 10 kW, primarily sourced from grid electricity (90%) and supplemented by LPG (Liquefied Petroleum Gas) and petrol for specific needs such as heating and backup power generation. The use of LPG is favored due to its cleaner burning properties compared to other fuels. There is a notable absence of renewable or alternative energy sources in their current operations,

with the company relying solely on grid electricity. Despite recognizing the potential benefits of reducing dependency on grid power, no concrete steps have been taken yet to integrate renewable energy solutions into their facility.

John Soni Sports faces challenges typical of small enterprises in transitioning to renewable energy, including high upfront costs, limited access to financing, and insufficient government support or policy frameworks. These barriers hinder their ability to adopt sustainable practices effectively. This company has not conducted a carbon footprint assessment nor implemented specific waste management or recycling practices beyond basic operational needs. Regulatory awareness and compliance regarding carbon emissions reduction and sustainability goals are also lacking.

John Soni Sports admits the importance of cost reduction and environmental sustainability, they currently lack the resources and governmental support necessary to implement renewable energy solutions and enhance their environmental stewardship. They suggest that government initiatives such as subsidies or grants for solar installations could facilitate a smoother transition to cleaner energy sources, potentially benefiting both their business operations and the environment.

**Rajpoot Group of Companies** entails a detailed view of their energy practices and challenges in the interview. The company's total energy consumption is around 10 KW, primarily sourced from grid electricity and LPG used for their steam iron press boiler. Their trend analysis highlights the shift towards energy-saving technologies such as LED lights and energy saver motors. Additionally, there is a notable interest in solar energy systems to reduce reliance on the grid, emphasizing the potential for daytime electricity generation through solar panels.

Regarding renewable energy, Rajpoot Group has not yet implemented significant changes. They have no existing partnerships with external organizations for energy efficiency or renewable energy initiatives. They also have not conducted a carbon footprint assessment or engaged in carbon capture technologies. However, they are aware of global standards and regulatory discussions, such as the Carbon Border Adjustment Mechanism (CBAM), and are prepared to seek necessary certifications if required by their customers. Despite this, there is a lack of concrete planning or established targets for carbon emission reductions, leaving the company in the initial stages of understanding and preparation for environmental regulations and goals.

Energy costs constitute about 20% of their production expenses, making it a significant factor in their operational strategy. They face challenges with high electricity tariffs, which impact their competitiveness in the international market. Rajpoot Group advocates for government support, including tax credits, grants, and subsidies, to facilitate the adoption of renewable energy. They are also exploring the idea of installing solar panels and are open to government-provided loans and environmental awareness programs to enhance their transition to cleaner energy sources. Despite their efforts to implement sustainable practices, such as using eco-friendly packaging materials, the company currently lacks comprehensive waste management and recycling programs, with minimal reuse of scrap materials.

Rajpoot Group is at a nascent stage in its journey towards sustainability. They acknowledge the importance of renewable energy and environmental compliance but require further support and guidance to overcome barriers such as high costs, lack of technical expertise, and insufficient governmental support. The company's future plans include exploring solar energy and seeking governmental aid to enhance their sustainability initiatives, aiming to align with international standards and improve their environmental footprint.

**Matrix Industries** is a company deeply rooted in the sports industry, leveraging significant energy resources for its operations. Currently utilizing approximately 50 kW of energy, Matrix Industries reflects a typical energy profile within the sector. The sports industry, broadly speaking, encompasses a diverse array of energy consumption practices, ranging from traditional grid electricity to alternative sources like solar panels and combustible oils such as natural gas and LPG. This diversity in energy sources is driven by the specific requirements of various manufacturing processes and operational needs across different sports product lines.

Regarding energy management strategies, Matrix Industries has been proactive in exploring alternatives to grid electricity. The adoption of natural LPG steam irons over electric ones exemplifies this trend towards more cost-effective and efficient energy solutions. This shift not only reduces dependency on traditional energy grids but also aligns with global trends favoring renewable and sustainable energy sources. Furthermore, the company has expressed interest in integrating solar energy into its operations, recognizing the long-term benefits of cost savings and reduced environmental impact associated with renewable energy technologies.

While Matrix Industries has not yet engaged in formal partnerships with external organizations specifically focused on energy efficiency or renewable energy, the company remains open to collaborations that could enhance its sustainability efforts. As the sports industry increasingly faces scrutiny over its environmental footprint, particularly concerning carbon emissions, Matrix Industries is exploring options for conducting a comprehensive carbon footprint assessment. This step underscores its commitment to environmental stewardship and aligns with international standards and initiatives aimed at reducing carbon emissions.

Looking ahead, Matrix Industries acknowledges the potential impact of regulatory measures such as the Carbon Border Adjustment Mechanism (CBAM), demonstrating readiness to comply with emerging global standards. This proactive stance reflects the company's recognition of the importance of environmental sustainability in shaping future business strategies and ensuring competitiveness in international markets.

In this interview, Matrix Industries exemplifies a forward-thinking approach within the sports industry, balancing operational efficiency with environmental responsibility. As the company continues to explore renewable energy options and potential collaborations, it positions itself strategically to adapt to evolving regulatory landscapes and consumer expectations centered on sustainability.

**Dekin Sports** allocated in Sialkot, Pakistan and faces challenges due to high energy costs and intermittent supply from the national grid. Currently, the industry consumes approximately 30 to 40 KW of energy daily, primarily sourced from the grid, natural gas (NG), and newly installed solar panels. The decision to adopt these sources is driven by cost-effectiveness and the desire for greater energy independence, especially given the favorable solar conditions in Pakistan for seven months annually.

The integration of solar panels has significantly reduced power-related disruptions and enhanced overall efficiency in Dekin Sports' manufacturing operations. However, the industry lacks a systematic approach to track or mitigate its carbon footprint, reflecting a general absence of specific targets or policies for emissions reduction. While there are no current partnerships with external organizations aimed at enhancing energy efficiency or renewable energy adoption, the company is aware of the potential benefits of technologies like carbon capture and storage, albeit without concrete plans for implementation.

Regarding regulatory frameworks, there's limited awareness and engagement with international agreements like the Paris Agreement or mechanisms such as the Carbon Border Adjustment Mechanism (CBAM). The lack of supportive policies and financial incentives from the government poses challenges for broader renewable energy adoption within the industry. Despite these obstacles, Dekin Sports acknowledges the importance of transitioning to renewable energy sources to reduce operational costs and align with global sustainability goals.

While Dekin Sports has made strides by adopting solar energy, there remains untapped potential for further integrating renewable energy technologies and establishing clearer environmental sustainability practices within the Pakistani sports manufacturing sector. The company emphasizes the need for government support in simplifying trade policies and enhancing incentives to accelerate the industry's transition to renewable energy, thereby improving competitiveness and sustainability on a global scale.

**Interactive session:** The interactive session was conducted in a “seminar and report launch” event that was organized at Pakistan Sports Goods Manufacturers and Exporters Association, PSGMEA Hall at Sialkot. The seminar was attended by over 70 participants, including sports associations heads, sports and apparel industrialists, Sialkot chamber of commerce and industry members, surgical instruments association members, solar companies' representatives, and industry professionals from diverse educational backgrounds such as energy systems, environmental studies, climate change, and environmental from Sialkot the sports hub of Pakistan. The ADS team organized an interactive session, and the questions and answers in this session are presented as follows:

The first question by Ms. Marium: how is the sports industry currently addressing the implementation of environmental laws and regulations, particularly in the context of decarbonization and sustainable growth?

Mr. Arshad Latif butt responded to the question in detail and entails the sports industry is gradually recognizing its role in addressing environmental concerns. There is an increasing focus on implementing and enforcing environmental laws and regulations within the sector to contribute to decarbonization and sustainable growth. Potential policy reforms are being explored to ensure that the industry aligns with global sustainability goals. These reforms could include incentivizing eco-friendly practices, reducing carbon footprints during events,

and promoting the use of renewable energy sources in sports facilities. However, significant challenges remain, such as the initial costs of adopting greener technologies and ensuring compliance across various stakeholders.

The second question by Mr. Adnan Yousaf was: could you explain how the concept of the ecological footprint relates to the sports industry?

This question was responded by Mr. Butt in a way, he replied the ecological footprint is a crucial metric that quantifies the amount of land and water area required to produce the resources it consumes and to absorb its wastes. It serves as a measure of humanity's demand on Earth's ecosystems. The sports industries global consumption is very low, less than 1% of Pakistan's total emissions, meaning that we are using less resources than the other industries regenerate carbon emissions. This leads to an ecological deficit, which contributes to the global sustainability crisis. If this trend continues, it could result in severe consequences, including resource depletion, loss of biodiversity, and increased environmental degradation, ultimately compromising the ability of future generations to meet their needs.

The next question was from Mr. Rafi Soni: what are the main challenges faced by the textile industry in Punjab, and how do these challenges impact its competitiveness in the international market?

Mr. Arshad responded, the sports industry in Sialkot faces significant challenges, particularly due to the ongoing energy crisis, energy shortages, and governance issues. Moreover, the increasing competition in the international export market is exacerbated by a lack of governmental support for transitioning to solar energy for continuous production. The government discourages the adoption of solar energy in industries because it has already invested heavily in high-cost electricity and prefers industries to utilize this existing resource (electricity from national grid). This reluctance to support solar adoption puts the industry at a disadvantage compared to international competitors who are embracing more sustainable and cost-effective energy solutions. Additionally, Mr. Amjad Nazeer discussed the interest of industrialists in the Competitive Trading Bilateral Contract Market (CTBCM) and energy privatization, alongside criticisms of the Special Investment Facilitation Council (SIFC) for its ineffective functioning and hindrance to sports industrial activities.

The next question by Ms. Zain ul Abideen was: what climate-friendly and sustainable energy solutions were discussed for sports production and supply chain facilities?

The response from Mr. Butt was, the sport industry associations are concerned about the climate-friendly and sustainable energy solutions for production and supply chain facilities. He mentioned about the existing energy landscape and technical considerations within sports industry with example like, Industry participants gained insights into the practical integration of energy-efficient systems, such as the use of renewable energy sources like solar power, optimizing building orientation for passive solar energy, and enhancing natural ventilation. These strategies are important for reducing energy consumption, lowering greenhouse gas emissions, and promoting sustainability in the construction and operation of buildings. He emphasized the importance of adopting these solutions to achieve long-term energy efficiency and environmental benefits.

The next question was from Mr. Harron: how can the sports industry reduce its environmental impact through advancements in air-conditioning technologies? Mr. Butt responded and highlighted the significant role of air-conditioning technologies in the food and beverage industry, particularly for refrigeration and food storage. Conventional vapor compression systems, commonly used in this sector, are energy-intensive and contribute to high greenhouse gas emissions. To reduce the environmental impact, the session proposed alternative, energy-efficient technologies such as evaporative and desiccant air-conditioning systems. These technologies offer a more sustainable solution by lowering energy consumption and minimizing emissions of harmful substances like chlorofluorocarbons (CFCs). Additionally, he discussed the broader potential for industrial decarbonization through technological advancements, underscoring the need for continuous innovation to achieve sustainability goals in this sector. The next question was from Ms. Malik Sarfraz: what were the key challenges discussed in the implementation of NEPRA's Competitive Trading Bilateral Contract Market (CTBCM) initiative?

Mr. Amjad responded and provided an overview of the challenges in implementing NEPRA's Competitive Trading Bilateral Contract Market (CTBCM) initiative. He discussed one of the main issues is the difficulty in transitioning to a privatized energy market, particularly given the existing regulatory and infrastructural limitations. He explained the potential role of these policies in promoting decarbonization, though it was noted that the practical application of CTBCM faces hurdles such as resistance from stakeholders and the need for more robust policy frameworks. Despite these challenges, Mr. Amjad emphasized that successful implementation could significantly

contribute to reducing carbon emissions and promoting a more sustainable energy sector in Pakistan.

The next question was from Mr. Javed Ranjha: how did the national energy politics to climate change, climate finance, etc. affect the sports industrial benefits?

Mr. Samson Iqbal responded by emphasizing the critical connection between national energy policies and climate finance, especially in addressing the challenges the sports industry faces due to climate change. He highlighted how the industry is increasingly vulnerable to climate-related impacts, such as extreme weather events that disrupt sports activities and damage infrastructure. Mr. Iqbal criticized policies that have historically prioritized fossil fuel expansion, noting that such policies have indirectly harmed industries like sports. He advocated for a more balanced approach to climate finance, ensuring that sufficient support is provided to mitigate the adverse effects of climate change on the sports industry and to promote sustainable practices within it.



## **Chapter 4:**

### **Discussion and Policy Recommendations**

#### **4.1. Barriers of industrial decarbonization**

**T**he barriers encountered in Pakistan's sports/apparel sector in adopting renewable energy and reducing carbon emissions are crucial that connected with ground scenarios and the transition to sustainable practices. These barriers range from economic benefits, technical implementations, governance, and regulatory issues. The following points outline the main barriers comes in the progress towards a green renewable energy sports sector in Pakistan:

- Limited awareness among industry stakeholders about sustainable practices and their benefits. Therefore, the high initial costs associated with adopting green technologies and making necessary upgrades.
- Lack of comprehensive governmental policies and support to drive decarbonization efforts.
- Dependence on fossil fuels due to inadequate renewable energy infrastructure.
- Insufficient number of skilled professionals with expertise in green technologies.
- Weak market demand for environmentally friendly sports products and services.
- Challenges in sourcing sustainable materials within the existing supply chain.
- Economic pressures prioritizing immediate profitability over long-term sustainability investments. Additionally, the cultural resistance and reluctance to change traditional manufacturing and operational practices.
- Insufficient investment in research and development for innovative green solutions.

#### **4.2. Challenges of industrial decarbonization**

In a similar vein, this section aims to present a detailed exploration of the formidable hurdles encountered by these industries in their pursuit of decarbonization. This section is predicated upon the candid revelations shared

by personnel from each industry, thus providing an authentic snapshot of the current landscape of impediments. Here, we elucidate the manifold barriers stymying the transition towards sustainability and highlight the necessity for pragmatic solutions to overcome these systemic roadblocks. By doing so, we hope to facilitate a deeper understanding of the unique complexities faced by each industry and pave the way for targeted, effective strategies to expedite their decarbonization journeys. Industries were surveyed to gauge the challenges encountered in the implementation of renewable energy within their production processes. A noteworthy majority (53.3%, or eight out of fifteen industries) acknowledged facing hurdles, highlighting the pervasive impediments in transitioning towards sustainable energy practices. Conversely, a meager percentage (6.67%) reported a smooth integration of renewable energy, indicating the potential for seamless adoption under specific circumstances. In contrast, a substantial 40% of industries admitted to never having considered incorporating renewable energy, exposing an untapped avenue for potential sustainability enhancements. Notably, the prevalence of this sentiment in the sports equipment sector surpasses that of the sport industry, attributed to the comparatively lower emissions in the sports equipment manufacturing process.

However, when considering the entire manufacturing lifecycle, the sports equipment sector exhibits heightened emissions, necessitating a proactive embrace of renewable energy solutions to address its ecological impact. These findings accentuate the urgency for tailored strategies to overcome obstacles and foster sustainable transformations within industries.

Continuing the inquiry into barriers to decarbonization and energy transition within industries, the data was amassed through a comprehensive multiple-response question, allowing for a detailed assessment of prevailing challenges. Strikingly, several industries reported a lack of perceived technological challenges or uncertain returns on investments (both at 0%). However, two industries (13.33%) identified a lack of supportive policy frameworks as a formidable obstacle, underscoring the imperative for robust regulatory support to drive sustainable initiatives. In addition, three industries (20%) cited inadequate access to financing options as a significant challenge, emphasizing the need for accessible financial mechanisms to facilitate decarbonization efforts. Moreover, five industries (33.33%) flagged renewable technologies prices as a critical hindrance, necessitating innovative approaches to enhance cost-effectiveness. Notably, the largest proportion (60%) of industries indicated

"N/A" for barriers, as they perceive their emissions to be negligible, reflecting a unique perspective warranting consideration.

Mr. Hameed highlights a significant barrier to renewable energy adoption, noting that the Government of Pakistan restricts net metering to 1MW. Additionally, he points out that interest rates on loans for solar system installation are higher compared to other countries. Dr. Muhammad Sultan, an Associate Professor at BZU Multan, expresses a pressing concern about Pakistan's reliance on imported renewable energy equipment, such as solar panels, inverters, and batteries, which burdens the economy and hinders the growth of the renewable energy industry. These challenges are represented in Fig. 15 and the major obstacle is the promoting renewable energy in industries. Within the backdrop of these challenges, industry leaders emphasize the critical role that government can play in bolstering their endeavors through a range of supportive measures.

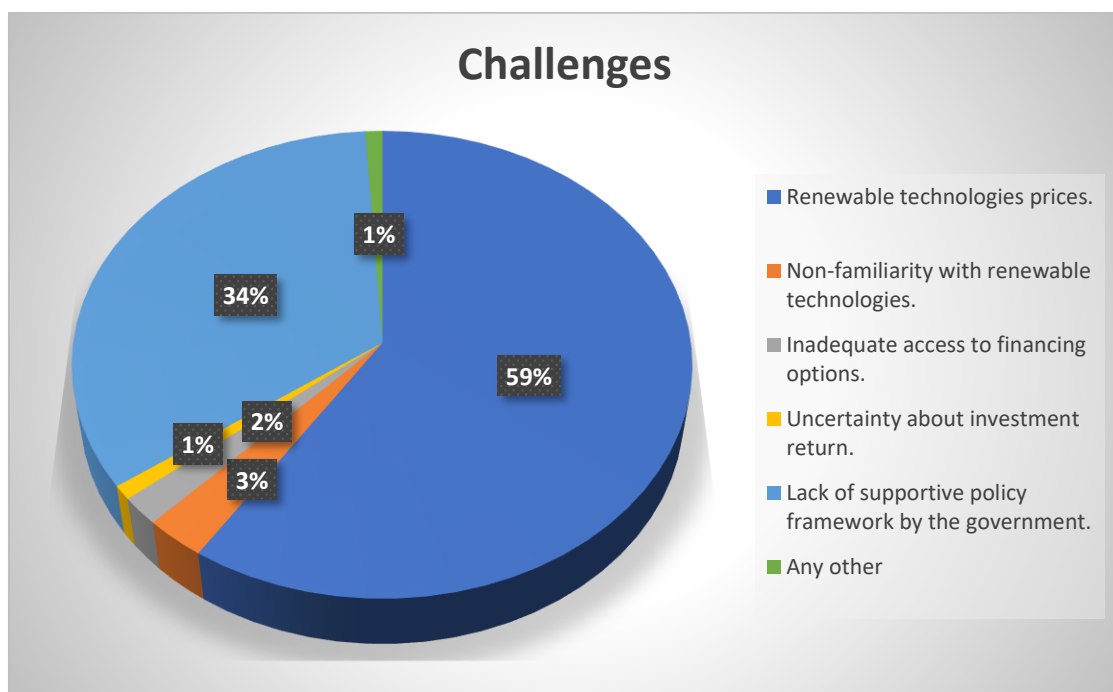


Fig. 15 Challenges in implementing RE practices.

### 4.3. Benefits of industrial decarbonization

Industrial decarbonization in Pakistan's sports industry presents significant advantages, promoting both environmental and economic sustainability. By adopting green practices, the industry can reduce its carbon footprint, enhance energy efficiency, and foster innovation. Here are the key benefits of pursuing industrial decarbonization in this sector:

- Lower greenhouse gas emissions, mitigating climate change and reducing the industry's overall environmental impact.
- Improved air quality, leading to better public health outcomes for communities surrounding industrial areas.
- Cost savings through increased energy efficiency and reduced waste, enhancing overall operational profitability.
- Enhanced brand reputation, as consumers increasingly favor companies with strong environmental responsibility.
- Competitive advantage in global markets that prioritize and reward sustainable products and practices.
- Attraction of environmentally conscious investors and partners, opening new avenues for funding and collaboration.
- Compliance with international environmental standards and regulations, avoiding potential penalties and trade barriers.
- Stimulation of innovation, driving the development and adoption of new green technologies within the industry.
- Creation of green jobs, fostering skill development and employment opportunities in sustainable practices.
- Long-term resilience and sustainability, helping the industry to adapt to and thrive amidst environmental and regulatory changes.

#### **4.4. Policy recommendations**

The obstacles encountered and policy recommendations enlighten for Pakistan's sports/apparel industries in adopting renewable energy and reducing carbon emissions in their operations following policy suggestions are as follows:

##### **4.1.1. Feed-in tariffs (FiTs) and power purchase agreements (PPAs)**

- i). The Ministry of Energy and its regulatory bodies, such as NEPRA, AEDB, and DISCOs, should enforce competitive Feed-in Tariffs (FiTs) and Power Purchase Agreements (PPAs) to stimulate private sector participation in renewable energy initiatives. These agreements ought to provide appealing incentives for wind, solar, and other sustainable technologies.

##### **4.1.2. Promote renewable energy adoption and incentives**

- i). The government ought to create and execute targeted incentives and subsidies to promote the uptake of renewable energy technologies, like solar panels and biomass boilers.

- ii). Set up feed-in tariffs and power purchase agreements to guarantee a stable and appealing market for producers of renewable energy, thus fostering investment in renewable energy generation.

#### **4.1.3. Enhance energy efficiency measures**

- i). Establish obligatory energy efficiency criteria for industrial processes, machinery, and equipment, ensuring ongoing enhancement in energy efficiency.
- ii). Promote industries to carry out routine energy assessments to pinpoint opportunities for energy conservation and adopt energy-efficient technologies and practices.

#### **4.1.4. Public-private partnerships**

- i). Encourage partnerships between sports industries and renewable energy providers or developers to enable the seamless integration of renewable energy solutions into industrial operations. This collaboration can involve various forms of support, including financial incentives, technical expertise exchange, and shared research and development efforts. By fostering such collaborations, both sectors can benefit from reduced carbon footprints, improved energy efficiency, and mutual advancement in sustainable practices.
- ii). Promote alliances with financial institutions such as commercial banks to offer readily available financing opportunities for renewable energy projects within the sector. These partnerships aim to streamline the process of accessing funds for renewable energy initiatives, facilitating smoother implementation and expansion of sustainable practices within the industry. By collaborating with financial institutions, the sector can leverage specialized expertise in project financing while ensuring that renewable energy projects receive the necessary financial support to thrive and grow.

#### **4.1.5. Supportive policy and regulatory framework**

- i). Enhance and uphold current policies concerning the integration of renewable energy, energy efficiency, and the reduction of emissions within the industrial sector. This involves bolstering regulatory frameworks, ensuring stricter enforcement mechanisms, and continuously updating policies to align with evolving technological advancements and sustainability goals. By strengthening these policies, the industrial sector can be more effectively guided towards adopting renewable energy sources, implementing energy-

efficient practices, and minimizing environmental impact through reduced emissions.

- ii). Implement carbon pricing mechanisms or carbon trading schemes to provide incentives for industries to decrease their carbon emissions and transition to cleaner technologies. These initiatives involve assigning a monetary value to carbon emissions, either through taxes or market-based trading systems, encouraging companies to invest in emission reduction strategies and low-carbon technologies. By introducing such mechanisms, industries are incentivized to internalize the cost of carbon emissions, fostering innovation, and driving the adoption of sustainable practices to mitigate climate change.

#### **4.1.6. Capacity building and training**

- i). Provide training programs and workshops aimed at enhancing the technical skills of industrial personnel in renewable energy technologies and energy management practices. These initiatives are designed to equip workers with the knowledge and expertise needed to effectively implement renewable energy solutions, optimize energy usage, and identify opportunities for efficiency improvements within industrial processes. By offering such training, industries can empower their workforce to embrace sustainable practices, leading to reduced energy consumption, lower operational costs, and a more environmentally responsible approach to production.
- ii). Establish a proficient workforce capable of facilitating the design, execution, and upkeep of renewable energy projects within the sector. This involves investing in training and education programs to equip individuals with the necessary skills and expertise required to successfully plan, deploy, and sustain renewable energy initiatives. By cultivating such a skilled workforce, the sector can effectively harness renewable energy resources, drive innovation, and ensure the long-term viability of sustainable energy practices within industrial operations.

#### **4.1.7. R&D and innovation**

- i). Each company sets aside resources for research and development focused on renewable energy technologies and sustainable manufacturing processes specifically tailored to the sports/apparel industry. This entails dedicating financial investments and manpower towards exploring innovative solutions that enhance energy efficiency, reduce environmental impact, and promote sustainability throughout the production chain. By prioritizing R&D in this area, companies aim to stay at the forefront of

technological advancements, meet evolving consumer demands for eco-friendly products, and contribute to the industry's overall transition towards a more sustainable future.

- ii). Establish innovation centers or technology hubs to foster collaboration among academia, industry, and research institutions, aimed at catalyzing technological progress within the sector. These centers serve as dynamic platforms where stakeholders can exchange ideas, conduct joint research projects, and leverage collective expertise to develop innovative solutions addressing the unique challenges and opportunities in the industry. By facilitating such collaborations, these hubs aim to accelerate the pace of technological advancements, promote knowledge sharing, and fuel the development of cutting-edge technologies that drive sustainable growth and competitiveness within the sector.

#### **4.1.8. Awareness and advocacy**

- i). Organize awareness campaigns and workshops aimed at educating industries about the advantages of embracing renewable energy and the significance of decarbonization. These initiatives seek to inform stakeholders about the potential economic, environmental, and social benefits of transitioning to renewable energy sources and reducing carbon emissions. By raising awareness and providing education on these topics, industries can make informed decisions that not only benefit their bottom line but also contribute to sustainability efforts on a broader scale.
- ii). Involve industry associations and advocacy groups in promoting sustainable practices and exchanging best practices among companies. This collaboration aims to encourage the adoption of environmentally responsible approaches within the sector by facilitating knowledge-sharing and fostering a supportive network. By engaging with these organizations, companies can access valuable resources, receive guidance on implementing sustainability initiatives, and collectively work towards advancing industry standards for environmental stewardship.

#### **4.1.9. Reporting and monitoring**

- i). Enforcing a mandate for companies within the Sports/Apparel sector to regularly disclose their carbon emissions data to the Ministry of Climate Change and Environmental Protection in Pakistan, fostering transparency and accountability. This requirement aims to ensure that businesses in these industries actively monitor and report their environmental impact, enabling

policymakers to assess progress towards emission reduction targets and implement targeted interventions to mitigate climate change. By promoting transparency and responsibility through mandatory reporting, companies can contribute to a more sustainable future while enhancing public trust and confidence in their environmental practices.

- ii). Establish a robust comprehensive monitoring framework to oversee the advancement of industries in achieving their objectives for reducing carbon emissions and integrating renewable energy. This system aims to systematically track and evaluate the performance of companies in meeting their targets, ensuring accountability and facilitating timely adjustments to strategies as needed. By establishing such a robust monitoring system, policymakers can effectively assess the effectiveness of policies and interventions, identify areas for improvement, and drive continuous progress towards a low-carbon and sustainable future.

#### **4.1.10. Circular economy practices/ sustainable supply chains**

- i). Encourage companies to assess and minimize the carbon footprint of their supply chains by collaborating with suppliers who adhere to sustainable practices and utilize renewable energy sources. This encouragement aims to incentivize businesses to prioritize sustainability throughout their procurement processes, fostering partnerships with suppliers committed to reducing environmental impact. By engaging with sustainable suppliers and integrating renewable energy into their supply chains, companies can contribute to broader efforts to mitigate climate change and promote responsible stewardship of natural resources.
- ii). Promote recycling and reuse in manufacturing processes to reduce waste and conserve resources.
- iii). Establish environmental-friendly supply chains and waste management systems. This entails designing and implementing systems that prioritize sustainability, from sourcing raw materials to managing waste, to minimize environmental impact and promote resource efficiency throughout the entire supply chain.

#### **4.1.11. Government support and funding**

- i). Allocate specific funding and financial assistance for the research, development, and implementation of renewable energy technologies within the industrial sector. This involves earmarking resources to support projects



aimed at advancing renewable energy solutions, fostering innovation, and accelerating the adoption of sustainable practices within industrial operations.

- ii). A green investment fund to back projects aligning with decarbonization goals. This fund supports initiatives promoting sustainability and renewable energy adoption.

## **Chapter 5:**

### **Conclusion**

#### **5.1. Conclusions**

**T**his comprehensive study covers a vivid picture of decarbonization efforts within the sports/apparel sectors in Pakistan. It reveals a prevailing dependency on grid electricity, supplemented by natural gas and coal, with only a minor shift towards renewable energy by couple of industries and largely relied on grid electricity. Furthermore, their collaborations with external organizations for renewable energy integration and energy efficiency remain underexplored.

Interestingly, while a majority of the sport/apparel industries have conducted energy audits, the adoption of carbon reduction goals is not commonly adopted. Nevertheless, a readiness to invest in on-site renewable energy and a focus on strategies like 'Energy Efficient System', 'Renewable Energy', and 'Reduce, Reuse, Recycle' are encouraging signs of a growing environmental consciousness. However, traditional ways such as 'natural gas utilization' and 'grid electricity consumption' dominate the landscape, whereas more advanced technologies like 'renewable energy sources', 'hydrogen as net-zero fuel' and 'Carbon Capture and Storage' are overlooked that revealed the need of awareness and initial investment/subsidies by government are required.

The report comprehensively presents the need to adopt robust strategies and innovative technologies to reduce emissions in sports industries. To overcome the challenges associated with decarbonization technologies, policy, financial, governance, and logistics are crucial but can be achieved for transition to low-carbon operations. Moreover, this study highlights the pivotal role of government as a catalyst in this transformation, most of the industry representatives were in favor of government offer them policy recommendations, incentives and subsidies to encourage the adoption of renewable energy, improve energy efficiency, utilization of efficient machines, supportive frameworks, and promote sustainable practices.

The study concludes by demonstrating the need of adopting renewable energy sources implementation within sports industries and their commitment to reducing emissions. This also calls on the government to take a proactive stance in facilitating this transition for a more sustainable and environmentally responsible future. This is imperative for sport industries to adopt green energy sources and carbon capture and utilization technologies. In the end, emphasizing our collective responsibility, the study advocates for the development of a sustainable and resilient industrial ecosystem to secure a better environmental future for all.

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