



**Renewable Energy Market Needs Rapid  
Assessment Report**  
**(Trends, Challenges, Opportunities)**

**Economic Empowerment for Decentralized Renewable  
Energy Innovations and Solutions to Promote Green Jobs,  
Environmental Protection, Climate Security, and  
Livelihoods Improvement – Yemen**

**Sep-2024**

## Table of Contents

Subject	Page
Preface	6
Abstract	7
Terminologies	9
Executive Summary	10
Section I: Methodological and theoretical framework of the study	12
1. literature review	12
Introduction	12
Reason for choosing the topic.	12
Importance of the study:	12
Third: Objectives of the study	13
Fourth : The problem of the study	13
Fifth: Limitations of the study	14
Methodology:	14
Seventh: Study population	14
Eighth: Study sample	15
Ninth: Data Collection Methods	16
Tenth: Methods of statistical analysis	16
The second topic: Renewable energy as a global phenomenon	17
The third topic: Yemen and renewable energy	19
The fourth topic: The geographical, social, and economic location of the targeted areas	20
Section Two: Analysis of Secondary Sources in the Field of Renewable Energy	22
The first topic: Market Analysis	22
The second topic: Market Challenges and Business Opportunities	23
The third topic: Policies and regulations	24
The fourth topic: Opportunities	24
The fifth topic: Challenges facing the solar energy sector in Yemen	26
Section Three: Field Study	28
The first topic: Field study procedures	28
The second topic: Renewable energy needs of individuals and business owners	30
The third topic: Renewable energy needs of traders and service providers	40
The fourth topic: Renewable energy needs in the public sector	52
The fifth topic: Renewable energy needs of international and local organizations and financing institutions	64
The sixth topic: Renewable energy needs with focus groups	88
The seventh topic: The analytical framework for renewable energy in the targeted areas	90
Analytical technologies	90
SWOT analysis	90
Value chain analysis (supply chain in target areas)	91
Stakeholders' analysis	93
Business Opportunities in Solar Energy for Youth	94
Section Four: Findings, Recommendations, Outputs, References and Appendices	96
The first section: Results	96
The second section: Recommendations	97
Opportunities and technical skills required to work in the field of renewable energy	99
Local experiences and success stories	100
Regional experiences in renewable energy	102
References	106

## Index of Tables

Table Number	Table Title	Page
1	Table showing the distribution of data collection tools and the study sample	15
2	Table showing the level of use of solar energy shops ( solar energy system)	31
3	Table showing the distribution of sample members according to the level of funding of the sample categories of renewable energy in the targeted areas	69
4	Table showing the distribution of the sample according to the financing of small projects	70
5	Table showing the distribution of sample members according to training	71
6	Table showing the distribution of the sample according to solar panels and their accessories	72
7	SWOT Analysis Table (Opportunities, Challenges, Weaknesses, Strengths)	90
8	PesteTable: Solar Energy in Target Areas	91
9	Key Stakeholder Analysis Table	93

## List of figures

Figure No.	Title of Figure	Page
1	Illustration of local actors in the solar energy sector in Yemen	22
	First: Graphical forms of renewable energy needs of individuals and business owners.	30
2	Figure showing the distribution of sample members by governorates, directorates, and regions	30
3	Figure showing the distribution of sample members by category	30
4	Figure showing the distribution of sample members by residence and gender	31
5	Figure showing the distribution of sample members by age	32
6	Figure showing the distribution of the sample according to educational level	32
7	Figure showing the distribution of sample members by field of work and residence	33
8	Figure showing the distribution of sample members according to years of work experience	33
9	Figure showing the distribution of sample members by category and products used	34
10	Figure showing the distribution of the sample according to the criteria for choosing the preferred type	34
11	Figure showing the distribution of sample members by field of residence and sources of funding	35
12	Figure showing the distribution of sample members according to the field of challenges when using renewable energy systems	36
13	Figure showing the distribution of sample members by category and recommending the use of renewable energy	36
14	Figure showing the distribution of the sample according to the criteria for the use of renewable energy	37
15	Figure showing the distribution of the sample according to the basic skills required when purchasing renewable energy technologies	38
16	Figure showing the distribution of the sample according to their opinion about the high costs of renewable energy	38
17	Figure showing the distribution of sample members according to high-cost services	39
	Second: Graphs of renewable energy needs of traders and service providers	40
18	Figure showing the distribution of sample members by governorates, districts, and nature of work	40
19	Figure showing the distribution of sample members by educational level	41
20	Figure showing the distribution of sample members according to the nature of work and years of experience	41
21	Figure showing the distribution of sample members according to the nature of work and renewable energy products	42
22	Figure showing the distribution of the sample according to the target markets	42
23	Figure showing the distribution of the sample according to the nature of the work and the challenges in the field of renewable energy	43

<b>Figure No.</b>	<b>Title of Figure</b>	<b>Page</b>
24	Figure showing the distribution of sample members according to the challenges facing wholesalers and retailers in the field of renewable energy	44
25	Figure showing the distribution of the sample according to the motivation towards investing in renewable energy by traders	45
26	Figure showing the distribution of the sample according to the skills required to work in the renewable energy sector according to the opinion of traders	45
27	Figure showing the distribution of sample members according to the need for training	46
28	Figure showing the distribution of the sample according to the required training areas	47
29	Figure showing the distribution of sample members according to project funding sources	47
30	Figure showing the distribution of the sample according to the recommendations addressed to the government	48
31	Figure showing the distribution of sample members according to the level of availability of maintenance and repair services for devices related to renewable energy	48
32	Figure showing the distribution of sample members according to the level of availability of materials and spare parts needed for energy technologies in the local market	49
33	Figure showing the distribution of sample members according to the availability of spare parts for renewable energy devices	49
34	Figure showing the distribution of sample members according to the challenges related to securing materials and spare parts, especially during peak periods	50
	Third: Graphs of renewable energy needs in the public sector	52
35	Figure showing the distribution of sample members by governorate	52
36	Figure showing the distribution of sample members by age groups	53
37	Figure showing the distribution of the sample according to educational level	53
38	Figure showing the distribution of the sample according to years of experience	54
39	Figure showing the distribution of the sample according to the sector in which the entity is interested	54
40	Figure showing the distribution of the sample according to the assessment of the level of interest of the entity in renewable energy	55
41	Figure showing the distribution of the sample according to the challenges facing the entities in the field of renewable energy	56
42	Figure showing the distribution of sample members according to the opportunities available to the entities to benefit from renewable energy	58
43	Figure showing the distribution of the sample according to the factors that contributed to the creation of opportunities in the field of renewable energy	58
44	Figure showing the distribution of sample members according to the evaluation of training and qualification in technical institutes	59
45	Figure showing the distribution of the sample according to the reasons for the shortcomings in the technical institutes	59
46	Figure showing the distribution of the sample according to the knowledge and skills required in the field of awareness and training in renewable energy	60
47	Figure showing the distribution of sample members according to cooperation and coordination between the entity and the private sector in the field of renewable energy	61
	Fourth: Graphs of renewable energy needs of international and local organizations and financing institutions	64
48	Figure showing the distribution of sample members by governorates and districts	64
49	Figure showing sample distribution by sample category	64
50	Figure showing the distribution of sample members by gender	65
51	Figure showing the distribution of sample members by age groups	65
52	Figure showing the distribution of the sample according to educational level	65
53	Figure showing the distribution of sample members according to years of experience	66
54	Figure showing the distribution of sample members according to the sectors in which organizations and financing institutions are interested	66

<b>Figure No.</b>	<b>Title of Figure</b>	<b>Page</b>
55	Figure showing the distribution of the area of intervention by category	67
56	Figure showing the distribution of the sample according to the reasons for non-interference in other renewable energy fields	68
57	Figure showing the distribution of the sample according to the intervention through climate change	72
58	Figure showing the distribution of the sample according to the intervention through environmental protection	72
59	Figure showing the distribution of sample members according to the challenges facing organizations and financing institutions	73
60	Figure showing the distribution of sample members according to the level of purchase of renewable energy technologies and supplies by organizations and financing institutions	74
61	Figure showing the distribution of sample members according to the challenges faced by organizations and financing institutions when purchasing renewable energy supplies	74
62	Figure showing the distribution of sample members according to training for staff of organizations and financing institutions	75
63	Figure showing the distribution of sample members by training at the level of renewable energy suppliers	75
64	Figure showing the distribution of sample members according to the level of training of service providers	76
65	Figure showing the distribution of the sample according to the level of training of the beneficiaries	76
66	Figure showing the distribution of the sample according to the most important knowledge and skills required in the field of awareness and training in renewable energy	77
67	shows the distribution of the sample according to the available job opportunities in the renewable energy sector for men and women	77
68	Figure showing the distribution of sample members according to the level of awareness of renewable energy in the community in which they work	78
69	Figure showing the distribution of the sample according to the obstacles facing the spread of renewable energy in the areas of interventions of organizations and financing institutions	80
70	Figure showing the distribution of sample members according to the role of the government and the private sector in supporting renewable energy	82
71	Figure showing the distribution of the sample according to the tools and services needed by the organization to enhance its capabilities in this field of renewable energy	83
72	Figure showing the distribution of the sample according to the policies and incentives that can be provided to encourage citizens to use technology	83
73	Figure showing the distribution of sample members according to the partnerships that have been built with the private sector to promote the field of renewable energy	84
74	Figure showing the distribution of sample members according to the partnerships that have been built with the government to promote the field of renewable energy	85
75	Figure showing the distribution of the sample according to the partnerships that have been built with partner institutions to promote the field of renewable energy	85
76	Figure showing the distribution of sample members according to the partnerships that have been built with individuals to promote the field of renewable energy	86
77	Figure showing the distribution of the sample according to the factors that contributed to the creation of opportunities in the field of renewable energy in Yemen	86
	Fifth: Graphs of renewable energy needs with focus groups	90
78	Figure showing the distribution of the sample according to the samples to which the focus groups were distributed	90
79	Value Chain	92

## Preface

Renewable energy is a vital topic in sustainable development, given its role in securing environmentally friendly and renewable energy sources, especially in countries facing significant economic and environmental challenges such as Yemen. Amid Yemen's challenges, including fossil fuel shortages, high energy costs, and political and economic instability, the need to explore alternatives to conventional energy has become urgent.

Renewable energy sources in Yemen include solar, wind, and bioenergy, which can provide economic and environmental solutions to improve quality of life and reduce dependence on imported fuels. This research aims to study the reality of renewable energy in Yemen, analyze the available possibilities, and assess the challenges facing the development of this sector. The study will also review opportunities to benefit from available natural resources, current initiatives to promote the use of renewable energy and their potential role in achieving sustainable development and improving the economic and social conditions in the country.

Solar energy is one of the most important sources of renewable energy that can contribute significantly to meeting Yemen's energy needs in light of the current economic and environmental challenges.

### **Here are some aspects that highlight the importance of solar energy to Yemen:**

- **Sustainable and available energy source:** Yemen enjoys high solar brightness rates throughout the year, making it one of the suitable countries to benefit from solar energy as a permanent and sustainable source of energy.
- **Reducing dependence on imported fuels:** Due to the high costs and restrictions on fuel imports in Yemen due to economic and political conditions, solar energy provides a local alternative that can reduce dependence on imported fossil fuels.
- **Reducing costs for households and communities:** The adoption of solar energy can reduce the costs of electricity consumption, especially in rural areas and areas lacking traditional energy infrastructure. Households can meet their basic energy needs at lower costs and with minimal operational costs.
- **Supporting economic development:** The development of solar projects can contribute to the creation of new job opportunities, both in the installation and maintenance of solar systems and in the solar equipment manufacturing sector, which supports the local economy and promotes sustainable development.
- **Reduce environmental impact:** Reliance on solar energy reduces carbon emissions associated with fossil fuel combustion, helping to reduce environmental pollution and improve public health, particularly in communities affected by air pollution.
- **Stable power supply:** Solar energy can provide a stable supply of electricity in areas experiencing frequent power outages, improving the standard of living and promoting the stability of basic services such as health and education.

Considering all these benefits, the importance of solar energy as a sustainable and essential solution to meet Yemen's energy needs and support the country's sustainable development path is highlighted.

## Abstract

This study aimed to assess the current situation of the renewable energy sector in the secondary areas of Yemen and to identify the challenges and opportunities available for the development of this sector. It also sought to map the value chain of renewable energy trade and to identify the required skills and job opportunities available in this field, in three governorates represented in Taiz (Al-Maafar), Lahj (Al-Maqatra and Al-Mudarabah), and Abyan (Ahwar). The study population was identified as local community members, shop owners, private sector representatives (wholesale and retail traders, service providers), public sector entities (vocational institutes and government facilities), as well as local and international civil society organizations and financial institutions. The study sample included (178) individuals and (22) interviews and (5) panel discussions, of which the most important findings of the study:

- There is a high demand for solar energy systems among individuals and shops.
- Consumers suffer from a lack of technical knowledge about renewable energy, which limits their ability to make informed decisions.
- Most consumers rely on self-financing, suggesting the need for concessional financing programs.
- Businesses face difficulty in obtaining spare parts and a shortage of trained specialists.
- Companies face complex bureaucratic procedures to obtain licenses and approvals.
- Local and international organizations play an important role in the provision of renewable energy in public utilities, but there is weak coordination between the public and private sectors.
- Weak purchasing power, inflation, and political instability hinder the spread of renewable energy.
- There are promising investment opportunities in the field of renewable energy, such as the establishment of maintenance centers and spare parts, and the provision of training services.

**The study also came up with a set of recommendations, the most important of which are the following:**

- Designing dedicated financing programs to support renewable energy projects.
- Provide tax incentives and simplify procedures to encourage investment.
- Promote public-private partnerships for infrastructure development.
- Providing training programs to qualify national capacities.
- Invest in research to develop new technologies.
- Extending studies on renewable energy to new areas.
- Providing facilities for suppliers and encouraging them to enter the market.
- Supporting complete supply chains in the field of renewable energy.
- Invest in establishing maintenance centers, providing training services, and developing local products.
- Developing the skills of technicians, consultants, and marketers in the field of renewable energy.

The study presented a variety of promising investment opportunities in the field of renewable energy, targeting especially remote areas in Yemen. These opportunities contribute to promoting sustainable development and providing new job opportunities, including:

- **Establishing a local supply chain:**
  - Maintenance centers and spare parts: Meeting the increasing demand for maintenance, installation, and provision of authentic spare parts.
  - Gathering and distributing spare parts: Reducing costs and improving the efficiency of supply chains.
  - Developing local products: Reducing dependence on imports and promoting local industry.
- **Support Services:**
  - Providing training services: Building local capacity and providing qualified cadres.
  - Sales and marketing centers: Providing the latest technologies and products related to renewable energy.
  - Installment sales centers: Facilitating citizens' access to these technologies.
- **Energy Services:**
  - Electricity Service Delivery Centers: Providing electricity to remote areas using renewable energy.
  - Battery maintenance centers: Maintaining the efficiency of systems and recycling used batteries.
  - Transportation and delivery centers: Facilitate the delivery of products and services to customers.

Based on the field study and the challenges faced by remote areas in Yemen, the technical jobs and the required skills are determined as follows:

**Key functions and skills required:**

- **Maintenance and Installation Technician:** This role requires practical skills in installing and maintaining solar and wind systems, as well as the ability to work in harsh environments and repair malfunctions.
- **Technical Advisor:** This role needs engineers specialized in the field of renewable energy, capable of analyzing data and designing innovative solutions that suit Yemeni conditions.
- **Marketer:** This role focuses on a deep understanding of the renewable energy market in Yemen, possessing strong communication, marketing, and relationship-building skills.
- **Instructor:** This role requires renewable energy experts who can transfer their knowledge and skills to others in an effective manner.

The study also identified supply chain milestones in the target areas.

## Terminologies

- **Renewable energy:** Energy derived from renewable natural sources such as the sun, wind, water, vitality, and geothermal.
- **Solar energy:** It is the energy utilized by harnessing sunlight.
- **Wind energy:** Wind energy is harnessed from the kinetic energy of wind using large wind turbines located either on land (onshore) or over the sea or freshwater (offshore). Geothermal energy: Geothermal energy uses the thermal energy available in the Earth's interior.
- **Geothermal energy:** Geothermal energy harnesses the thermal energy available within the Earth's subsurface.
- **Hydroelectricity:** Hydroelectricity uses the energy of water flowing from top to bottom.
- **Marine energy:** Marine energy is derived from technologies that use the kinetic and thermal energy of seawater.
- **Bioenergy:** Bioenergy is derived from a variety of organic materials, collectively known as biomass.
- **Secondary areas:** Rural and remote areas that suffer from a lack of basic services.
- **Value chain:** The chain of processes that renewable energy products go through from the manufacturing stage until they reach the consumer.
- **Supply chain:** A network of companies and organizations working together to provide a product or service.

## Executive Summary

This study aims to assess the renewable energy market in secondary areas in Yemen, with a focus on Taiz (Maafar), Lahij (Al-Muqatara, Al-Mudaraba), Abyan (Ahwar) and Sana'a through secondary sources.

The main objective is to identify trends, challenges, and opportunities in the development of this sector, especially solar energy, and to map the value chain of renewable energy.

The study discusses the potential employment opportunities and skill sets required for youth and women in this area.

The data was collected through (22) interviews, (5) focus group discussions, and consultations with (178) participants, including community members, business owners, public and private actors, financial institutions, government agencies, and civil society organizations.

### Key Findings:

- **High demand for solar energy:**

Solar energy is the most in-demand source of renewable energy, especially among individuals and businesses, due to its long-term cost and reliability in areas with unstable access to electricity.

- **Gaps in technical knowledge:**

There is a significant lack of technical knowledge related to renewable energy technologies, which limits consumers' ability to make informed decisions, and this gap is particularly pronounced in rural areas, where access to technical expertise is limited.

- **Financial Constraints:**

Consumers rely mainly on self-financing to purchase renewable energy systems, indicating the need for available financing options such as micro-loans and pay-as-you-go models. High initial costs are a major obstacle to widespread adoption.

- **Supply chain challenges:**

Renewable energy projects face difficulties in securing spare parts, trained labor, and affordable systems. In addition, business owners face bureaucratic obstacles when obtaining

licenses, which leads to delays in the implementation of projects.

- **Investment Opportunities:**

Opportunities in the renewable energy sector include establishing maintenance centers, providing spare parts, and providing training services, especially in unserved rural areas. These initiatives can stimulate local economic development and meet the growing demand for renewable energy solutions.

### Overview of SWOT and PESTEL analysis

The study identifies strengths, weaknesses, opportunities, and threats (SWOT) in Yemen's renewable energy sector.

Strengths include the abundance of sun in Yemen and the strong demand for solar energy, particularly in rural areas, however, challenges such as high initial costs, poor product quality, and lack of technical expertise hinder growth. Opportunities lie in creating jobs through training programs and expanding funding models.

On the other hand, threats include political instability, inflation, and weak regulatory oversight, which allow substandard products to enter the market.

As for the external factors analyzed through PESTEL, political instability in Yemen hinders infrastructure development, while economic challenges such as inflation raise the costs of solar components. Socially, the sector provides great job opportunities for youth and women, despite the persistence of technological and environmental challenges due to the lack of skilled labor and the absence of clear regulations related to the quality of products, despite these obstacles, the high potential of solar energy, especially in rural areas, puts Yemen in a good position to expand renewable energy.

### Recommendations:

#### **First: Technical and social recommendations**

- **Developing financing programs:** Create financing options such as micro-loans and pay-as-you-go models to make solar systems

accessible to low-income households and small businesses.

- **Fiscal incentives:** Streamline bureaucratic processes and introduce tax incentives to encourage private sector investment in renewable energy projects.
- **Boosting PPPs:** Improve collaboration between government, the private sector, and international organizations to improve infrastructure and expand access to renewable energy.
- **Expand Technical Training:** Launch technical training programs to develop local capacities in the installation and maintenance of solar energy systems, creating employment opportunities and addressing the existing skills gap.
- **Product Quality Regulation:** Implement national standards to ensure the import and distribution of high-quality solar energy products, enhancing consumer trust and minimizing system failures.
- **Promote Gender Inclusion:** Encourage women's participation in technical and non-technical roles within the renewable energy sector through targeted training programs and awareness campaigns.
- **Enhance Research and Development:** Invest in research and development to advance renewable energy technologies, particularly solar power, and explore additional renewable options like wind systems and biogas solutions.

## **Second: Economic recommendations**

- **Maintenance centers:** Establish centers to provide maintenance services and provide spare parts, especially in remote areas.
- **Assembly and Distribution:** Establish companies focused on assembling and distributing solar energy components locally to reduce costs and enhance supply chain efficiency.
- **Training and capacity-building:** Provide technical training to develop a skilled workforce capable of installing and maintaining solar energy systems.
- **Solar-Powered Service Centers:** Establish solar-powered charging stations and battery recycling centers to support sustainable electricity delivery in rural areas.

## **Conclusion**

The renewable energy sector in Yemen has great potential, especially in the field of solar energy, with strong demand in disadvantaged areas, however, challenges such as high costs, lack of technical expertise, and low quality products need to be addressed.

Targeted interventions, including financial support programs, regulatory frameworks, and expanded technical training, are necessary to promote renewable energy growth. By implementing these recommendations, Yemen can achieve sustainable energy solutions, create jobs for youth and women, and promote long-term economic development.

## **Section I: Methodological and theoretical framework of the study**

### **The first topic: Methodological framework**

#### **Introduction**

In the face of numerous global challenges, the renewable energy sector is “staying resilient” and has proven its ability to create jobs. Governments around the world are pursuing sectoral policies that support the expansion of renewable energy jobs in their countries. The establishment of a local value chain not only contributes to the creation of new business opportunities and jobs for individuals and communities but also enhances the reliability of supply chains and energy security in general, as reports show that an increasing number of countries are creating jobs in the renewable energy sector.

Investments in energy efficiency are also growing in line with agreements to decarbonize the planet, which has reflected positively on investors' interest in the renewable energy market, and reliance on it has begun to increase in generating the necessary energy, which has led to the emergence of the need for labor, whether in real-world jobs or digital jobs that coincided with the entry of green technology.

Yemen's rural areas face significant energy challenges, suffering from electricity supply shortages and frequent outages. The shift towards renewable energy represents a real opportunity to improve access to energy and achieve sustainable development in these regions.

This study aims to assess the current status of the renewable energy market in secondary areas of Yemen and identify current trends, challenges, and opportunities, in addition to analyzing the entire value chain of the renewable energy industry and focusing on innovative performance indicators <sup>(1)</sup>.

#### **First: Reasons for Choosing the Topic:**

YLDF and UNDP share an interest in promoting renewable energy in Yemen as part of climate change within the Sustainable Development Goals (SDGs) as it is important to have a full and positive impact in the shift from the use of fossil fuels towards adaptation to the use of renewable energy.

Within this mission, YLDF seeks to gather sufficient evidence on the market dynamics of renewable energy in four targeted geographies. A rapid market assessment was conducted with a focus on renewable energy (trends, challenges, opportunities, and market demand). Furthermore, the assessment will highlight the value chain of the renewable energy industry from the industry stage until the final stage of delivery to the final consumer.

#### **Second: The importance of the study:**

The importance of this scientific and applied study is as follows:

##### 1- Scientific importance:

- This study contributes to the expansion of knowledge about the renewable energy sector in the targeted areas, especially in the context of Yemen, which enriches the scientific literature in this field.
- Provide accurate and comprehensive information to local decision-makers to make informed investment decisions and policies to support the development of the renewable energy sector.
- It helps identify knowledge gaps in previous research, opening up new horizons for future studies.

---

<sup>(1)</sup> <https://yemenfuture.net/researches/16527>

- The research findings can contribute to the development of new theories and concepts related to the development of the renewable energy sector in developing countries.
- The data collected through this research can contribute to building a comprehensive database on Yemen's renewable energy sector, facilitating further analysis and studies.

## 2- Practical Importance:

- The research findings can help decision-makers in governments, international organizations, and the private sector to make informed decisions on supporting and developing Yemen's renewable energy sector.
- Helping international organizations working in Yemen to direct their programs and assistance/investment towards secondary areas.
- Helps identify investment priorities in the renewable energy sector, contributing to more effective resource channeling.
- Research findings can contribute to the development of policies and incentives that encourage investment in renewable energy and promote environmental sustainability.
- The research findings help empower local communities to participate in the development of renewable energy projects and improve their standard of living.
- Research findings can contribute to reducing fossil energy dependency and reducing carbon emissions, contributing to the fight against climate change.

### **Third: The objectives of the study:**

#### 1- Overall Objective:

Rapid assessment of the current status of renewable energy in the targeted areas.

#### 2- Sub-objectives:

- Identify trends, challenges, opportunities, and demands in the renewable energy sector.
- Identify the types of renewable energy sources and which are most applicable in the Yemeni context.
- Determine the renewable energy supply chain (upstream and downstream).
- Map the supply chain for renewable energy technology and services in Yemen.
- Identify the most feasible and sustainable specific small business ideas for men and women according to the needs and capabilities of the target groups.
- Identify specific skills, training, and viable business types related to gender-disaggregated renewable energy to be able to participate in this and similar opportunities.
- Submitting the necessary proposals and recommendations to improve the performance level of the renewable energy market.

### **Fourth: The Study Problem**

The problem of the study is determined by the following questions: What is the current status of the renewable energy sector in the targeted areas, and what are the factors affecting its growth and development? From the main question of the problem of this study are the following questions:

- What are the trends in the development of the renewable energy sector in the targeted areas?
- What are the main challenges facing the renewable energy sector in these regions?

- What are the key elements in the supply chain of renewable energy technology and services in Yemen?
- How do these elements interact with each other?
- What are the challenges facing this series?
- What are the key skills required to work in the renewable energy sector?
- What types of training are needed to develop these skills?
- What employment opportunities are available in this sector for men and women?
- What actions can be taken to improve the investment environment in the renewable energy sector?
- How can public-private cooperation in this sector be strengthened?
- What policies and incentives can be offered to encourage the use of renewable energy?

#### **Fifth: Limitations of the study:**

The limits of the study were as follows:

- **Objective Limitations:** A rapid market assessment was conducted with a focus on renewable energy (trends, challenges, opportunities, and market demand). Moreover, highlighting the evaluation of the value chain of the renewable energy industry from the industrial stage until the final stage of delivery to the final consumer, this study focused, in its objective aspect, on measuring the main indicators of innovation, and in this aspect, everything related to the scientific theoretical framework of the concepts of renewable energy, and the value chains of the study subject, will also be presented to achieve the objectives of the study.
- **Spatial limitations:** This study was limited to four governorates: (Taiz, Abyan, Lahj, Sana 'a) and (Sana 'a) as a secondary data review.
- **Human limitations:** This study included (community members, traders, the public and private sector, non-governmental organizations, and funding institutions) males and females.
- **Time limitations:** This study dealt with the analysis of the reality of renewable energy, the extent of opportunities and challenges, and the extent of the application of pilot projects in Yemen: Taiz Governorate, Abyan Governorate, Lahj Governorate, and the Secretariat of the Capital Sana 'a from August 14 to September 26, 2024.

#### **Sixth: Methodology:**

A research methodology combining quantitative and qualitative analysis was used, collecting data from multiple sources, including:

- **Secondary data,** government reports, market studies, scientific research, previous studies of international and local organizations, and others.
- **Preliminary data,** interviews with experts in the sector, questionnaires directed to citizens, companies, and the public sector, field visits to renewable energy projects, and focus group discussions.

#### **Seventh: Study Population:**

In carrying out the task, the study adopted a focus on stakeholders by identifying relevant sectors such as financing, development, maintenance, operation, training, and education and selecting a representative sample in each sector to ensure the representation of the value chain and the supply chain.

The study population consists mainly of:

- Individuals from the community and shop owners in the targeted areas of the study.

- The private sector (wholesalers - retailers - service providers of consultants and engineers) who are interested in renewable energy at the level of the governorates targeted by the study.
- The public sector (vocational institutes for education and training in renewable energy) and related government facilities.
- Local and international civil society organizations and funding institutions have previously worked in the field of renewable energy in Yemen.

### Eighth: Study Sample

Due to the diversity of the study population, it is not possible to rely on a single sample method, but several methods must be combined to obtain a sample that accurately represents the community, and the selection was made in the following ways:

- **Simple random sample:** Individuals from the local community.
- **Stratified sample:** All groups in the study population, where the community was divided into strata (such as the private sector, the public sector, local and international organizations, and funding institutions) and then a random sample was selected from each stratum in proportion to the size of the class in the community.
- **Intentional sample:** Service providers and experts in the field of renewable energy due to their small number in the targeted areas.

**Table No. (1) shows the distribution of data collection tools and the study sample**

Governorate	Category	Individuals	Traders	Public Sector	Private Sector	with local organizations	International Organizations	MFI's	Total
Taiz (Al Maafer)	Questionnaire	20	20	10	10				60
	Interview					6	3	3	12
	FDGs	1	1						2
Lahj (Al- Muqtaqatarah and Al- Mudaraba)	Questionnaire	25	25	5	5				60
	Interview					2	2	2	6
	FDGs	1	1						2
Abyan (Ahwar)	Questionnaire	25	25	4	4				58
	Interview					2	1	1	4
	FDGs	1							1
Total	Questionnaire	70	70	19	19	0	0	0	178
	Interview					10	6	6	22
	FDGs	3	2						5

### **Ninth: Data Collection Methods**

- **Theoretical aspect:** It relied on references and secondary sources, that dealt with the subject of the study, namely: (books - studies and previous published reports - journals and scientific periodicals - websites - and available electronic libraries). Secondary data were collected and analyzed from previous reports and assessments conducted at the national level, as well as based on their availability at the level of governorates and districts.
- **The field side:** The data collection was adopted by the questionnaire, with the method of in-depth interview and focus discussions, and the questionnaires were created electronically using the tool: Kobo Toolbox.

### **Tenth: Methods of statistical analysis**

The collected data were subjected to statistical analysis by computer and by the Statistical Software Package for the Social Sciences (SPSS).

## **The second topic: Renewable energy as a global phenomenon**

### **Renewable Energy Concept <sup>(2)</sup>**

Renewable energy is energy produced by natural sources that are renewable at a rate greater than what is consumed, sunlight and wind, for example, from sources that are constantly renewable, and renewable energy sources are abundant and ubiquitous around us.

Conversely, fossil fuels (coal, oil, and gas) are non-renewable resources whose formation takes hundreds of millions of years and which, when burned to produce energy, cause emissions. Fossil fuels, when burned to produce energy, cause harmful emissions of greenhouse gases, such as carbon dioxide.

Emissions from renewable energy generation are much lower than those from burning fossil fuels, so a shift from fossil fuels, which currently account for the lion's share of emissions, to renewable energy is key to addressing the climate crisis.

Renewable energy is currently less expensive in most countries, and it creates three times more jobs than fossil fuels. Here are some of the most important sources of renewable energy:

#### **1) Solar Energy:**

Solar energy is the most abundant of all energy sources and can even be generated in cloudy weather, and the rate at which the Earth intercepts solar energy is approximately 10,000 times greater than the rate at which humans consume energy.

Solar technologies can provide heat, cooling, natural lighting, electricity, and fuel for a range of applications. Solar technologies convert sunlight into electrical energy either through photovoltaic panels or through mirrors that focus solar radiation.

While not all countries have solar energy equally, the significant contribution to the combination of

The cost of manufacturing solar panels has fallen dramatically in the past decade, making solar energy affordable and often less expensive. Solar panels have been used for about (30) years, and their grades vary according to the type of materials they are manufactured.

#### **2) Wind Energy:**

Wind energy is extracted from the kinetic energy of the wind using large wind turbines located on land (land), at sea, or in freshwater (rivers), and has been using wind energy for thousands of years, but onshore and offshore wind energy technologies have developed over the past few years to produce the largest volume of electricity using longer turbines and larger rotating diameters.

Although average wind speeds vary greatly by location, the global technical potential of wind power exceeds global electricity production, and ample potential exists in most regions of the world to enable significant wind energy deployment.

Many parts of the world have strong wind speeds, but the best locations for generating wind energy are sometimes remote. Offshore wind energy offers huge potential.

---

<sup>(2)</sup> <https://www.un.org/ar/climatechange/what-is-renewable-energy>

### **3) Geothermal Energy:**

Geothermal energy uses the heat energy available in the ground and heat is extracted from geothermal reservoirs using wells or other means.

Naturally hot enough and permeable reservoirs are known as hydrothermal reservoirs, while sufficiently hot reservoirs that are optimized by hydraulic stimulation are called optimized geothermal systems.

Once it reaches the surface, liquids of different temperatures can be used to generate electricity. The technology of generating electricity from hydrothermal reservoirs is mature and reliable. It has been used for more than 100 years.

### **4) Hydroelectric Energy:**

Hydroelectric power uses the energy of water flowing from top to bottom, and it can be generated from reservoirs and rivers. Hydroelectric power storage plants rely on water stored in a reservoir, while downstream hydroelectric power plants exploit energy from the riverbed. Hydroelectric power tanks often have multiple uses: the provision of drinking water and irrigation water, flood and drought control, navigation services, and power supply.

Hydropower is currently the largest source of renewable energy in the electricity sector, and it is generally dependent on stable rainfall types. It may be adversely affected by droughts or changes in ecosystems that affect rainfall types. The infrastructure needed to generate hydropower can also negatively affect ecosystems. For this reason, small-scale hydropower is considered by many to be a more environmentally friendly option, particularly suited to communities in remote areas.

### **5) Marine Energy:**

Marine energy is derived from technologies that use the kinetic and thermal energy of seawater (waves or currents, for example) to produce electricity or heat, and marine energy systems are still in an early stage of development, with several prototypes of wave devices and tidal currents explored. The theoretical potential of marine energy far exceeds current human energy requirements.

### **6) Bioenergy:**

Bioenergy is produced from a variety of organic materials, known as biomass, such as wood, coal, dung, and other manures to produce heat and energy, and crops for liquid biofuels. Most of the biomass in rural areas is used for cooking, lighting, and heating, and generally by the poorest populations in developing countries.

Modern biomass systems include dedicated crops or trees, residues from agriculture and forestry, and various organic waste streams.

Energy from biomass burning produces greenhouse gas emissions but at lower levels than burning fossil fuels such as coal, oil, or gas.

However, bioenergy should be used for only limited applications, given the potential negative environmental impacts associated with large increases in forest plantations and bioenergy, and the resulting deforestation and land-use change.

### **The third topic: Yemen and renewable energy**

Yemen, a country with great solar potential, suffers from energy challenges due to political instability and infrastructure constraints, however, the increasing demand for reliable and sustainable energy sources has opened opportunities for the solar energy systems industry<sup>(3)</sup>.

This desk review aims to analyze the current state of the solar energy systems industry in Yemen, identify potential business opportunities for young people with limited grants, and propose a value chain framework for sustainable development.

The conflict in Yemen has significantly reduced access to energy, with many areas completely cut off from diesel and other sources, and this has led to a high demand for solar energy systems, as the population relies on solar appliances or generators for energy.

Accordingly, solar systems, especially at the household level, have gained great popularity in the northern and central regions of Yemen, mainly because of the urgent need for basic lighting and the operation of small devices. In contrast, the southern regions, where the national electrical grid is available irregularly, face various challenges, as the high demand for refrigeration and air conditioning, along with the interruption of grid supplies, have affected the rate of adoption of solar energy.

In addition, many organizations are working to promote decentralized renewable energy solutions, including solar and wind energy, while ensuring that new systems do not harm the environment. These organizations focus on sustainable practices, such as improving irrigation and raising awareness of water resources management. For example, the project "Supporting Livelihoods, Food Security and Climate Adaptation in Yemen" (Rural Resilience 1 and 3) is an example of empowering micro and medium enterprises while improving energy access and promoting economic growth in Yemen. The projects "Supporting Livelihoods, Food Security and Climate Adaptation in Yemen" (Rural Resilience 1 and 2) are working to implement small solar-powered electrical grids to support public services and promote energy access in commercial and residential areas. About (15) small electrical grids will be managed by micro, small, and medium enterprises (MSMEs), using rooftop space and generating rental revenues to host enterprises.

Recently, many MFIs have played a big role in improving this market, both in reaching new sectors and improving the quality of products and systems.

The solar market is working well while the demand is high, and this leads to a great potential for young people to find livelihood opportunities in this market on many levels and aspects.

However, many obstacles hinder the expansion of the solar energy market in these areas, and the high cost of solar systems, especially when compared to the limited purchasing power of rural populations, is a major obstacle. In addition, there is a noticeable lack of technical expertise and knowledge about optimal use, which is coupled with the low quality of available products and the scarcity of financial support, which creates significant challenges for these communities<sup>(4)</sup>.

---

*3A review of Yemen's current energy situation, challenges, strategies, and prospects for using renewable energy systems / Environmental Science and Pollution Research - Springer Link*

(4) [https://eadp.eu/uploads/WP201901\\_Yemen\\_Solar\\_%D9%90AR.pdf](https://eadp.eu/uploads/WP201901_Yemen_Solar_%D9%90AR.pdf)

## **The fourth topic: The geographical, social, and economic location of the targeted areas**

### **1) Maafar District<sup>(5)</sup>**

#### **a) Geographical Location**

Al-Maafar district is located southwest of Taiz City, and it is bordered by several other districts such as Al-Shamayayn and Al-Mawasit district.

#### **b) Social Situation**

The district of Al-Ma 'far consists of several sub-districts (Ozal), including Al-Mashawala, the Al-Anbuh Al-A'ala, Al-Jubziyah, Al-Sawa, Al-Shu 'bah, Al-Sunnah, and Al-Kalaibah. Its population reached about (110,924) people according to the 2004 census.

#### **c) Economic Condition**

The region depends heavily on agriculture, where many crops such as grains, vegetables, and fruits are grown, and some commercial and artisanal activities contribute to the local economy.

#### **d) Political situation**

Maafar is part of Taiz Governorate which has seen political and military conflicts in recent years, however, local communities are seeking stability and development in the region.

### **2) Al-Maqtarah District<sup>(6)</sup>**

#### **a) Geographical Location**

Al-Muqatara district is located northwest of the city of Al-Houta, about 83 kilometers from it, bordered to the west by the districts of Mudaraba and Al-Arah, to the south and east by the district of Tur Al-Baha, and to the north by parts of Taiz governorate.

#### **b) Social Situation**

Al-Muqatara district consists of (23) Ozlah, including; Zureiqat Al-Sham, Zureiqat Al-Yemen, Al-Nujaysha, Al-Abadla, Al-Ba'imah, Al-Kawash, Al-Ashbout, Al-Mudjadara, Zuqaiha, Al-Zaimah, Al-Hunaysha, the Anpoah, Al-Sawalha, Mu 'aqib, Al-Soud, Al-Jalila, Al-Muqabira, Al-Muqharramah, Al-Huwaishah, and Al-Dahmishah.

#### **c) Economic Condition**

Most of the population of the district depends on seasonal rain-fed agriculture, however, due to the recent lack of water, many people in the region have tended to expatriate and seek job opportunities in other cities such as Sana 'a, Aden, Hodeidah, and Taiz. Some are also engaged in the cultivation and marketing of Qat, but mainly for self-consumption.

#### **d) Political situation**

Al-Muqatara is part of the Lahj governorate which has seen political and military conflicts in recent years, however, local communities are seeking stability and development in the area.

---

(5) [https://en.wikipedia.org/wiki/%8A%D9%85%D8%AF%8A%D9%D8%B1%D9%D8%A9\\_%D8%A7%D9%84%D9%85%D8%B9%D8%A7%D9%81%D8%B1](https://en.wikipedia.org/wiki/%8A%D9%85%D8%AF%8A%D9%D8%B1%D9%D8%A9_%D8%A7%D9%84%D9%85%D8%B9%D8%A7%D9%81%D8%B1)

(6) [https://en.wikipedia.org/wiki/%8A%D9%85%D8%AF%8A%D9%D8%B1%D9%D8%A9\\_%D8%A7%D9%84%D9%85%D9%82%D8%A7%D8%B7%D8%B1%D8%A9](https://en.wikipedia.org/wiki/%8A%D9%85%D8%AF%8A%D9%D8%B1%D9%D8%A9_%D8%A7%D9%84%D9%85%D9%82%D8%A7%D8%B7%D8%B1%D8%A9)

### 3) Al Mudaraba and Al-Arah District<sup>(7)</sup>

#### a) Geographical Location

The district of Al-Mudaraba and Al-Arah is located in the western part of Lahj governorate. It is bordered to the north by Taiz governorate, to the south by the Red Sea, to the east by Tour Al-Baha district, and to the west by Al-Mokha district of Taiz governorate.

#### b) Social Situation

The population of the district was about (45,808) people according to the 2004 census. The district consists of several isolated villages and is characterized by its social and cultural diversity.

#### c) Economic Condition

The population of the district depends heavily on agriculture and fishing due to its proximity to the Red Sea, and some commercial and artisanal activities contribute to the local economy.

#### d) Political situation

Al-Mudaraba is part of Lahj governorate which has seen political and military conflicts in recent years, however, local communities are seeking stability and development in the region.

### 4) Ahwar District

#### a) Geographical Location

Ahwar district is located in the southeastern part of Abyan governorate. It overlooks the Arabian Sea. It is bordered to the north by Al-Mahfad district, to the west by Modiya district, and to the east by Shabwa governorate.

#### b) Social Situation

The population of the district was about (25,246) people according to the 2004 census. The district consists of several villages and regions and is characterized by its social and cultural diversity.

#### c) Economic Condition

The population of the district depends heavily on agriculture and fishing due to its proximity to the Arabian Sea, and some commercial and artisanal activities contribute to the local economy.

#### d) Political Situation

Ahwar is part of Abyan governorate which has experienced political and military conflicts in recent years, however, local communities seek stability and development in the region.

---

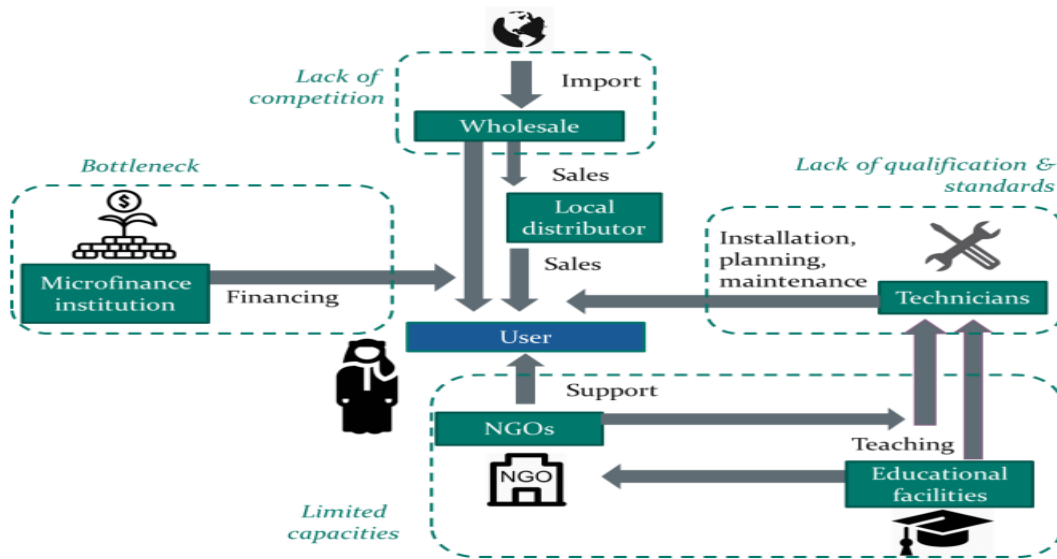
(7) [https://en.wikipedia.org/wiki/%D9%85%D8%AF%D9%D8%B1%D9%D8%A9\\_%D8%A7%D9%84%D9%85%D9%82%D8%A7%D8%B7%D8%B1%D8%A9](https://en.wikipedia.org/wiki/%D9%85%D8%AF%D9%D8%B1%D9%D8%A9_%D8%A7%D9%84%D9%85%D9%82%D8%A7%D8%B7%D8%B1%D8%A9)

## Section Two: Analysis of Secondary Sources in the Field of Renewable Energy

### The first topic: Market Analysis <sup>(8)</sup>

Naturally, Yemen's location is very suitable for the exploitation of solar energy, along with other renewable sources such as wind and geothermal energy. However, the demand for solar energy is increasing, especially in remote areas where the connection to the electrical grid is unreliable or unavailable, and the high cost of electricity and frequent power outages make solar systems a viable alternative. In addition, the demand for solar energy in the agricultural sector is growing, especially for pumping water to improve the current situation of food security. The main players and competition in the market, based on the dynamics of the value chain, are importers, wholesalers, local distributors, users, microfinance institutions, technicians, NGOs, and training centers, as mentioned in the following figure:

Figure (1): Illustration of local actors in the solar energy sector in Yemen



Source: [https://eadp.eu/uploads/WP201901\\_Yemen\\_Solar\\_AR.pdf](https://eadp.eu/uploads/WP201901_Yemen_Solar_AR.pdf)

### The second topic: Market Challenges and Business Opportunities

After the outbreak of the conflict in Yemen, the demand for renewable energy products increased, but the focus was on solar energy due to widespread power outages. This led to the flow of solar energy products to the market, especially in remote areas. However, the lack of experience among key stakeholders, such as importers, sellers, and end users, coupled with the lack of strict regulations and quality control in ports, led to the spread of poor-quality solar energy products. These products, often small in size and poorly manufactured, quickly flooded the market. Especially in rural areas, as a result, the reputation of solar energy systems in Yemen has been affected, as many users have suffered from frequent malfunctions and inefficiencies, which undermine confidence in solar energy technology. In addition, some experts pointed out that most solar energy systems implemented before 2018 are no longer functional, and this is largely due to the poor quality of products and improper practices by end

(8) [https://eadp.eu/uploads/WP201902\\_Yemen\\_Solar\\_EN.pdf](https://eadp.eu/uploads/WP201902_Yemen_Solar_EN.pdf)

consumers. These factors have greatly shortened the expected life of solar energy systems, preventing them from achieving Their expected normal operating life <sup>(9)</sup>, and this situation highlighted the need to improve quality control, regulation, and consumer awareness to ensure that only reliable solar systems are used throughout the country<sup>(1 )</sup>.

However, the quality and types of solar energy systems in Yemen have witnessed a remarkable development in recent years. Thanks to customs exemptions implemented in May 2020, the costs of solar modules, batteries, and inverters have decreased, making them more accessible. However, challenges such as the impact of port closures have led to high prices and delays in shipments. Most of the solar energy components used in Yemen are imported from China and India. Shipments usually take from (3) to (4) months to reach the main warehouses. Over time, a remarkable shift has occurred in the market, as both traders and customers have become more aware of the importance of high-quality solar components, and have moved away from the lower-quality options that were previously more common.

Based on our review of several sources, there is great potential for young people to establish commercial projects in the solar energy sector in Yemen. Some promising opportunities include:

- a) **Installation and wholesale of small solar systems in rural areas:** Youth can benefit from the demand for affordable and accessible solar energy by establishing commercial projects that sell and install small solar systems in rural areas, and this is especially applicable where access to electricity is limited.
- b) **Solar and Wind Water Pumping Services:** Another business opportunity is to provide installation and maintenance services for solar or wind water pumping systems Although the initial capital investment is higher, this can be mitigated through partnerships or community financing models, making it an attractive business for young entrepreneurs.
- c) **Microgrids in market areas:** Establishing solar-powered microgrid systems in local market areas can provide constant power to businesses and vendors. This business model supports economic activities in rural communities and ensures a reliable energy source for trade.
- d) **Training and education programs on solar technology:** Youth can also focus on capacity building by offering training programs that increase awareness and technical skills related to solar energy. This not only creates jobs but also enables the community to adopt solar energy solutions more effectively.
- e) **Solar Mobile Maintenance Services:** Mobile maintenance units for solar systems can be developed to meet the needs of remote areas.
- f) **Manufacturing and assembling solar energy systems** Youth entrepreneurs can enter the field of manufacturing and assembling solar energy components and integrate them with other technologies to provide customized solutions. This region has growth potential, especially with the increasing demand for locally produced systems.

These business ideas are not only feasible but can also contribute to the broader goals of energy access, economic development, and environmental sustainability in Yemen. However, data collected from the field will be necessary to validate these ideas and discover additional potential opportunities in the solar sector. This empirical evidence will help improve the proposed business models and ensure that they are tailored to the specific needs and conditions of communities in Yemen.

---

(9) <https://library.fes.de/pdf-files/bueros/jemen/19520.pdf>

(1 ) [https://eadp.eu/uploads/WP200902\\_Yemen\\_Solar\\_EN.pdf](https://eadp.eu/uploads/WP200902_Yemen_Solar_EN.pdf)

### The third topic: Policies and regulations

Most solar energy products in Yemen currently lack comprehensive regulations, especially concerning taxes and customs. Recently, the authorities in Sana'a enacted a law to regulate these aspects. However, the restrictions imposed by the coalition, including the prohibition of some solar energy inputs, have negatively affected prices and timely access to solar energy systems. The following is a summary in this regard<sup>(1)</sup>:

- **Customs exemptions:** These were implemented in May (2020), as these exemptions reduced customs duties on solar modules and batteries, which encouraged the import of high-quality solar components.
- **Impact of Port Closures:** The closure of most shipping ports has contributed to the rise in prices of solar components and the delay of shipments.
- **Import of components:** Most of the solar components are imported from China and India, with shipments taking approximately (3) to (4) months to reach the main warehouses in Yemen.
- **Market transformation:** The solar market has undergone significant changes in terms of products, as traders and customers have become more aware of the importance of purchasing high-quality solar components.
- **Current challenges:** Institutional weaknesses, lack of law enforcement, and economic issues have hindered the progress of renewable energy projects.

It is worth noting that the United Nations Development Programme (UNDP) in Yemen recently developed strategies that highlight important renewable energy opportunities across the country. The new UNDP Renewable Energy Hybrid Investment Plan emphasizes the potential of both on-grid and off-grid clean energy solutions. This strategy not only identifies large-scale opportunities but also highlights the need for local capacity building and skills development.

The strategy indicates that while solar energy remains a great opportunity, especially for youth to participate in business sectors or support services, there is an urgent need to strengthen local technical expertise to take full advantage of these opportunities. It also addresses the importance of job creation in the renewable energy sector, to empower local communities and contribute to sustainable development in Yemen<sup>(1)</sup>.

### The fourth topic: Opportunities

As for opportunities, many interventions to support solar energy projects have improved access to communications and employment opportunities in the solar energy sector, which benefits local communities, as there is a demand for employment at all levels, from large importers to small local shops, and many vendors are looking for employees with experience in sales and maintenance, indicating a growing market for trained personnel. Areas of opportunity can be identified as follows<sup>(1)</sup>:

- **Increasing job opportunities:** The solar energy sector creates jobs, especially in the field of maintenance and sales. The community's exposure to solar energy solutions leads to the

---

(1) Friedrich-Ebert-Stiftung. (n.d.) Sustainable Transformation of Yemen's Energy System. Retrieved from <https://library.fes.de/pdf-files/bueros/jemen/19245.pdf>

(1) <https://www.undp.org/yemen/press-releases/private-sector-engagement-and-renewable-energy-investment-are-key-boosting-sustainable-development-yemen>

(1) UNDP, 2020, *Good Practices and Lessons Learned: Solar Interventions Under-Ery Project in Yemen*

development of interest and knowledge, which enables individuals to participate in the solar energy market.

- **Productivity enhancement:** The installation of solar photovoltaic systems in production associations has led to increased working hours and business recovery. For example, dairy associations in Hodeidah have increased their working hours from six to thirteen hours per day, which is of particular benefit to women.
- **Cost savings:** Associations reported an average monthly savings of more than YR (75,000) (approximately US \$127) previously spent on diesel, allowing for reinvestment in raw materials and household expenses.
- **Social cooperation:** Solar energy systems promote community participation, with production associations acting as hubs for training and social events, fostering cooperation and support among members.

Increasing local expertise in solar energy systems, especially in the agricultural sector, coupled with the relatively less technical complexity of these systems compared to fossil fuel systems, has driven their widespread deployment<sup>1</sup> .<sup>4</sup>

The costs of renewable and clean energy technologies have been reduced, so many countries plan and invest in these technologies, and many countries have set ambitious goals to diversify and develop their energy mix by increasing the share of renewable sources. This transformation not only enhances energy security but also addresses concerns related to climate change<sup>1</sup> .<sup>5</sup>

Moreover, the low prices of solar energy systems globally and the availability of small-scale systems with reasonable capabilities have contributed to the growth of the solar energy market in Yemen significantly. These smaller systems are especially accessible to households, which has led to their widespread adoption, especially in rural areas. After-sales services are also a valuable job opportunity for youth. While most vendors do not offer these services, especially in remote areas, there is a growing demand for maintenance and support, making it a promising sector for young entrepreneurs to explore, providing reliable after-sales support can improve customer satisfaction and build confidence in the solar market, driving its further expansion.

---

(1) <https://fycci-ye.org/upload/17240626523.pdf>

(1) [https://devchampions.org/uploads/publications/files/RYE\\_25\\_PolicyBrief\\_Scaling-up\\_Solar\\_Energy\\_Investments\\_in\\_Yemen\\_AR-1.pdf](https://devchampions.org/uploads/publications/files/RYE_25_PolicyBrief_Scaling-up_Solar_Energy_Investments_in_Yemen_AR-1.pdf)

## The fifth topic: Challenges facing the solar energy sector in Yemen

The challenges facing entrepreneurs and the solar energy sector in Yemen, especially for small and medium enterprises, are large and multifaceted, and the following is a summary of the main challenges

(1) (1) (1) :

6 7 8

### 1. Financial Challenges:

- **Microfinance:** More than (60%) of private institutions, including SMEs, rely on self-financing due to the scarcity of financial institutions and sources in Yemen, and this limits the ability of SMEs to invest in solar energy projects.
- **High profit margins:** Local financial institutions, such as banks, charge high commission margins, which reduces the demand for financing solar products, especially those with advanced technology and higher costs.
- **Difficulty in recovering financial guarantees:** The private sector faces challenges in recovering financial guarantees deposited in local banks when the project is completed, due to weak government revenues, which weakens the desire for new projects and partnerships.

### 2. Institutional and Infrastructure Challenges:

- **Absence of government policies:** There is an absence of government policies and strategies dedicated to renewable energy, with a continued focus on traditional energy sources.
- **Inadequate institutional laws:** Inadequate laws and institutions, especially about investment and trade, reduce the incentive for domestic investment in renewable energy.
- **Poor quality control:** There is a lack of national specifications for solar energy systems and products, which leads to the flow of counterfeit and non-standard products, damaging the reputation of legitimate companies.
- **Poor infrastructure:** Yemen's infrastructure, especially concerning the transport and storage of renewable energy, is poor due to aging and war-affected public electricity grids.

### 3. Operational Challenges:

- **Higher transportation costs:** Higher fuel prices have increased transportation fees, adding to the overall cost of solar products, especially in rural areas.
- **Lack of technical expertise:** There is a lack of technical expertise and specialized training for engineers and technicians in the field of solar energy, which hinders the development and operation of renewable energy projects.
- **Limited access to finance:** Retail and convenience stores struggle with financial liquidity, and there is no access to finance from MFIs and banks to support their businesses.

These challenges present significant obstacles to the growth of the solar energy sector in Yemen, especially for SMEs and entrepreneurs, and addressing these issues requires coordinated efforts to improve access to finance, strengthen institutional capacity, enforce quality control, and strengthen technical expertise within the sector.

---

(1) <https://fycci-ye.org/upload/1720626523.pdf>

[1] <https://www.youtube.com/watch?v=ulBrqz4OYEw> |||UNTRANSLATED\_CONTENT\_END

1 United Nations Development Programme. |||UNTRANSLATED\_CONTENT\_END|||Solar Energy Systems Value Chain  
. <https://www.undp.org/yemen/publications/solar-energy-systems-value-chain>.

#### 4. Recommendations for SMEs in the solar energy sector:

- **Supporting youth with seed capital:** To empower youth with seed capital to launch businesses, it is essential to collaborate with MFIs and key stakeholders. This initiative should provide access to finance through dedicated microcredit and grants, facilitate collateral to mitigate financial risks for lenders, and establish business linkages between established private companies to provide guidance and support. In addition, a framework for effective partnership management should be put in place to ensure ongoing collaboration between young entrepreneurs and private sector stakeholders.
- **Enhancing training programs:** Focus on improving awareness and capacity-building initiatives related to solar systems installation. Encourage wider participation by family members in training sessions and distribution of educational materials to increase understanding of solar technology and its benefits.
- **Ensuring high-quality installations:** Prioritizing safe and secure installation practices that can withstand environmental challenges, such as high winds and wildlife interference (especially for fans), will not only protect investments but also enhance customer satisfaction and product trust.
- **Enhancing sales maintenance and training:** Implementing training programs covering both maintenance and sales along with distributing solar lanterns. This approach will help create job opportunities for youth, build local expertise, and ensure the sustainability of solar projects.
- **National specifications:** Cooperation with quality control and monitoring bodies in Yemen to complete the national specifications for solar energy products. Ensure customs officers are trained to only allow compliant goods, which enhances product quality in the local market.
- **Local manufacturing:** Encouraging local investors to establish factories for solar products, and benefit from technology transfer projects, will help promote competition with imported goods, save foreign currency, and strengthen the Yemeni economy.
- **Financial partnerships:** Urging microfinance institutions and banks to form strategic partnerships within the solar value chain, including financing startups and expanding existing companies, in addition to financing agricultural investments that use clean energy solutions, which reduces high fuel costs.
- **Consumer Awareness:** Raising awareness of energy-efficient and efficient appliances among consumers, and providing continuous maintenance services to promote a culture of renewable energy.
- **Financial support for solar energy initiatives:** Promoting loans to consumers and micro, small, and medium enterprises to invest in solar energy systems and energy-saving devices, and supporting community microgrids and solar pumping for agriculture and basic services such as schools and health facilities.
- **Research and Development:** Establishing research and development institutions focused on introducing innovative technologies, such as hybrid systems, energy-efficient devices, battery recycling, and other renewable energy technologies will help improve installation quality and optimize energy use.

### **Section Three: Field Study**

This section of the study begins with the actions that have been followed to implement the field study, including the work plan, training the field team, and preparing data collection tools to ensure their validity to achieve the objectives of the field study.

#### **The first topic: Field study processes**

##### **1. Data collection tools**

At this stage, several processes were implemented to prepare for the fieldwork, which are as follows:

- Developing the work plan, methodology, and implementation mechanism.
- Review of secondary sources (previous studies from organizations and the government sector and evaluations of previous projects).
- Mapping and identifying target and sample locations in each area.
- Preparing the tools for the evaluation process according to the samples specified in the technical offer, including a questionnaire tool (individuals, shop owners, traders, and service providers - the public sector - the private sector (wholesalers, retailers, and service providers) and interview tools (international organizations - local organizations - financing institutions) and a focus group discussion tool (individuals - traders).
- Presenting the tools to experts in the scientific research side and a statistical analyst.
- Send the tools to the YLDF to review them and absorb the observations.
- The questionnaires were designed electronically using the Kobo Toolbox.
- Testing tools and the electronic form on a simple sample.
- Modify the instruments according to the test results.

##### **2. Field Team Selection and Training**

At this stage, the fieldwork team was selected and trained on the tools. The procedures were as follows:

- Selection of field researchers based on several criteria, namely: experience in fieldwork, that it is from the same target areas, that it is good to be creative, conduct, and deal with the community.
- Receiving many biographies of researchers.
- Sorting and reviewing resumes and selecting the team according to the criteria.
- Contracting with researchers and determining the responsibilities, roles, and specific outputs of each researcher.
- Establishing a WhatsApp group with researchers to follow up with the field team, address challenges, and send daily reports.
- Implementation of a training course for field researchers on Friday (23/08/2024 ) to explain the tools, mechanism of work, and required outputs and develop proposals to meet the expected challenges.
- Preparing field plans, the criteria associated with each sample, and the timetable for the researchers' work.
- Follow up daily for researchers and address challenges.
- Review the electronic entry forms with the daily reports sent by the researchers.
- Review field researchers' reports and ensure the quality of outputs.
- Statistical analysis through the SPSS program.

### 3. Challenges and Remedies

The field study faced several challenges, which were addressed according to the following table:

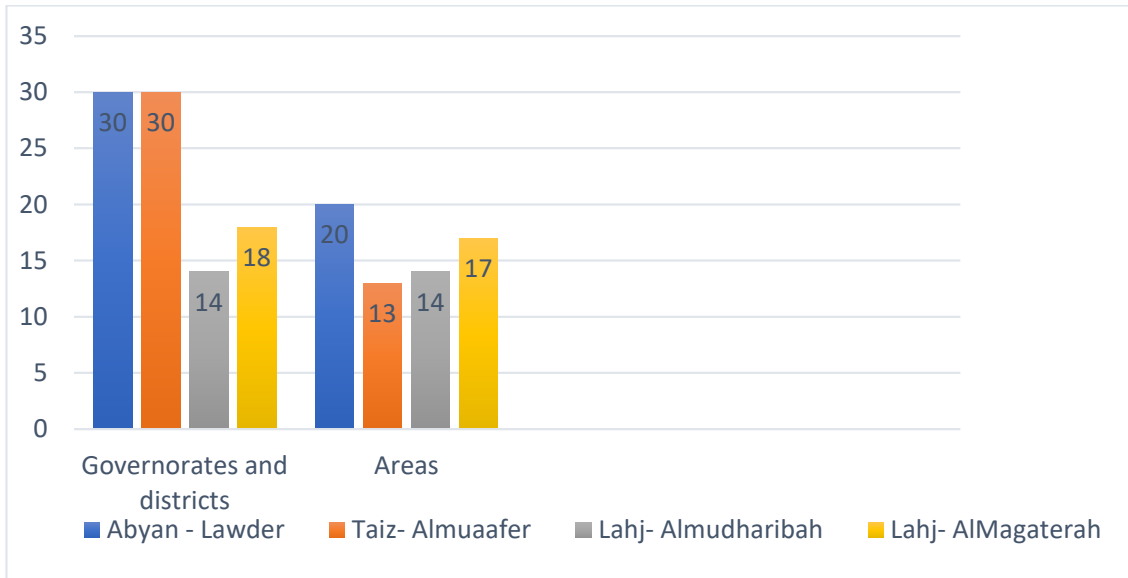
Challenges	Treatments
There are no headquarters for international organizations or funding institutions in the targeted areas.	Executive offices or the closest headquarters to the targeted areas were used.
In some areas, there are no wholesalers in the targeted areas	The scope was expanded by targeting retailers' and wholesaler's proximity to the targeted areas
Some individuals require a funding opportunity in exchange for their cooperation in answering the questionnaire.	It was clarified by the researchers that the study has nothing to do with supporting and may generate opportunities for the community in interventions by the relevant authorities.
Lack of access to secondary references	All available sources have been used.
Weak Internet in some targeted areas, which hindered the work of researchers in sending daily reports	Searching for an area near where the Internet is available

## The second topic: Renewable energy needs of individuals and business owners

This part of the study aims to assess the needs of individuals and retailers in the field of renewable energy by analyzing opportunities and skills. This assessment seeks to identify current gaps in the renewable energy market and identify opportunities to develop innovative solutions that meet the needs of these groups in the targeted areas.

### 1) Governorate, District, and Region

Figure No. (2) shows the distribution of sample members by governorates, directorates, and regions



The questionnaire was distributed to a random sample of (92) individuals over three governorates: Abyan, Taiz, and Lahj. The distribution was equally distributed among the three governorates. As for the villages or neighborhoods, the distribution varied, as the Lahj governorate increased by (31) areas, while the number in Taiz reached (13) and Abyan (20).

This balanced distribution aims to ensure a fair representation of all the target areas in the study, which enhances the strength of its results and their dissemination at the level of managers and similar villages.

### 2) Target group :

Figure No. (3) shows the distribution of sample members by category

The data in the table below indicate that the study focused more on individuals compared to shops, as the percentage of targeted individuals was (77%) compared to (23%) for shops, and this distribution makes sense given that the number of individuals in the community is much larger than the number of shops.

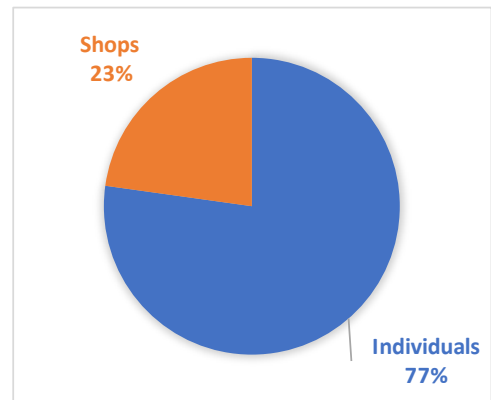


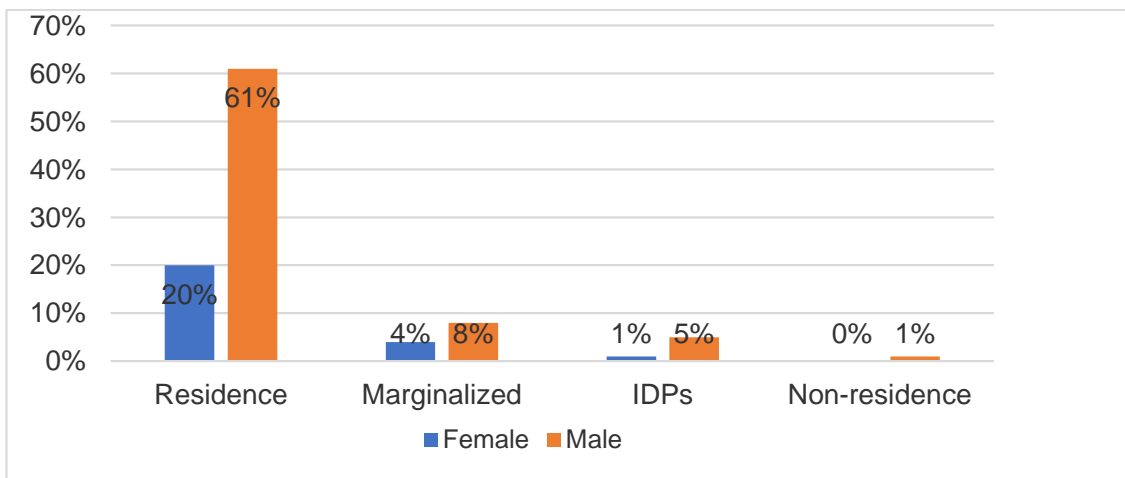
Table No. (2) shows the level of use of solar energy by shops (solar energy system)

Shop Type	Frequency	Percentage
Groceries	2	11
Fuel Selling Station	2	11
Desalination Plant	2	11
Restaurant	2	11
Cooling refrigerator	1	5
Pharmacies	1	5
Cafeteria	1	5
Sweets shop	1	5
Clothing store	1	5
Toaster	1	5
Car wash	1	5
Blacksmith Workshop	1	5
not used	3	16
<b>Total</b>	<b>19</b>	<b>100</b>

It is clear from the table that most shops rely on solar energy and (84%) of the total shops, grocery stores, fuel stations, and desalination plants are among the most shops that use solar energy, and this is due to their continuous need for lighting, as they represented (33%) of the total shops. In general, most shops suffer from government power cuts, which negatively affects their business and interests. The costs of purchasing fuel to operate generators are also a major burden for shop owners, especially under difficult economic conditions, so solar energy provides a sustainable and reliable solution to the energy needs in these areas.

### 3) Residence Status Gender

4) Figure No. (4) shows the distribution of the sample according to residence and gender



The graph shows the distribution of the study sample by residence status and gender and shows that the vast majority of study participants are male (75%), with a reasonable percentage of females (25%), and that most of them are permanently residing in the targeted areas (81%).

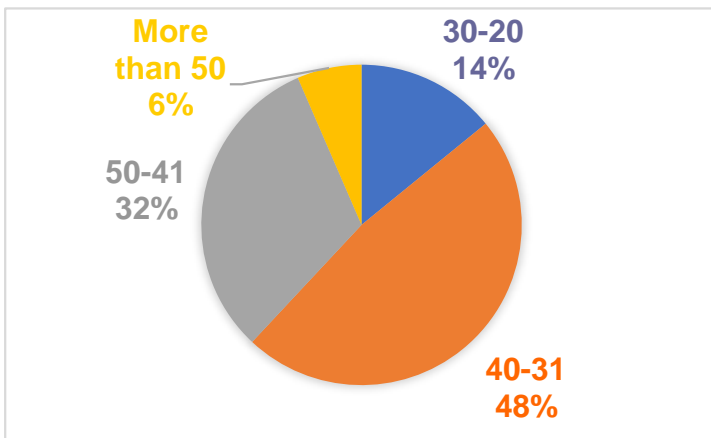
Despite the focus on permanent residents, the study was keen to include segments of vulnerable groups such as the marginalized and the displaced, as the percentage of marginalized groups (12%) and the

displaced (6%) in the sample, taking into account the gender variable in each category. This distribution indicates that the sample well represents the population diversity in the targeted areas, as special attention was paid to including the most vulnerable groups, which enhances the comprehensiveness of the study and its ability to provide a clear picture of the current situation.

Despite the superiority of males, as they control the management of money and the purchasing process mostly, the presence of a significant percentage of females in the sample highlights the importance of including their opinions in studies, especially since the role of women in the Yemeni family is gradually increasing.

### 5) Age

Figure No. (5) shows the distribution of sample members by age

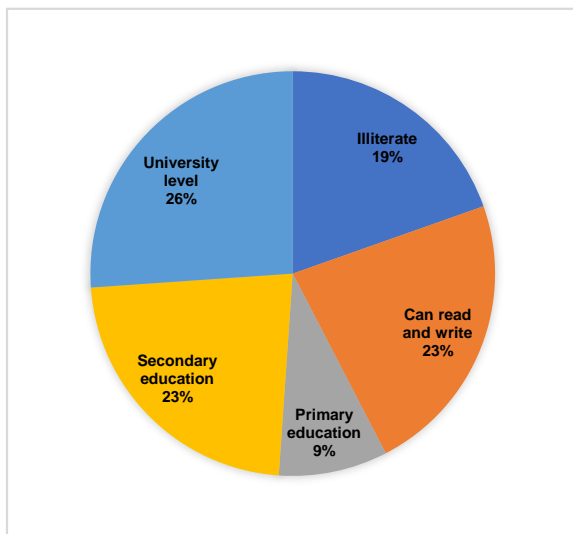


The data in the table indicates that the majority of the sample is concentrated in the age group between (31-40) years (48%), followed by the age group between (41-50) years, (32%). This concentration in the two middle age groups is usually associated with the stage of marriage and family formation, which increases the need for renewable energy to meet the daily life requirements of families. The age group between (20-30) years comes in third place by (14%), which is lower compared to the previous two categories, and this is mainly due to the low

marriage rates in this age group. As for the age group over (50) years, it represents a lower segment in the sample. Overall, this age distribution reflects a model of the nature of the demographics in the target areas and well represents the energy consumption-related needs in these age groups.

### 6) Education Level

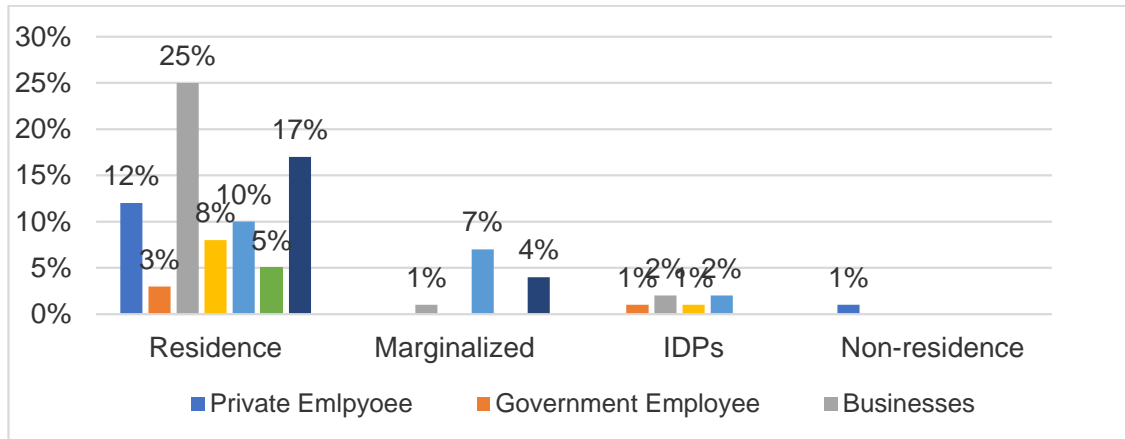
Figure No. (6) shows the distribution of the sample according to the educational level



When analyzing the educational level of the sample, it was found that the highest educational percentage was for university graduates (26%), followed by the segment of those with a high school diploma (23%). It is worth noting that the percentage of those who read and write also reached (23%), which indicates a diversity in educational levels within this category. As for illiterates, they constituted (19%) of the sample, while the percentage of those with basic education did not exceed (9%). This distribution reflects diversity in the educational level of the sample, which corresponds to the varying nature of the target areas, and the representation of all educational groups in reasonable proportions increases the strength and comprehensiveness of the study, which allows for more accurate results.

## 7) Field of work and residence

Figure No. (7) shows the distribution of sample members by field of work and residence



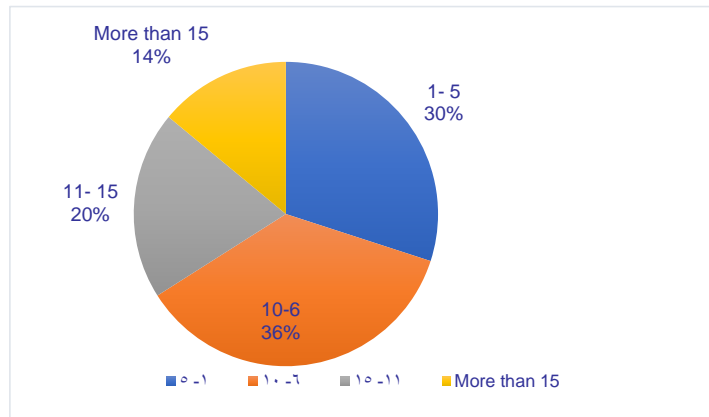
The indicators of the graph reveal that the majority of the respondents, (25%), own their businesses, and most of them are residents. This reality reflects the high dependence on the informal sector in providing job opportunities, especially in light of the limited employment opportunities in the public and private sectors, as the percentage of workers in the public sector reached (3%) only, while the percentage of workers in the private sector reached (12%). (10%) of the unemployed were also included in the sample, and (5%) were housewives. As for the marginalized, their total percentage is (12%), they are distributed among (7%) unemployed and (1%) have a private project, as well as the displaced, (1%) work for the government, (2%) have a private project, (1%) workers, and (2%) are unemployed.

This reflects the challenges facing the labor market in the studied region, and this diversity in employment conditions ensures a fair representation of all target groups, which contributes to enriching the results and disseminating them to the study community.

## 8) Years in business/work

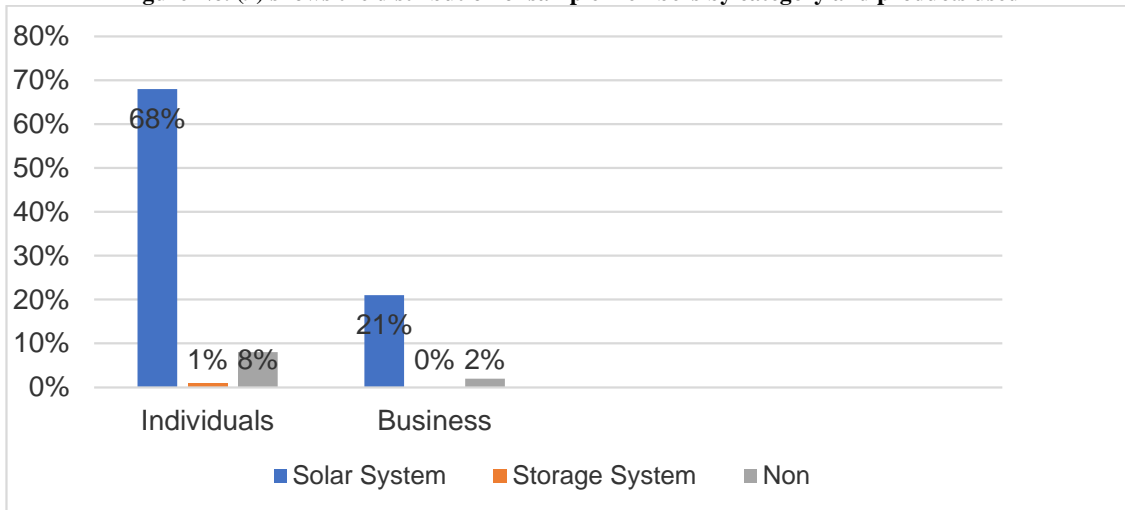
Figure No. (8) shows the distribution of the sample according to years of work experience

The results of the graph show that the majority of the sample members who work, (20%), have more than (11) years of work experience, while the percentage of individuals with less than (5) years of experience is about (30%), and (36%) have an average experience ranging from (6-10) years. This diversity in years of experience reflects a variation in the experiences and skills of the sample members, which contributes to a deeper understanding of their needs related to renewable energy. It is expected that individuals with long experience will have a broader view of the challenges facing the sector, and thus be more willing to adopt new technologies such as renewable energy.



### 9) The products you use in your home or business

Figure No. (9) shows the distribution of sample members by category and products used

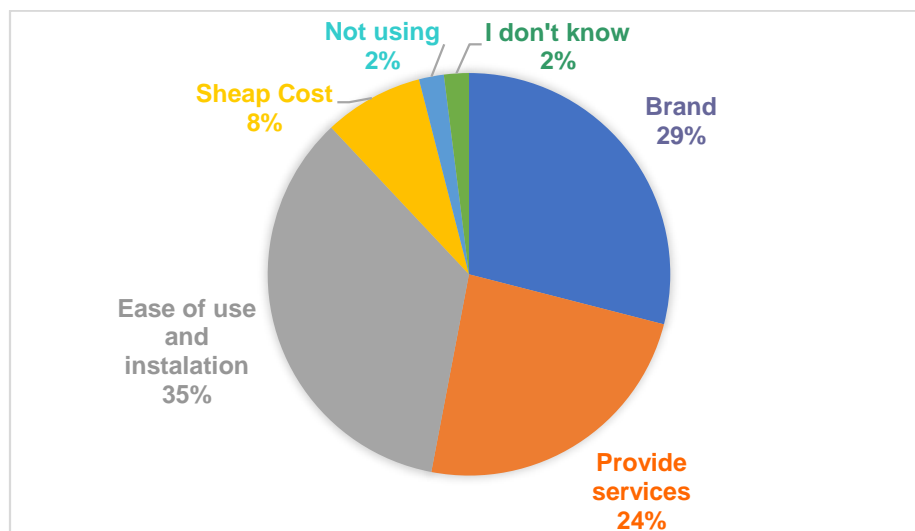


The sample was asked about renewable energy products used in their homes or businesses and the following options were presented: solar energy systems, energy storage systems, wind turbines, and solar heaters.

The results of the graph show that there is a great focus on the use of solar energy systems among the sample members, whether individuals or shops, as the percentage reached (89%). However, the use of storage systems, especially batteries, was very limited, as it reached (1%) only and is an important part of the solar energy system and is rarely used individually. On the other hand, a segment of individuals who do not use any type of renewable energy systems was included, which provides a more comprehensive picture of the trends in the use of these technologies. This focus on solar energy is attributed to several factors, including the availability of these systems in the local market and their reasonable cost compared to other systems such as turbines. No results of solar heaters or any other technologies were shown in the sample answers.

### 10) Preferred Quality Selection Criteria in Renewable Energy Products

Figure No. (10) shows the distribution of the sample according to the criteria for choosing the preferred type



In light of the focus of the sample members on the solar energy system according to the previous answer, the criterion of ease of use and installation (35%) is one of the most important criteria in the selection of consumers, as they prefer products that can be installed and operated easily without the need for advanced technical expertise, and this indicates the desire of consumers for practical and comfortable solutions, especially since they are in remote areas.

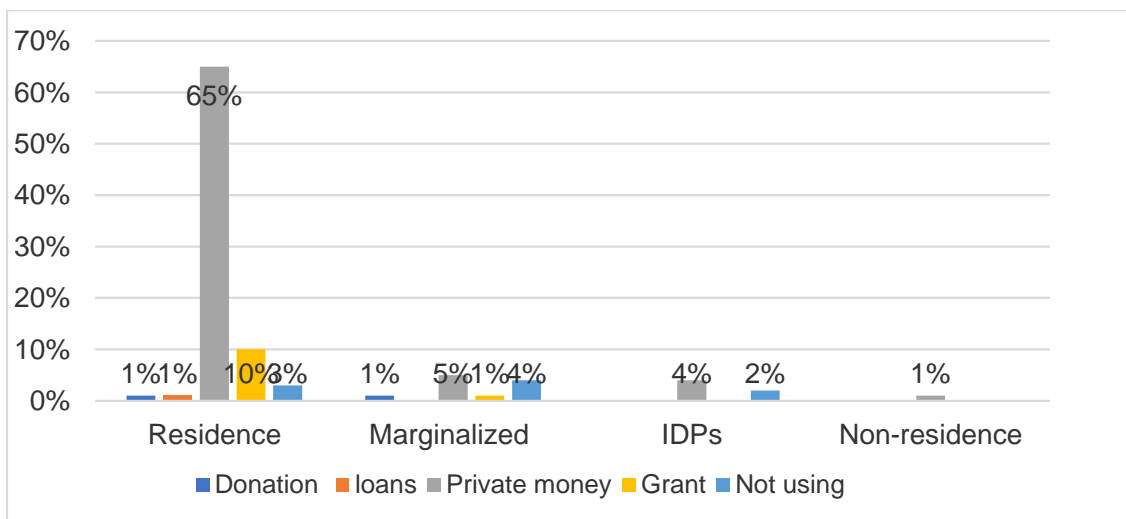
Brand type (29%) comes second, with the brand name playing a crucial role in building consumer trust. This is based on the brand's reputation in the market, and its history of delivering reliable products.

As well as providing maintenance capabilities (24%), this criterion is also very important to consumers, as it ensures the long-term continuity and efficiency of the product. It also reflects their concern about the availability of spare parts and maintenance services in case they are needed. As for the cheap cost criterion (8%), despite being an influential factor, the cost alone does not entice consumers to pay more for a high-quality and effective product that lasts for a long time.

Also, the choice is non-use and lack of knowledge (4%) This percentage indicates an opportunity to increase awareness of renewable energy products and their benefits, which requires intensive awareness and marketing efforts.

### 11) Residence and funding sources

Figure No. (11) shows the distribution of the sample according to the residence and sources of funding



The diagram shows the distribution of the study sample according to the status of residence and the method of obtaining renewable energy products, and shows that the vast majority of the study participants are permanent residents (80%), and that the main source of funding for these products is private money purchase (65%) for both marginalized and displaced people.

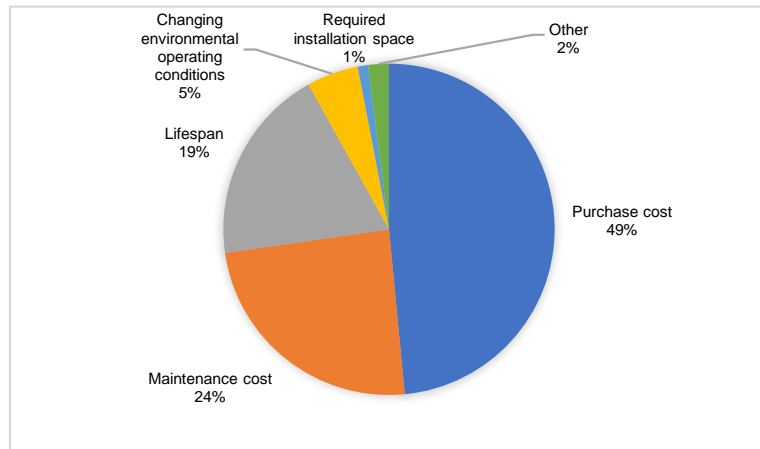
Bank financing focused on a single case with an existing project, as banks generally provide funding to established business owners. Additionally, grants were limited to residents only, except for one instance involving a marginalized individual. This highlights the critical need for prioritizing vulnerable groups when organizations implement renewable energy distribution projects.

The analysis reveals a high reliance on self-financing, especially among permanent resident groups. However, a large gap in funding appears to be directed to vulnerable groups such as the marginalized and displaced, raising questions about the effectiveness of current efforts to mainstream the use of renewable energy among all segments of society.

The high reliance on buying with private money indicates that individuals and shop owners rely heavily on their resources to finance the purchase of renewable energy systems. This indicates that there is a strong community will to adopt these technologies, but at the same time, it indicates that there is a significant financial barrier facing many families and shops and reveals opportunities to invest in renewable energy in these areas.

### 12) Challenges to the use of renewable energy systems

Figure No. (12) shows the distribution of the sample according to the field of challenges in the use of renewable energy systems



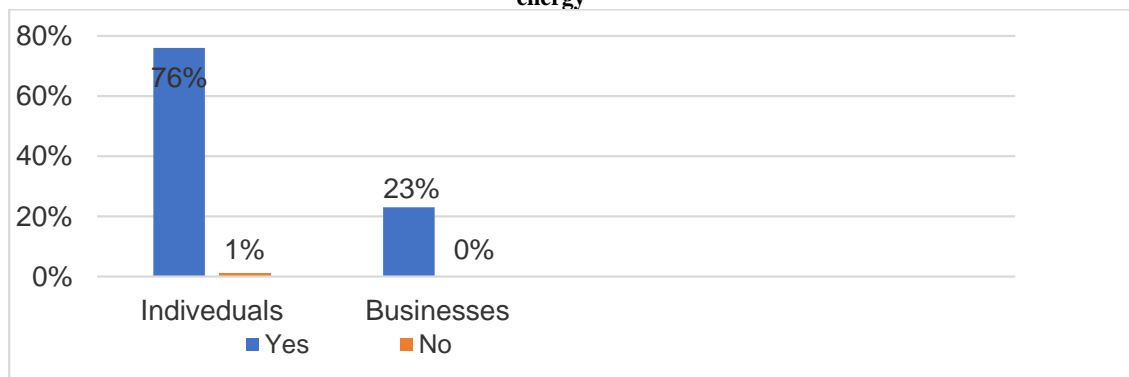
The results of the graph show that the biggest challenge facing users of renewable energy systems in the targeted areas is the initial cost of purchase, which reached (49%), mainly due to the difficult living conditions in these areas, which make the purchasing power of individuals limited. The second challenge is the cost of maintenance, at (24%), partly due to the difficulty of obtaining specialized maintenance services in these areas, which may lead to high

repair and replacement costs. (19%) of the respondents also pointed to the shelf life of storage systems as one of the main challenges, and this challenge is related to the quality of the components used in these systems, as high-quality systems are often more expensive. As for changing environmental operating conditions, the percentage of answers to them was less, because the targeted areas are generally characterized by abundant sunlight throughout the year, which reduces the impact of climate changes on the performance of the systems.

In describing the challenges, the respondents indicated that the cost of the renewable energy system is high within the framework of low income, short shelf life of storage systems, and high maintenance costs as a result of distance, poor quality in the market, and lack of coverage of the need. There is not enough space to develop the system, which shows that there is a problem in the design and indicates that there is a need and opportunities for investment in this field.

### 13) Do you recommend renewable energy to others?

Figure No. (13) shows the distribution of sample members by category and the recommendation to use renewable energy

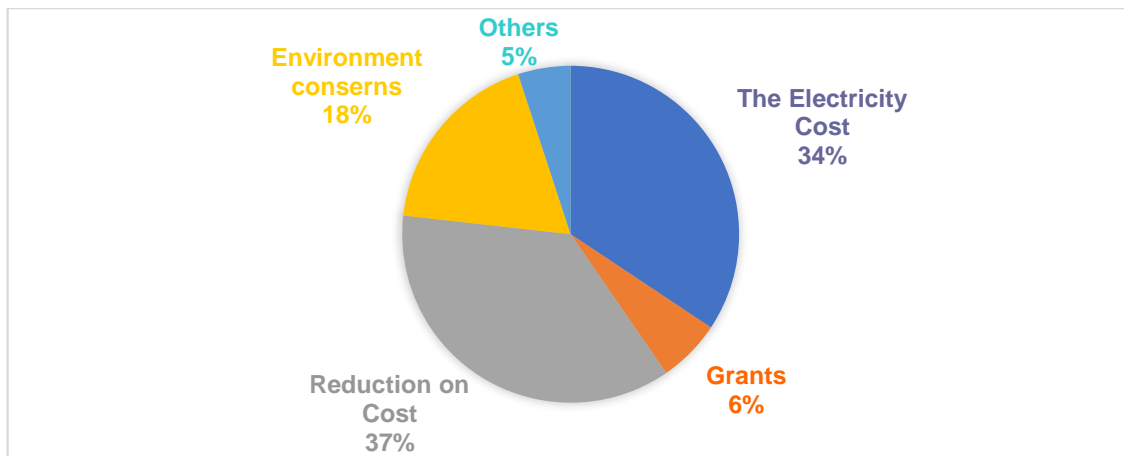


The results of the survey showed that the vast majority of the sample (individuals and shops), (99%), recommended the use of renewable energy. This high turnout reflects an increasing awareness of the importance of these technologies and an urgent desire to move to sustainable energy sources. However, as previous results indicated, the high initial cost of these systems is still a major obstacle that prevents many from adopting them. This discrepancy between the desire to use and the financial challenges highlights the need to provide financial incentives and technical support to help individuals overcome these obstacles. It is worth noting that this collective awareness is very close to the fabrication of educational levels and the areas in which the population lives.

The reason for this is a high awareness of the importance of these technologies, accompanied by the absence of public electricity in these areas and the high cost of traditional electricity based on oil derivatives through generators in light of the high prices of oil derivatives.

#### 14) The motivation for using renewable energy.

Figure No. (14) shows the distribution of the sample according to the criteria for the use of renewable energy



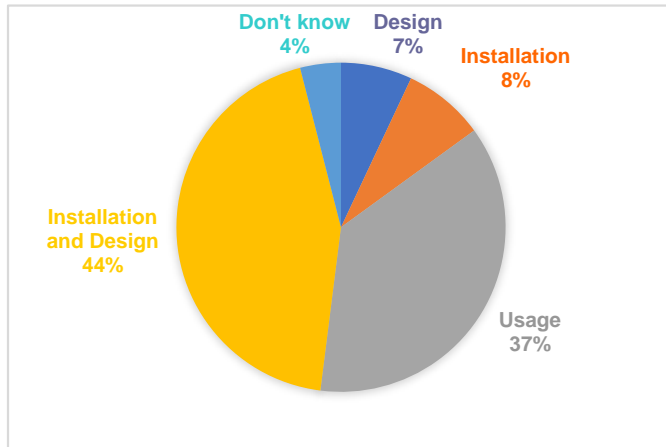
The results of the graph show that the main motivation behind the adoption of renewable energy in the targeted areas is the desire to obtain low-cost energy compared to traditional electricity, as this percentage (37%) of the total reasons, due to the high prices of traditional electricity, especially in light of the harsh climatic conditions in these areas, which require intensive use of cooling during the summer, which increases electricity bills significantly, the respondents confirmed that the cost of traditional electricity is high (34%).

In addition, the results showed the existence of environmental awareness among some individuals, as (18%) of them stated that they wish to preserve the environment, and the support provided by civil society organizations played a role, although limited, in encouraging the use of renewable energy, as (6%) of the respondents stated that they benefited from support programs.

This analysis indicates that the motivations of individuals to adopt renewable energy are multiple and intertwined, as economic and environmental considerations overlap, and this diversity of motivations reflects the importance of designing policies and programs that stimulate investment in renewable energy, with a focus on providing affordable solutions and raising community awareness of the importance of these technologies.

### 15) Basic skills required when purchasing a renewable energy product

Figure No. (15) shows the distribution of the sample according to the basic skills required when purchasing renewable energy technologies



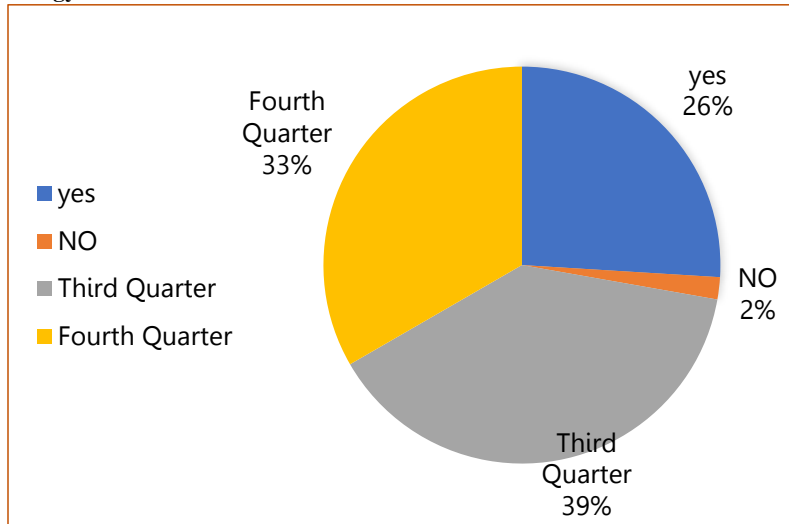
The results of the survey revealed that the main skill that respondents look for when buying renewable energy products is ease of installation and use, as the percentage of those who prefer this feature (44%) This high demand for easy-to-use products indicates that there is a gap in consumers' knowledge about renewable energy technologies, especially solar systems, which constitute the vast majority of their interest.

Here several challenges arise, as the focus on ease of installation and use reflects a lack of technical knowledge among consumers,

which makes it difficult for them to assess the efficiency of different systems and determine their actual needs, as well as the interest in use has risen to (37%) and by simple percentages for design and installation. These indicators emphasize the urgent need to provide specialists in the field of installation, operation, and maintenance of renewable energy systems, to provide the necessary support to consumers and meet their needs.

### 16) High purchase or maintenance costs for renewable energy products

Figure No. (16) shows the distribution of the sample according to their opinion about the high costs of renewable energy



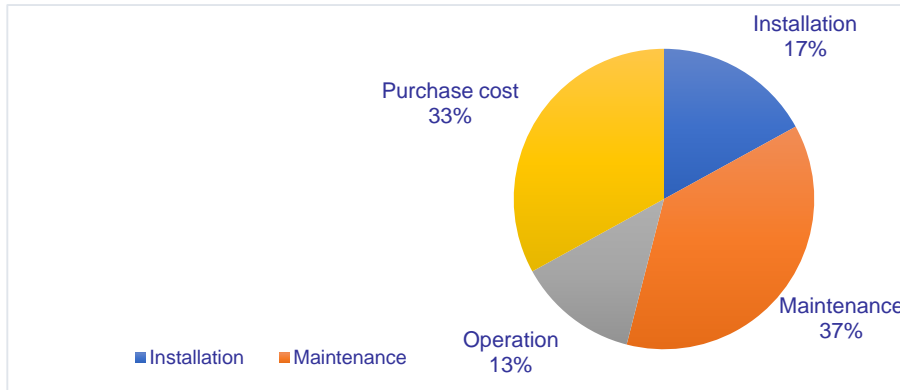
The results of this graph unequivocally confirm our findings in previous analyses, which indicated that high procurement and maintenance costs represent a major barrier to individuals' adoption of renewable energy systems. With an approval rate of (93%), survey participants stressed that these costs negatively affect their ability to adopt these technologies.

This broad consensus suggests that the decline in the standard of

living for this segment of society plays a crucial role in constraining their energy choices, as the rising cost of living in general, coupled with the additional costs associated with adopting new technologies, makes it difficult for individuals to bear these financial burdens.

## 17) High-cost services in renewable energy

Figure No. (17) shows the distribution of sample members according to high-cost services



The results of this figure confirm the previous results that indicated the high maintenance costs of renewable energy systems, as the majority of respondents believe that the maintenance cost is the highest compared to the rest of the services associated with these systems (37%).

The high maintenance costs are mainly due to the scarcity of engineers and technicians specializing in the maintenance of renewable energy systems, which leads to increased demand for their services and high prices. Users also bear additional costs such as transportation costs to remote places and installation fees, which increase the total maintenance costs.

(33%) of the respondents also referred to other services as expensive, and when scrutinizing these services, it was found that most of them are related to procurement costs. This indicates that the high costs of procurement and maintenance represent a great burden on individuals in these areas, especially in light of the difficult living conditions.

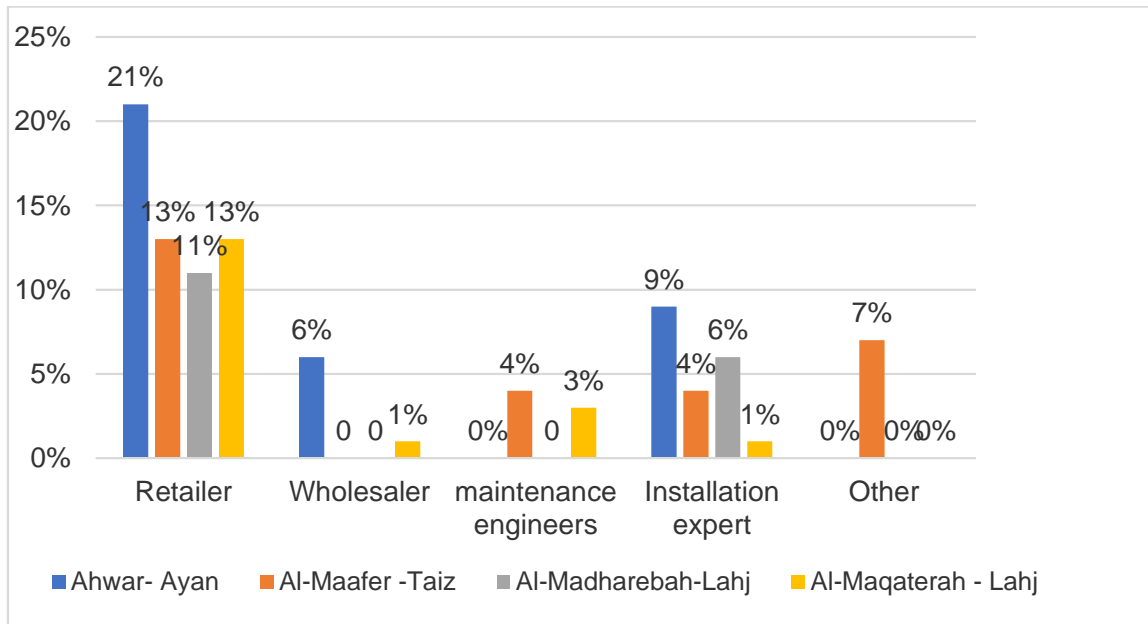
These findings reveal that there are significant challenges facing individuals who wish to adopt renewable energy systems in these areas. High maintenance costs, coupled with high procurement costs, are a major barrier preventing many from benefiting from these technologies.

## The Second topic: Renewable energy needs of traders and service providers

This part of the study aims to provide an assessment of the needs of traders and service providers in the field of renewable energy in Yemen as an important step toward understanding the challenges and opportunities available in this vital sector and analyzing data and information that can be built upon to develop policies and programs to support this sector in the targeted areas.

### 1) Governorate, Directorate, and nature of work

Figure No. (18) shows the distribution of sample members by governorates and directorates and the nature of the work

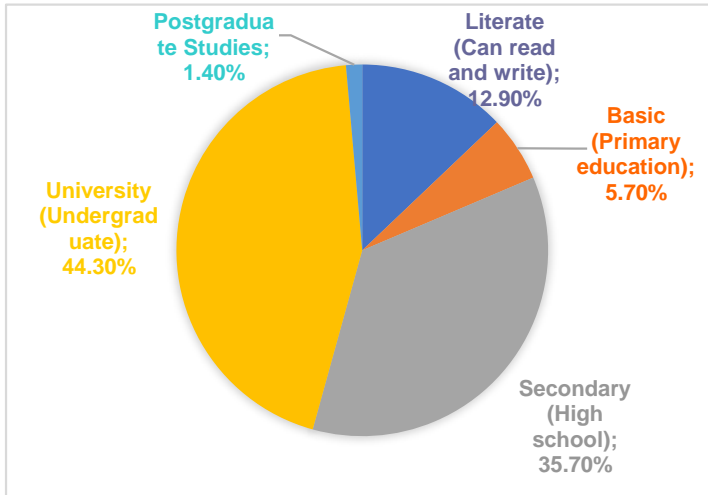


The questionnaires were distributed to four governorates with an average of (37) districts within the directorates, most of which were Lahj managers for (15) districts, (12) districts for Abyan and (10) districts for Lahj Governorate. This framework was also deviated from when taking the sample of wholesalers in Abyan and moving to traders in the nearest neighboring governorate, represented by Aden Governorate. Retail trade constitutes the largest percentage (58%) of the total workers in this field, which indicates that there is an active market for renewable energy products at the level of the final consumer. Wholesalers represent (7%) of the total sample and wholesalers are absent in all target areas. Therefore, retailers seek traders in the main cities.

Service providers and installation engineers also represent a significant percentage (20%), and a small percentage (7%) for maintenance engineers, which emphasizes the importance of after-sales services in ensuring the continuity of systems work and providing technical support to customers. Service providers' indicators emphasize the importance of providing good after-sales services to ensure customer satisfaction and the continuity of systems work, and there is a shortage of maintenance engineers.

## 2) Educational level

Figure No. (19) shows the distribution of sample members by educational level

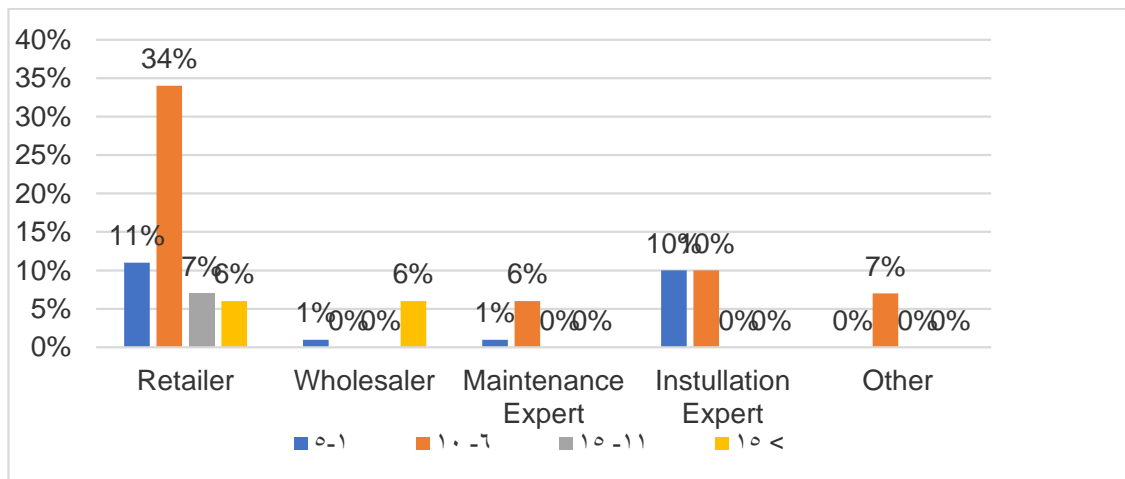


The diagram shows the distribution of a sample of traders working in the field of renewable energy according to their educational level and shows that the majority of the sample has a university degree (44.3%), followed by a secondary certificate (35.7%).

A shortage of graduate students was observed (1.4%). Relatively, their percentage did not exceed (1%). As for those who can read and write only, their percentage was (12.9%). In general, it appears that traders and service providers have an appropriate educational level that is consistent with the objectives of the study.

## 3) Nature of work and years of experience

Figure No. (20) shows the distribution of sample members according to the nature of work and years of experience



It is clear from the graph that retail trade constitutes the largest percentage (58%) of the total workers in this field, and their experience for more than (6) years reaches (47%), which indicates that there is an active market for renewable energy products at the end-consumer level.

As for the wholesalers, they represent (7%) of the sample, and most of them have experience of more than (15) years, and they represent the main base for the work of retailers and service providers of maintenance and installation engineers, as well as service providers representing (27%), and their experience is concentrated between (1 – 10) years and the presence of a percentage of workers with intermediate experience indicates the continued flow of new cadres to the sector, which ensures the vitality of the sector and its continued growth.

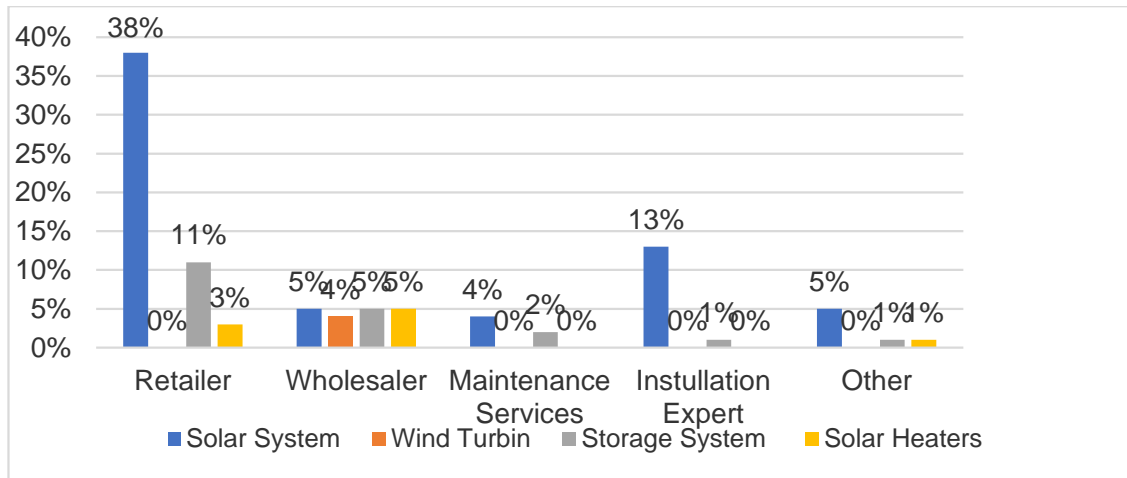
It shows us that the vast majority of workers in this field (57%) have experience ranging from (6-10) years, which indicates stable growth of this sector and a solid base of intermediate experience.

A shortage of very long experience (more than 15 years) was observed in all types of business, (12%) which may indicate the relatively newness of the sector or the transfer of some experts to other fields.

The vast majority of workers in all types of businesses (retail, wholesale, services) have experience ranging from (1-5) years, which indicates that the sector may still be in the mature stage. Retail trade constitutes the largest percentage of workers in the sector, and this indicates that the market for renewable energy products is active and that there is a great demand for it by consumers.

#### 4) The products you deal with and the nature of the business

Figure No. (21) shows the distribution of sample members according to the nature of work and renewable energy products



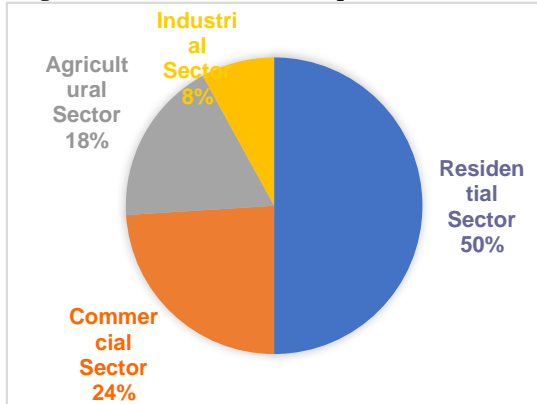
The chart shows that most traders deal with solar energy systems by up to 65%, 20% with energy storage systems represented by batteries and slightly with wind turbines by 4% and solar heaters by no more than 9%.

Sales accounts for the largest percentage of employees in the sector (71%), which indicates a focus on the commercial and marketing side more than the technical aspects.

There is a noticeable shortage of engineers specialized in the field of renewable energy, whether they are installation or maintenance engineers whose work is focused on solar energy and storage systems only, and at the same time the absence of engineers or technicians specialized in the field of wind turbine systems or solar heaters, which are basic technologies in the field of renewable energy.

#### 5) Target markets

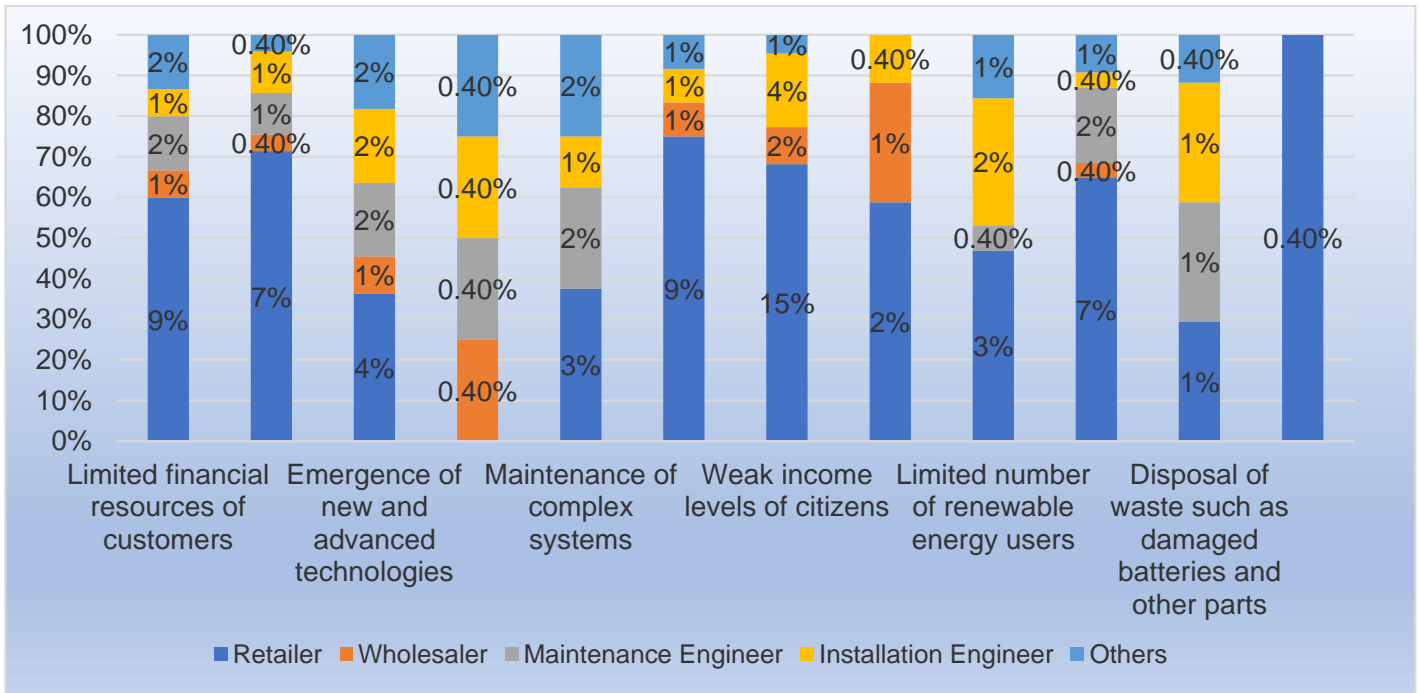
Figure (22) Distribution of sample members according to target markets



It is clear from the indicators of the graph that the residential sector, with a rate of 50%, is the most targeted by traders, followed by the commercial sector, with a rate of 24%, then the agricultural sector by 18%, and a simple rate of 8% for the industrial sector. These answers reflect the nature of the region, where housing and shops are abundant, in addition to the presence of the agricultural side, while the industrial side is less, and if it appears, it is limited to simple industries.

## 6) Challenges to working in the field of renewable energy and the nature of work

Figure No. (23) shows the distribution of the sample according to the nature of the work and the challenges in the field of renewable energy



The data in the graph indicates that financial challenges are the biggest obstacle to the spread of renewable energy, with respondents attributing poor income among citizens (22%) and limited financial resources among them and customers (15% and 9.8%, respectively) as the most prominent reasons. This confirms that the costs associated with buying and operating renewable energy systems constitute a major obstacle for citizens, traders, and service providers.

Looking at this indicator, we find that most of the challenges are focused on retailers, especially financial traders, and by the nature of their work, their customers are citizens, which confirms the low income of energy users in general in the targeted areas, and therefore the urgent need to find innovative solutions that contribute to expanding the scope of service in easy ways.

In addition, the data show that limited awareness of the importance of renewable energy (12%), difficulty in obtaining financing and loans (10.8%), the emergence of new and advanced technologies (11%), the maintenance of complex systems (8%), and the small number of users (6.8%) represent additional challenges that hinder the widespread spread of renewable energy.

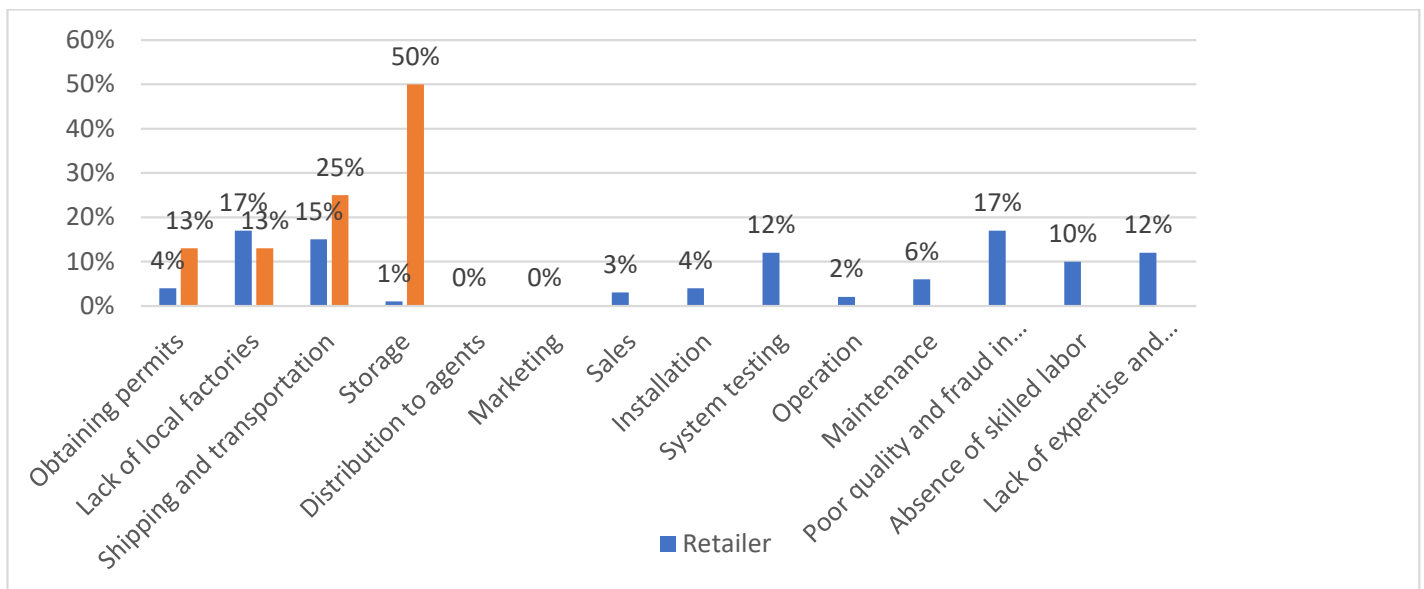
The study also highlighted the role of other factors such as government policies and procedures, disposal of waste from systems (3.4%), and changing environmental operational conditions (1.6%). However, the results suggest that environmental changes are not a major challenge in the studied areas, which corresponds to the responses of individuals.

For maintenance engineers, the challenges focused on the limited financial resources of customers, who are citizens, the emergence of new and advanced technology, the maintenance of complex systems, and the difficulty of obtaining financing or loans, all of which took on relative importance (2%). As for installation engineers, their focus was on the weakness of citizens' income (4%) and the emergence of new and advanced technology (2%). This requires the provision of up-to-date information on new energy technologies through the training service.

Here, it is clear that the weakness of citizens' income is the most important variable in facing the challenges of working in the field of renewable energy, in addition to the existence of gaps in installation, maintenance, and training services.

### 7) Challenges for Renewable Energy Wholesalers and Retailers

Figure No. (24) shows the distribution of the sample according to the challenges facing wholesalers and retailers in the field of renewable energy



Through the graph (challenges), the issuance of permits is a major challenge (13%) for wholesalers and (4%) for retailers, and this indicates the bureaucracy and administrative obstacles facing importers and distributors.

The absence of local manufacturing of products increases dependence on imports and thus raises costs and limits flexibility in the supply chain, and at the same time shows a promising investment opportunity for manufacturing in this field.

Shipping and transportation are a challenge of (25%) for wholesalers and (15%) for retailers, and this may be due to high shipping costs, difficult access to remote areas, or lack of logistical infrastructure.

Storage is a challenge (50%) for wholesalers and 1% for retailers, and this indicates a lack of suitable warehouses to store sensitive products such as batteries and solar panels.

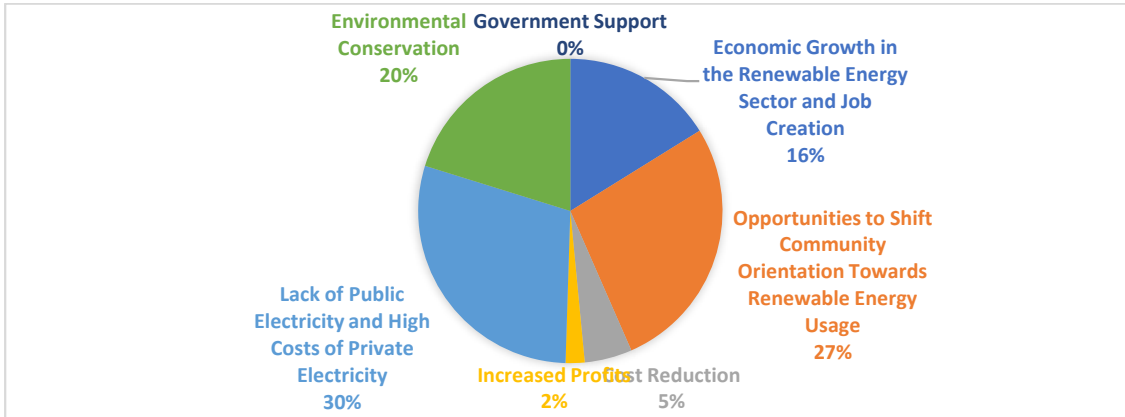
**Distribution to Dealers:** This challenge does not attract much attention from dealers, suggesting that the distribution system is not sufficiently developed.

The rest of the challenges are concentrated among retailers, where traders face challenges in selling by (3%), and this may be due to the lack of experience in the field of sales or the inability of traders to bear the costs, and also in the installation of systems by (4%), and this may be due to the lack of trained technicians or the lack of necessary tools and equipment.

Challenges have also emerged in the quality of products and services, as it is clear that poor quality and fraud in products constitute the largest challenge (17%), which affects the reputation of the market and reduces consumer confidence. As for the absence of skilled labor: traders face a shortage of skilled labor (10%) that affects the quality of services provided. As well as the lack of experience and capabilities: It is a challenge (12%) in both categories, which affects the ability of merchants to provide integrated solutions to customers.

### 8) Motivation towards investing in renewable energy by traders

Figure No. (25) shows the distribution of the sample according to the motivation towards investing in renewable energy by traders



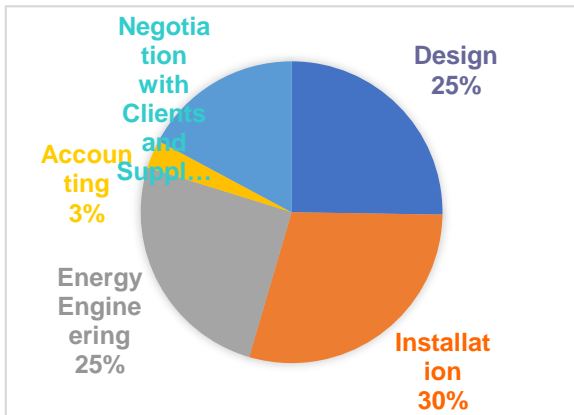
The diagram shows that the main motivation for investing in renewable energy among traders in these governorates is "opportunities for societal orientation around the use of renewable energy" by (27%), followed by "lack of public electricity and high private electricity costs" by (30%). This indicates that traders are aware of the importance of renewable energy not only from an economic point of view but also from an environmental and societal point of view. The data show that traders are driven by a mixture of social and economic motives. They see renewable energy as an opportunity to improve the image of their business, contribute to solving the problem of electricity shortage, and reduce operational costs in the long term. Traders show an increasing interest in preserving the environment, as this motive constitutes (20%) of the total motives.

The high rate of motivation associated with "economic growth in the renewable energy sector and job creation" (16%) indicates that traders see this sector as an opportunity to make profits and increase the size of their business.

Remarkably, government support was not given any attention by the traders surveyed, suggesting a lack of government role in encouraging investment in the sector.

### 9) Basic skills required to work in the renewable energy sector, according to traders

Figure No. (26) shows the distribution of the sample according to the skills required to work in the renewable energy sector according to the opinion of traders

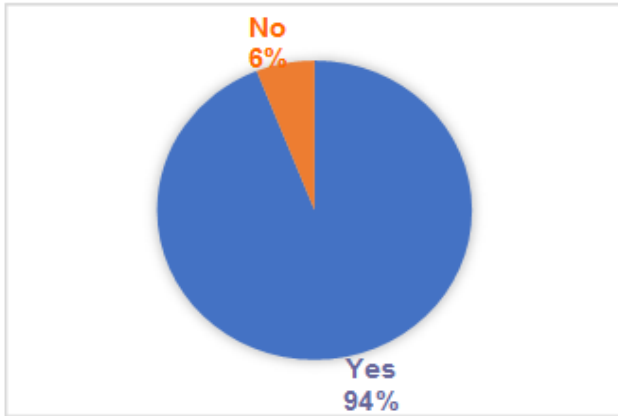


The diagram shows that the basic skills that traders deem necessary to work in the renewable energy sector are: design by (25%), which indicates the importance of the ability to design solar systems and other renewable energy systems, and installation comes in second place (30%), which emphasizes the need for technicians capable of installing these systems accurately and efficiently, as well as power engineering in third place by (25%), which indicates the importance of the engineering background to understand the technologies used in this field.

Despite the importance of management and financial skills, communication and negotiation skills have been achieved (17%), which confirms the importance of these skills in dealing with customers and suppliers and accounting by (3%), indicating that traders focus more on technical skills.

### 10) Employees need training in renewable energy.

Figure No. (27) shows the distribution of the sample according to the need for training



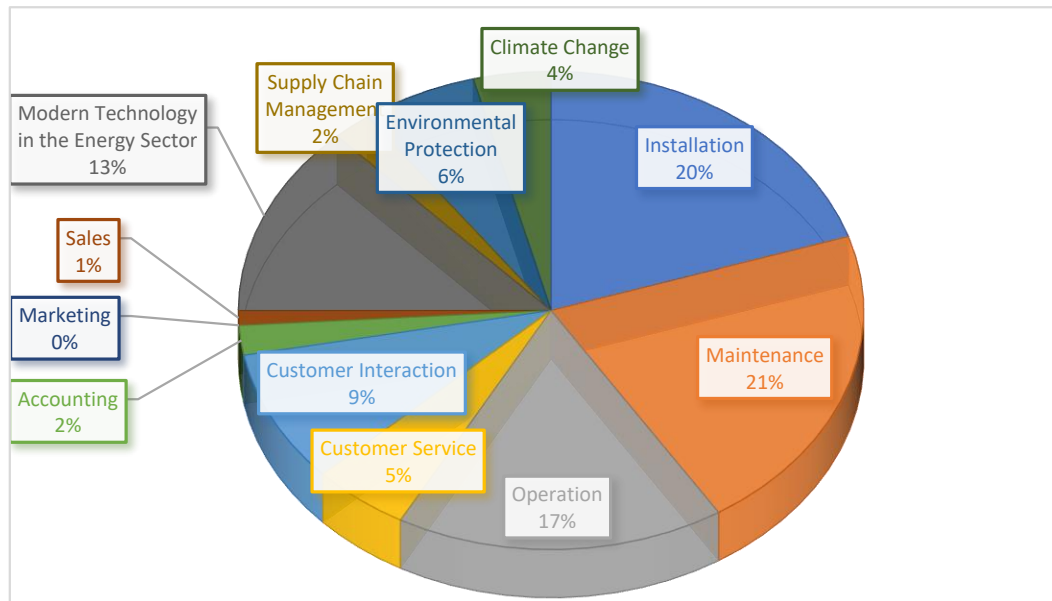
The graph shows that (94%) of the employees of traders need training to work in the renewable energy sector. This indicates that there is a large gap in qualified cadres in this sector and that there is an urgent need for intensive and comprehensive training programs.

The existence of this large gap indicates that many employees work in this sector without the necessary skills and knowledge, which affects the efficiency of work and the quality of services provided, and therefore the urgent need to invest in training, which will contribute to raising the efficiency of workers and

improving the performance of companies operating in this sector.

## 11) The required training

Figure No. (28) shows the distribution of the sample according to the required training areas



The chart shows that traders focus heavily on technical and practical skills, with installation, maintenance, and operation accounting for the largest percentage of training needs ( 58%). This indicates that traders are aware of the importance of technical competence in the implementation of projects related to renewable energy.

Interest in training in modern technology in the field of energy ( 13%) indicates the desire of traders to keep pace with technological developments in this sector.

Although the focus is on technical skills, the table indicates that there is a need for some management skills such as customer service and handling, accounting, sales, supply chain management, environmental protection, and climate change.

## 12) Projects Financing

Figure No. (29) shows the distribution of the sample according to the sources of project funding

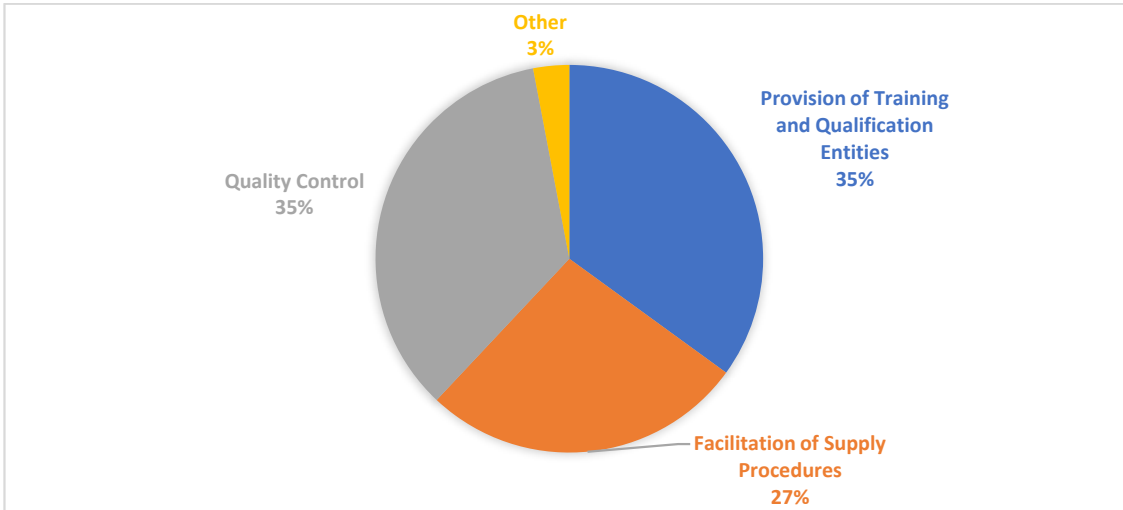


The table shows that the vast majority of traders (96%) rely on self-financing their projects, that is, from their savings or profits. This indicates that external financing is still limited and not readily available to renewable energy traders.

The very small percentage of getting support from organizations (4%) indicates weak institutional support for SMEs in the field of renewable energy.

### 13) Recommendations to the Government from the Sample Point of View

Figure No. (30) shows the distribution of the sample according to the recommendations addressed to the government

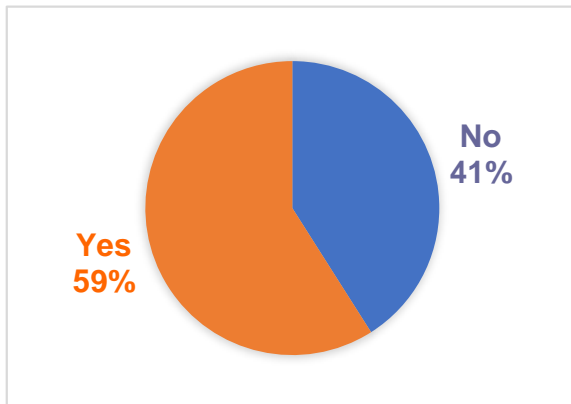


The chart shows that traders focus heavily on the first three main recommendations to provide training and qualification bodies. This recommendation constitutes the largest percentage (35%), indicating that traders see the lack of qualified teams as the biggest challenge facing the sector, and quality control in the second place (35%), indicating that traders see that the quality of products and services provided in the sector needs to be improved.

As well as facilitating procedures and licenses, this recommendation comes in third place (27%), which indicates that administrative and bureaucratic complexities hinder the growth of the sector. Several recommendations were also mentioned in the other option, which is supporting projects in the field of energy, establishing renewable energy plants, controlling the exchange rate, not taking amounts in points on energy supplies, and combating corruption.

### 14) Maintenance and repair services for devices related to renewable energy

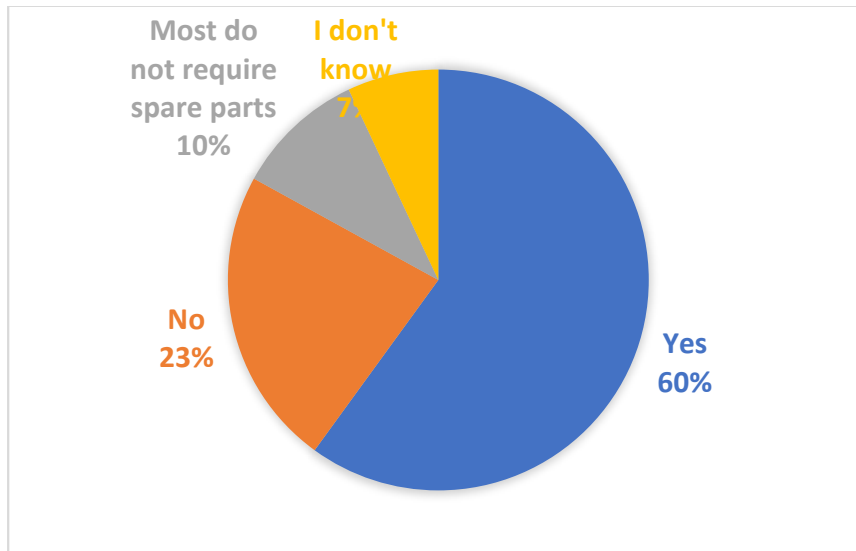
Figure No. (31) shows the distribution of the sample according to the level of availability of maintenance and repair services for devices related to renewable energy



The graph shows that (59%) of the sample provide maintenance and repair services for devices related to renewable energy, while (41%) do not provide these services, and indicates a gap in the coverage of these services, especially in remote areas or where there is not a large concentration of companies working in this field.

**15) Availability of materials and spare parts for energy technologies in the local market**

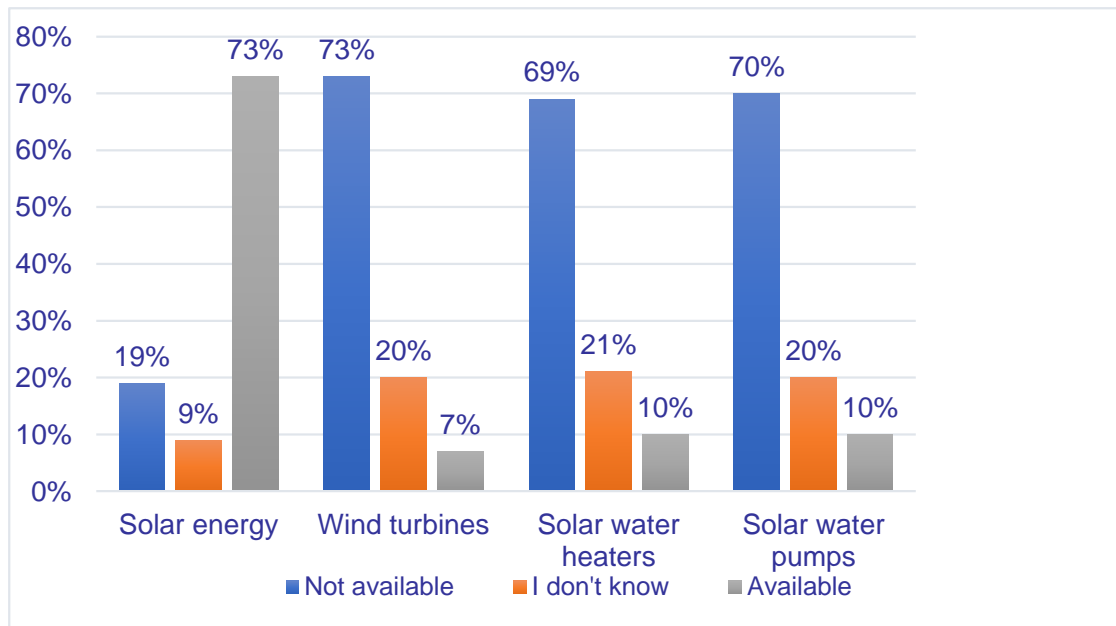
Figure No. (32) shows the distribution of the sample according to the level of availability of materials and spare parts needed for energy technologies in the local market



The chart shows that (60%) of the sample confirms the availability of materials and spare parts for renewable energy technologies in the local market. However, there is (23%) indicate that these materials and parts are not fully available, and this shows a gap in market coverage, and another (10%) indicates that most of them do not need spare parts.

**16) Availability of spare parts for renewable energy devices**

Figure No. (33) shows the distribution of the sample according to the availability of spare parts for renewable energy devices



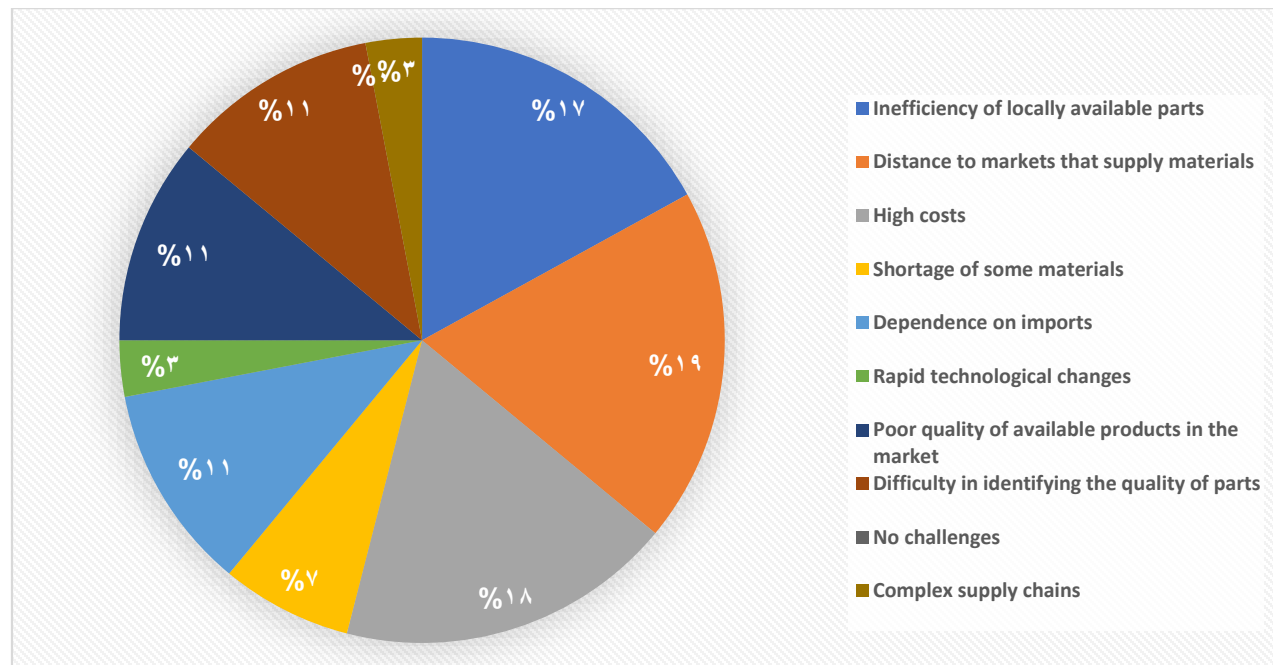
The graph shows that there is a great disparity in the availability of spare parts for various renewable energy devices. In general, it can be seen that spare parts for renewable energy devices according to the opinion of the sample are not available significantly with all renewable energy technologies available in the local market, with a large percentage of wind turbines (73%), solar heaters (69%), pumps (70%), except for solar energy, where they are available (73%). The reason is that most of what is available is solar energy technologies, however, (19%) stated that spare parts are not available.

This indicates that there is a noticeable shortage of spare parts for many renewable energy technologies in the local market, at (58%), which indicates that there is a large gap in the market that can be exploited. However, the shortage of spare parts for turbines, solar heaters, and pumps represents a golden opportunity for entrepreneurs to establish companies specialized in providing these spare parts and providing maintenance and repair services, thus contributing to promoting the spread of renewable energy and creating new job opportunities.

Therefore, this indicates that there is a need in these areas, and in general, the use of the rest of the technologies decreases, and therefore the percentage of spare parts decreases, which confirms the availability of job opportunities in these areas.

### 17) Challenges faced in securing materials and spare parts, especially during peak periods

Figure No. (34) shows the distribution of the sample according to the challenges related to securing materials and spare parts, especially during peak periods



The graph shows the challenges related to securing cucumber parts and the highest challenge in the dimension of markets that provide materials by (19%), the high cost by (18%), the inefficiency of available parts in the local market by (17%), as well as the dependence on import, rapid technological changes and the difficulty of identifying the quality of parts by an equal percentage of (11%) and other challenges. We can draw out the following main challenges:

- High dependence on imports is a major challenge, as the sector is exposed to global price fluctuations and geopolitical factors.
- The market suffers from a shortage of spare parts, especially for some specialized technologies.

- Imported products have a quality problem, which affects the performance and shelf life of systems.
- Supply chains suffer from complexity, leading to higher costs and delivery delays.
- Remote areas have difficulty accessing markets that provide spare parts.
- The costs of purchasing and installing spare parts are rising, which is a barrier to investing in renewable energy.
- Traders have difficulty obtaining accurate and comprehensive information about local market requirements and spare parts needs.

### **18) Other Additions and Suggestions**

After a comprehensive analysis of the proposals submitted by the sample, they can be classified and summarized in the following axes:

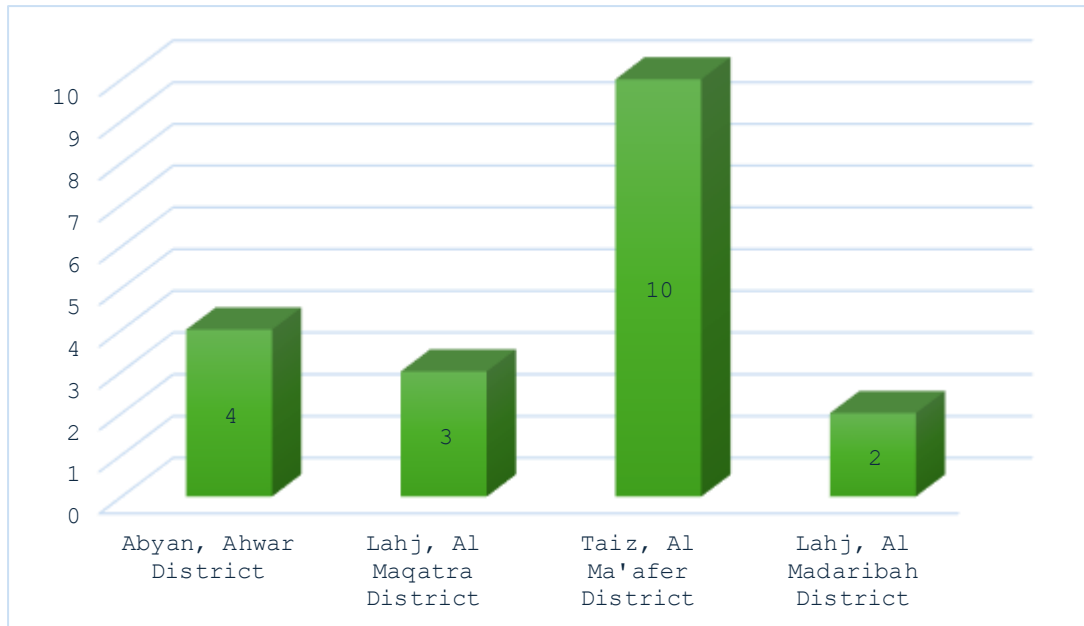
- Developing renewable energy infrastructure through the establishment of networks capable of absorbing intermittent renewable energy, and modernizing existing networks to facilitate the integration of renewable energy sources.
- Establish maintenance and repair centers equipped with the latest technology to provide spare parts and repair devices related to renewable energy.
- Supporting the establishment of local factories to produce solar panels and other components for renewable energy.
- Design and implement intensive training programs in the design, operation, and maintenance of renewable energy systems, and provide practical training opportunities.
- Organizing awareness campaigns targeting various segments of society to highlight the importance of renewable energy and its economic and environmental benefits.
- Simplify the procedures related to obtaining the necessary licenses and approvals for the implementation of renewable energy projects.
- Offer various financial incentives to investors, such as tax breaks, soft loans, and creative financing schemes.
- Set ambitious targets to increase the share of renewable energy in the national energy mix, and set time plans to implement these targets.
- Building partnerships with countries and international institutions to share experiences and provide financing and technology.
- Allocate a budget to support research and development in the field of renewable energy, and provide financial support to small and medium enterprises.

### The Third topic: Renewable energy needs in the public sector

This part of the study seeks to identify the pivotal role that the public sector can play in promoting the use of renewable energy in the targeted areas, by assessing the actual needs, the current policies and supporting legislation, the obstacles facing the implementation of renewable energy projects, the indicative factors and the level of cooperation with relevant parties at the level of the targeted areas.

#### 1) Governorate, Directorates, Regions and Gender

Figure No. (35) shows the distribution of sample members by governorate

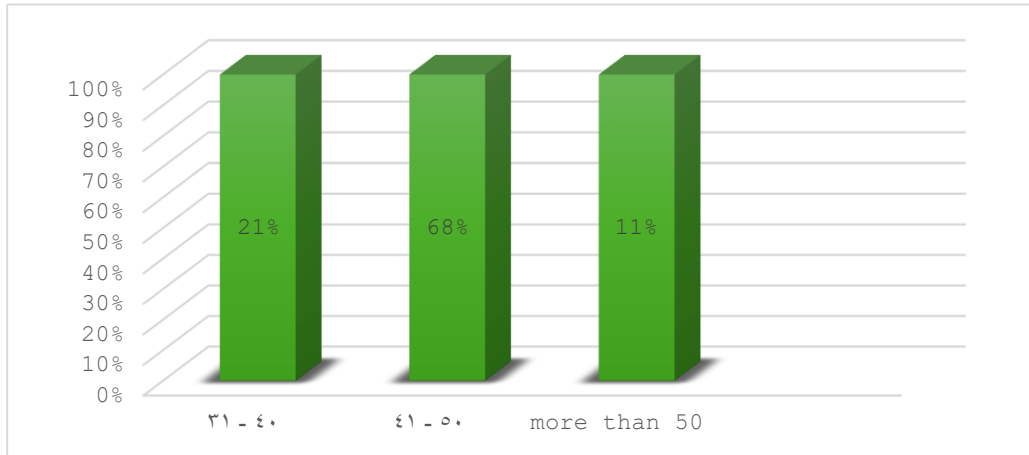


The questionnaire was distributed to a random sample of (19) in three governorates: Abyan, Taiz, and Lahj. The Maafar was selected as (10) entities, (4) in Ahwar and (5) in Lahj Al-Mudarabah and Al-Muqatarah. This number and the geographical distribution of the authorities related to renewable energy were carried out to ensure the achievement of the objectives of the study and a fair representation of the targeted areas. (15) areas were also targeted. The main criterion was the presence of the local authority in them. This approach aims to enhance the strength of the results and their validity for dissemination at the level of similar directorates and villages.

Due to the concentration of government leaders in remote areas mainly on males and the lack of female representation in these positions, the study sample was limited to males, and this selection is due to the desire to obtain accurate data that reflects the reality in these areas.

## 2) Age

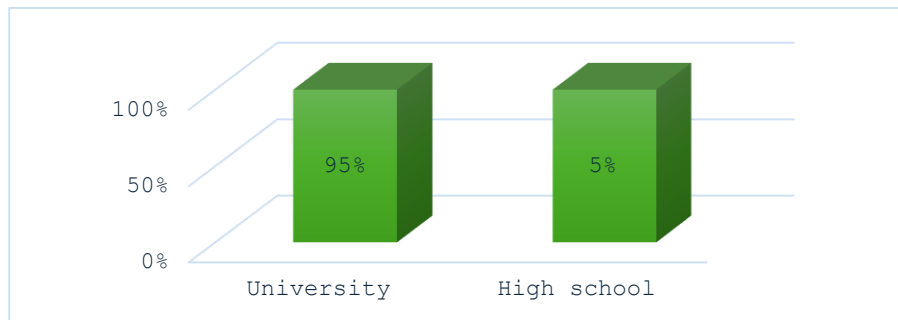
Figure No. (36) shows the distribution of sample members by age groups



Through the data of the target group, the majority of the respondents fall within the age group between (41 and 50 years), (68%), followed by the age group between (31 and 40 years) (21%). The age group older than (50 years) comes in third place, by (11%). This age distribution indicates that the workforce in the target areas is characterized by great experience, which helps to achieve the objectives of the study.

## 3) Education Level

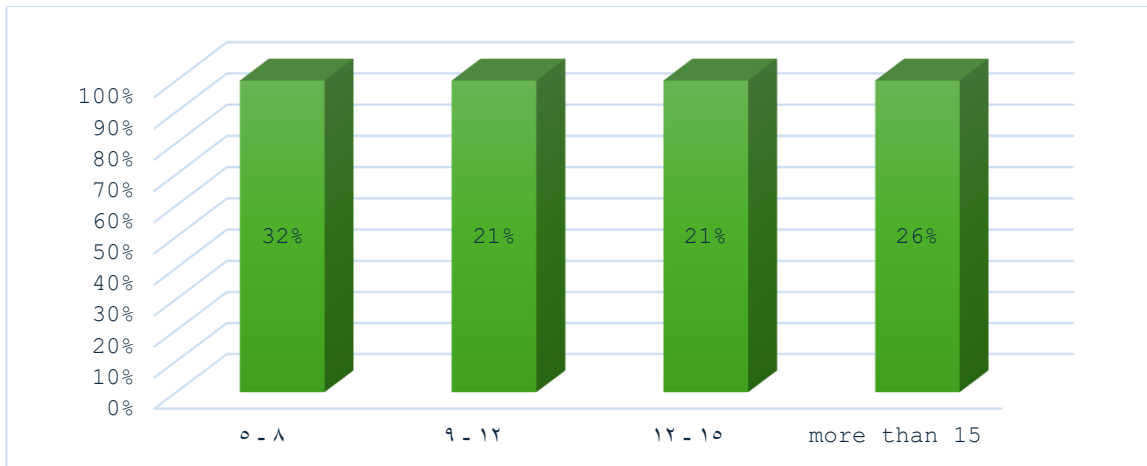
Figure No. (37) shows the distribution of the sample according to the educational level



The diagram shows that the vast majority of the sample, (95%), holds a university qualification, while the percentage of those with a high school diploma is only (5%). However, this distribution reflects the focus on leaders in the public sector. In general, the scientific qualifications of the sample correspond to the requirements of the current study.

#### 4) Years in business

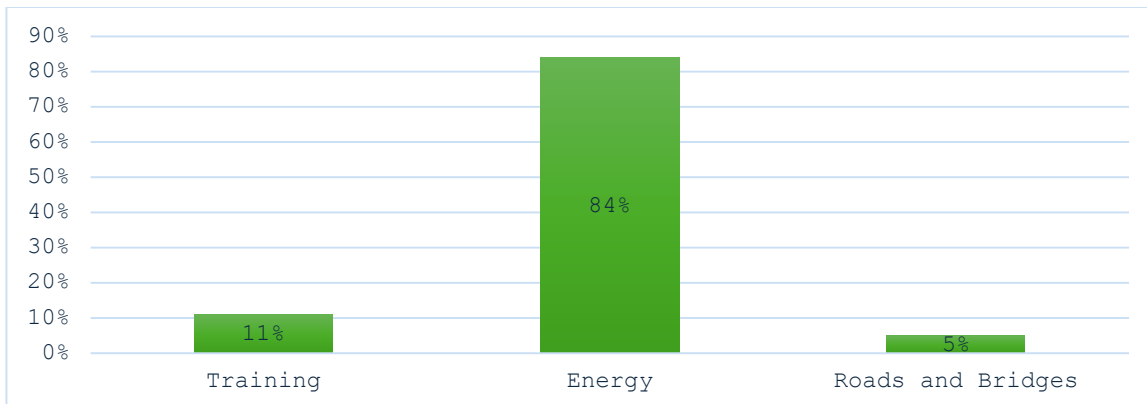
Figure No. (38) shows the distribution of the sample according to years of experience



The results of the table reveal a diverse distribution of the years of practical experience among the respondents, as the percentage of those with more than (15 years) experience was about (26%), while the percentage of those with less than (5 years) experience was about (32%), as the results showed (42%). Of the sample, they have an average experience ranging from (9 to 15 years). This discrepancy in experience indicates that there is a mix of competencies and skills within the public sector, which opens new horizons to understanding their needs related to renewable energy.

#### 5) The sector in which the entities are interested

Figure No. (39) shows the distribution of the sample according to the sector in which the entity is interested



The data reveal a great interest on the part of the public sector in renewable energy, as the percentage reached (84%). This high turnout reflects a deep awareness by government institutions of the importance of this technology in light of the challenges facing the energy sector in remote areas. The focus on training by (11%) emphasizes the importance of building human capacity, which is a crucial element in the success of any project in this field. The results also showed an interest in the field of roads and bridges by (5%), and that renewable energy is of great importance in light of the current conditions due to the inability of the state to provide energy in those targeted areas.

## 6) The role of entities in the field of renewable energy

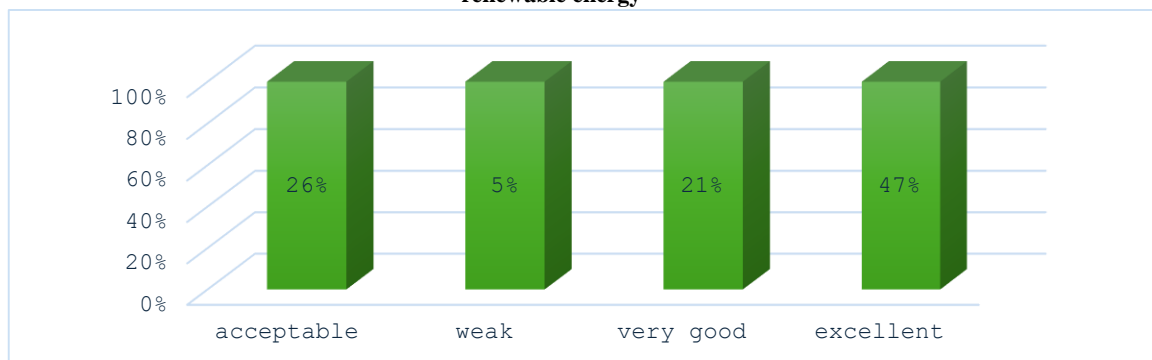
By asking the sample of public sector representatives about the role of the entities in the field of renewable energy, the answers revolved around the following points:

- Raising the need for projects related to renewable energy for government offices and local and international organizations.
- Coordination, follow-up, and encouraging organizations to intervene in the fields of renewable energy in service projects (water-health-education projects).
- Training youth in the fields of renewable energy and facilitating the tasks of the implementing agencies for renewable energy projects.
- Conducting preliminary studies and marketing them to donors to intervene in these activities.
- Search for alternative energy sources to operate the hospital instead of traditional sources.
- Seeking to provide renewable energy projects.
- Encouraging the use of renewable energy systems and facilitating procedures in this field.
- Keeping abreast of projects with developments in the field of renewable energy to preserve the environment and also reduce the operational energy expenses of the project.
- Coordinate with supporting organizations in the fields of solar systems to support water projects, health centers, and schools.
- Conducting a feasibility study of the use of energy and raising the authorities and donors to support farmers with a solar system and guide well owners to use solar energy.
- Conducting courses in the field of solar energy.

The opinions of the respondents show that the public sector relies heavily on external support from international and local organizations, and although there are plans and ambitions, there is a large gap between the planning and actual implementation of projects. The focus is largely on solar energy, with some proposed projects for live irrigation energy. Renewable energy also covers vital sectors such as health, education, and agriculture, indicating an interest in improving basic services.

## 7) Assess the level of interest of entities in the field of renewable energy.

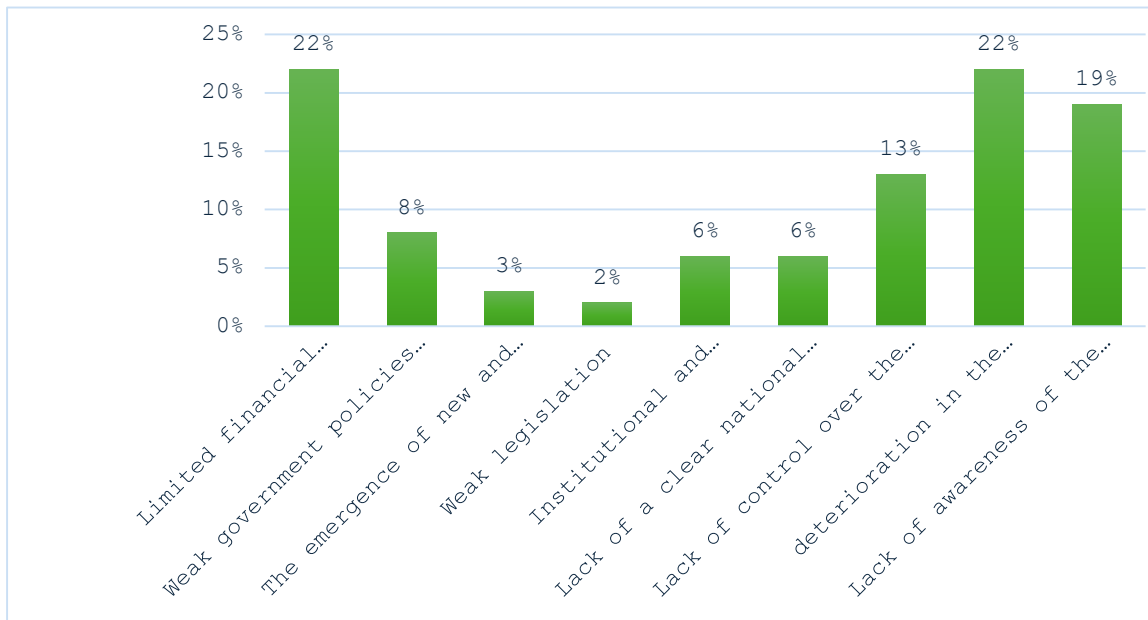
Figure No. (40) shows the distribution of the sample according to the assessment of the level of interest of the entity in renewable energy



The table shows a large variation in the level of interest of various sectors in renewable energy, as there are highly interested parties (excellent), and other sectors with limited (weak) interest, as the results indicate that most of the operating sectors have an acceptable interest in renewable energy, as they represent (47%) of the sample, and despite the importance of renewable energy, the percentage of sectors that are highly interested (excellent) does not exceed (47%). The presence of (5%) of parties with a weak interest in renewable energy indicates that there are challenges in some parties.

## 8) Challenges facing entities in the field of renewable energy

Figure No. (41) shows the distribution of the sample according to the challenges facing the entities in the field of renewable energy



The data indicate that the public sector in the targeted areas faces an overlapping set of challenges that hinder the spread of renewable energy projects, and these challenges can be summarized as follows:

- **Financial and economic challenges by (44%):**

The biggest challenges are limited financial resources. (22%) of the participants indicated that lack of funding is the main obstacle, as well as (22%) inflation and currency deterioration, as inflation leads to increased project costs, which puts additional pressure on limited budgets.

- **As for the cognitive and institutional challenges, they represented (55%) of the challenges and focused on the following:**

- Lack of awareness (22%): The sector suffers from a lack of awareness of the importance of renewable energy and its environmental and economic benefits, which reduces public and political support for these projects.
- Weak regulatory framework (27%): This challenge is divided into the absence of control over the quality of systems (13%), weak government policies and procedures (8%), and deficiencies in institutional and regulatory aspects (6%) that hinder the development of the sector.
- Absence of the national vision (6%): The absence of a clear vision to promote renewable energy at the national level, limits coordination and integration between the concerned authorities.

- **Other technical challenges by (5%) represented in the following:**

- The emergence of new technologies, at (3%) despite being a challenge, but the emergence of new technologies opens new horizons for renewable energy, but it requires investments in research and development and capacity building.

- Weak legislation (2%) There may be a lack of legislation supporting renewable energy, creating an unfavorable environment for investment.

#### **9) Policies and legislation related to work in the field of renewable energy**

Through the answers of the participants, it was found that there are no legislations or policies for the use or provision of renewable energy, but they only have plans based on the region's need for renewable energy, which the organizations working to meet this need, where the state must make policies and legislation to facilitate the entry of energy to the country and help organizations to provide it through customs facilities, taxes, and others. In all countries of the world, the state must make legislation and policies to encourage the use of renewable energy in light of its failure to provide power.

#### **10) Achievements and measures achieved by entities in the field of renewable energy support**

Through the answers, we found out that the most important achievements achieved by the entities are the following:

- The district's projects were provided with solar energy systems with the support of local and international organizations.
- Reducing diesel consumption in the facilities where the solar systems were installed, where the operational budget was saved from (22,00 to 13,00 riyals) and the amount of diesel was reduced from (20 thousand liters to 10 thousand) liters after installation.
- The provision of solar systems by local and international organizations helps the public sector to provide its basic services in its basic sectors such as education, health, agriculture, and others without stopping.
- Training was conducted by local and international organizations on renewable energy for some public utilities.
- Providing irrigation and agriculture projects with solar systems has been positively reflected in reducing the cost of the water unit and reducing the maintenance costs of pumping equipment, as well as reducing environmental pollution, in addition to reducing noise.

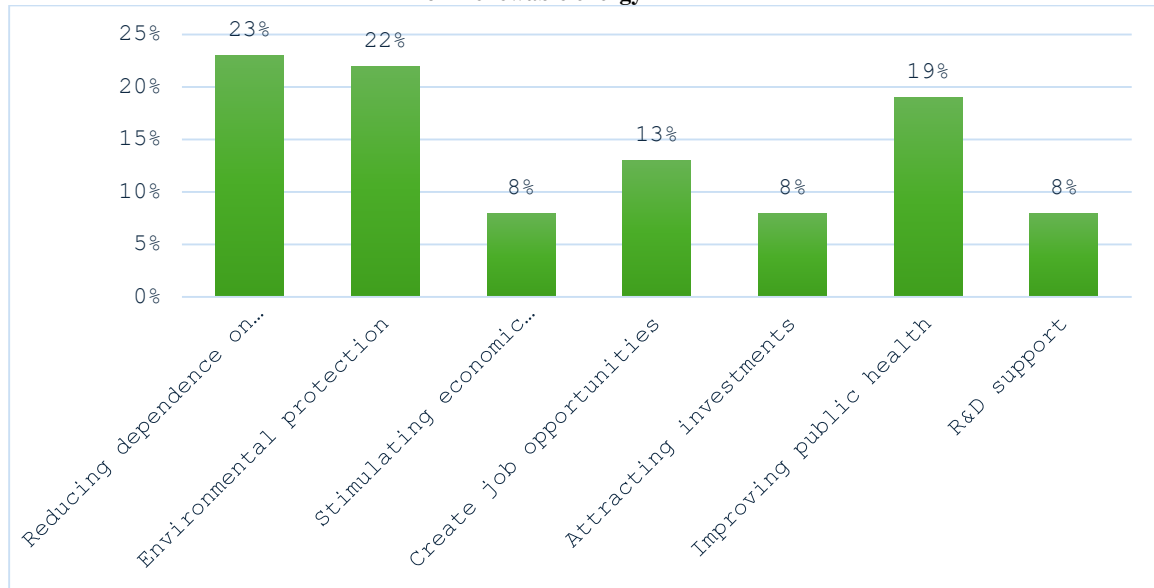
#### **11) Ways to raise the role of entities in the field of renewable energy**

Through the available data collected from the sample, the following can be summarized:

- Providing vital projects in the targeted areas, especially the public sector, with solar systems so that they can provide their services to the community in light of the lack of electricity.
- Conducting training for the staff in the public sector facilities that are provided with renewable energy in terms of maintenance, installation, and operation.
- Supporting technical institutes of the public sector in renewable energy by raising their capacity to provide training in the field of energy. This requires providing an excellent learning environment by providing them with the necessary equipment and rehabilitating the necessary workshops for such training.
- Directing funding towards renewable energy because of its importance, whether by organizations or the government, especially wind energy, because there are places that can be used there.
- The government has made some amendments in legislation and policies in line with the introduction of renewable energy in the country.

## 12) Opportunities for the public sector to benefit from renewable energy

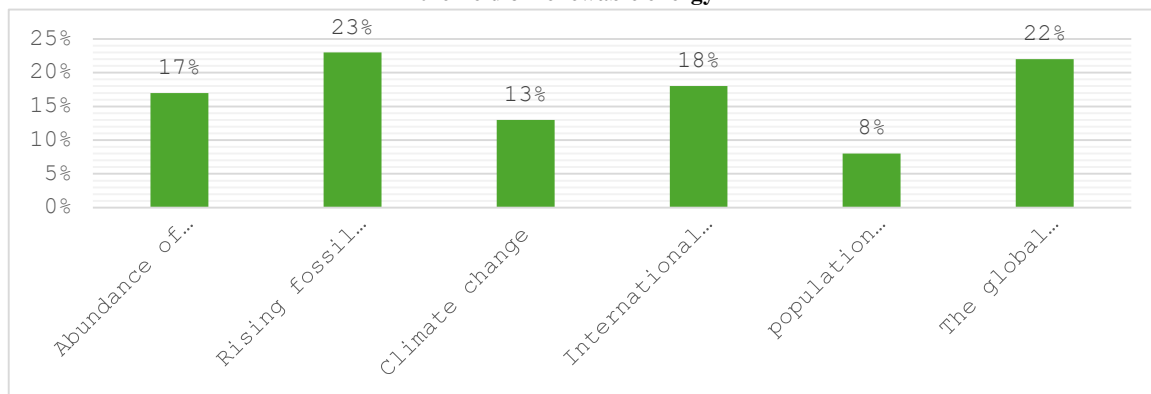
Figure No. (42) shows the distribution of the sample according to the opportunities available to the entities to benefit from renewable energy



The data revealed that participants see renewable energy as promising opportunities on several levels. In addition to its role in reducing dependence on fossil fuels by (23%) and protecting the environment by (22%), participants also indicated that renewable energy contributes to improving public health by (19%) and creating new jobs by (13%). The results also highlighted the role of renewable energy in stimulating economic growth, supporting research and development, and attracting investments by (8%) each, which shows that public opinion links renewable energy to a wide range of benefits.

## 13) Factors that help create renewable energy in Yemen

Figure No. (43) shows the distribution of the sample according to the factors that contributed to creating opportunities in the field of renewable energy

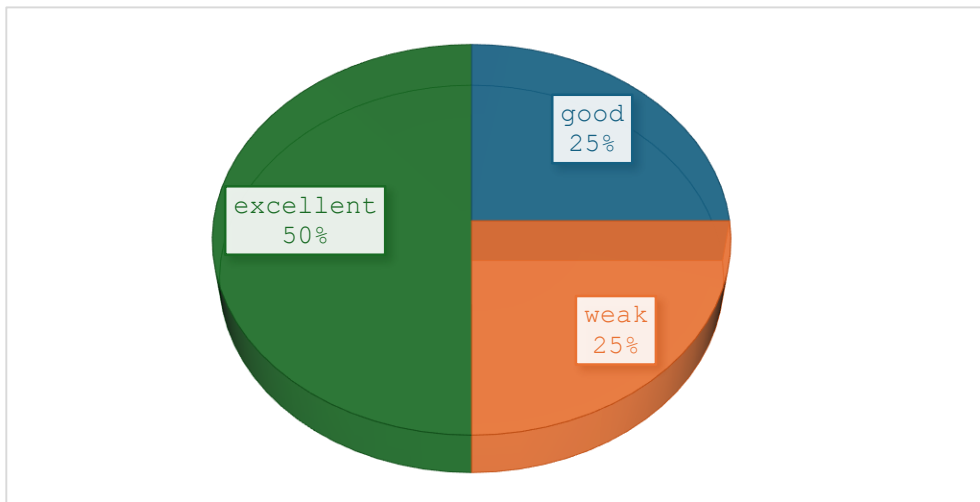


The chart shows that several factors combined contributed to the creation of promising opportunities in the field of renewable energy in Yemen, one of the most prominent of these factors is the high costs of fossil fuels. This point was the biggest motivation for officials and citizens to search for more sustainable and economic alternatives, as (23%) of the participants indicated that the high costs of traditional fuels are the most important factor, as well as the impact on Yemeni public opinion on the global trend towards renewable energy, as (22%) of the participants, believe that this global trend encourages investment in

this field as well. (18%) of the participants believe that international support for renewable energy projects encourages investment in this field, as well as the abundance of natural and climate resources, as (17%) of the participants realized that Yemen has suitable natural and climatic potential for generating renewable energy, such as solar and wind energy. (13%) of the participants indicated that climate change and its global interest prompted the search for sustainable solutions such as renewable energy, and (8%) of the participants indicated that population growth and increased demand for energy increase the importance of searching for alternative energy sources.

#### 14) Evaluation of training and qualification in technical institutes

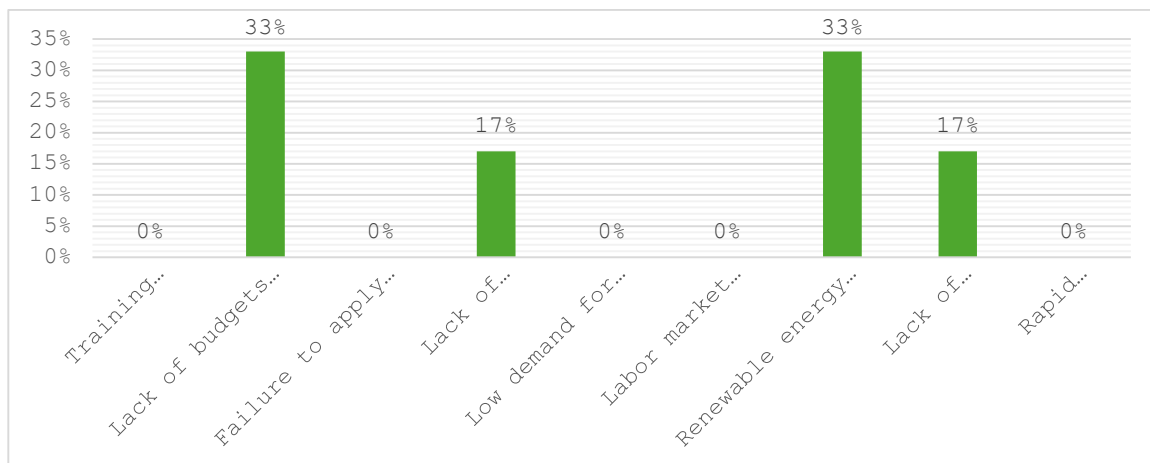
Figure No. (44) shows the distribution of sample members according to the evaluation of training and qualification in technical institutes



The results of the evaluation showed a difference in the opinions of the respondents about the quality of vocational and technical training, while half of the respondents (50%) indicated that the quality of the training is excellent, but the other half saw that the quality is either good (25%) or weak (25%), and this indicates a gap in the quality of training, which requires a deeper study of the factors affecting it.

#### 15) Causes of deficiencies in technical institutes

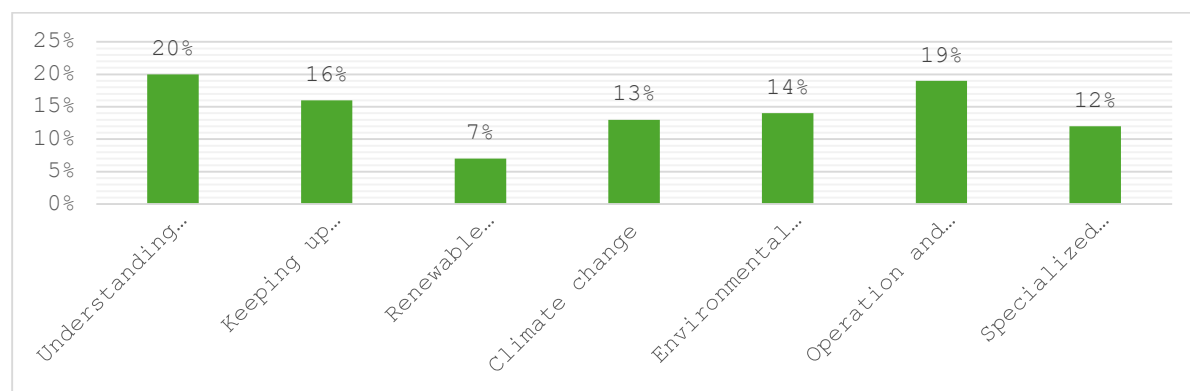
Figure No. (45) shows the distribution of the sample according to the reasons for the deficiencies in the technical institutes



The chart shows that the absence of renewable energy from the development priorities of the government and the lack of budgets for training represent the biggest challenge by (33%), each of which leads to a lack of resources necessary to develop the infrastructure of institutes, provide modern equipment, train cadres, and implement effective training programs. In the second place is the lack of qualified training cadres by (17%), which negatively affects the quality of training provided to students, and the inability of institutes to keep pace with modern technological developments. The lack of awareness of the importance of renewable energy is another challenge by (17%), as it affects the motivation of students and cadres to focus on this field, and the lack of sufficient attention from society to the importance of renewable energy.

## 16) Knowledge and skills

**Figure No. (46) shows the distribution of the sample according to the knowledge and skills required in the field of awareness and training in renewable energy**



It is clear from the diagram that the understanding of the basic technologies and systems of renewable energy ranks first by (20%), which confirms the importance of the technical basis in the field of renewable energy. This indicates the need for trainers to have a clear understanding of how different renewable energy technologies work, such as solar, wind, and bioenergy. Operation and maintenance comes in second place at (19%), which confirms the importance of the practical aspect in the field of renewable energy. This indicates the need for individuals to be trained on how to operate and maintain various renewable energy systems.

Continuous keeping abreast of developments in the field of renewable energy comes in third place (16%), reflecting the dynamic nature of the renewable energy sector, and emphasizing the continuous need to update knowledge and skills to keep abreast of technological developments and new policies in this field.

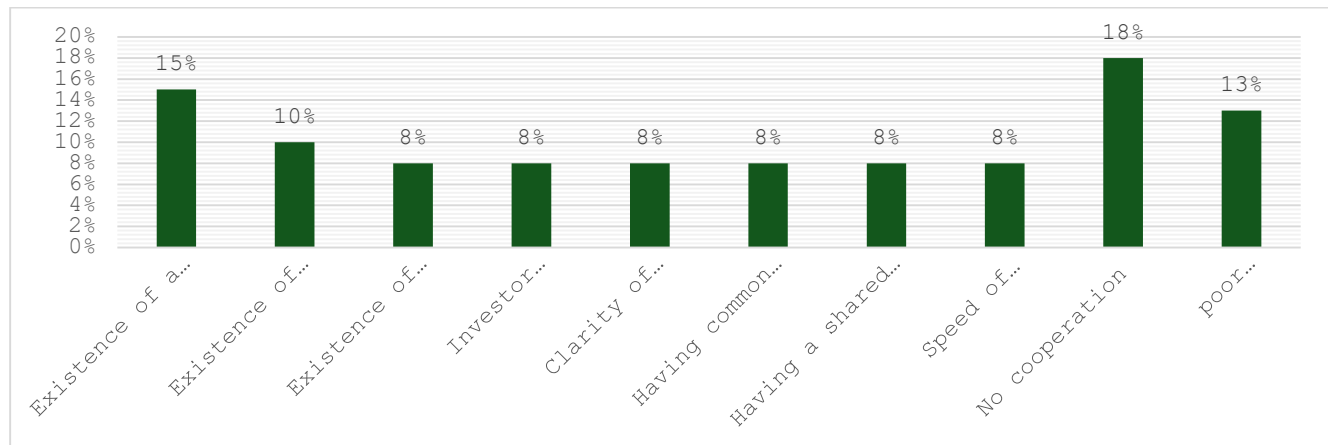
Environmental protection comes in fourth place at (14%), and climate change in fifth place at (13%), reflecting the close link between renewable energy and environmental protection and the importance of highlighting the role of renewable energy in reducing climate change and improving environmental quality.

The feasibility study comes in sixth place at (12%), which confirms the importance of the economic aspect in renewable energy projects.

As for policies and legislation related to renewable energy, this knowledge comes in seventh place (7%), which confirms the importance of the legal and political aspects in this field.

## 17) Public-Private Cooperation and Coordination

Figure No. (47) shows the distribution of sample members according to cooperation and coordination between the entity and the private sector in the field of renewable energy



Through the diagram, it is clear that political stability is one of the most important factors to enhance cooperation. This factor has achieved a percentage of (18%), which indicates the importance of political stability as a key factor in attracting investments, encouraging sustainable development, and affecting the rest of the factors.

The existence of a legal and regulatory framework is one of the factors affecting the level of cooperation by (15%). This indicates the need for clear laws and regulations governing the renewable energy sector and encouraging investment in it. (13%) confirmed that coordination is weak, as well as the existence of mechanisms for consultation and coordination by (10%). This shows the importance of providing effective channels of communication between the government entity and the private sector to ensure coordination and integration between the efforts of the two parties.

At a rate of (8%) for each of the factors are the existence of joint training programs, the existence of joint strategic plans, the clarity of roles and responsibilities, the existence of a joint data bank, the speed of decision-making, the conduct of transactions and the satisfaction of investors.

## 18) What are the most important obstacles to cooperation between the two sectors?

Rural directorates suffer from great challenges in the field of renewable energy, mainly the weakness of infrastructure, the insufficiency of the role of the private sector, the small size of the market, the lack of awareness and knowledge, and poor coordination. Together, these challenges prevent investment in renewable energy projects and limit the population's access to clean and renewable energy. In short, the challenges are concentrated according to the opinion of the respondents as follows:

- **The Weak Infrastructure:**
  - a. **Lack of basic services:** The districts suffer from a severe lack of basic services such as roads, bridges, communications, and electricity.
  - b. **Lack of basic infrastructure:** This shortage makes it difficult to attract investments and develop projects.
- **Private Sector:**
  - a. **Lack of private sector:** There is no effective private sector presence in these areas, limiting investment and development opportunities.
  - b. **Lack of cooperation:** There are no clear mechanisms for cooperation between the public and private sectors.

- c. **Lack of expertise:** The local private sector lacks the necessary expertise and competencies to develop renewable energy projects.
- **Market:**
  - a. **Small market size:** Directorates lack large markets and local suppliers of renewable energy.
  - b. **Lack of supply chain:** There is no integrated supply chain for renewable energy, which increases costs and limits the options available to consumers.
- **Awareness & Understanding:**
  - a. **Lack of awareness:** The population suffers from a lack of awareness of the importance and benefits of renewable energy.
  - b. **Lack of training:** There are not enough training programs to develop local cadres in this field.
- **Interagency coordination**
  - a. **Poor coordination:** There are no effective mechanisms for coordination and consultation between the various stakeholders.
  - b. **Lack of a common database:** This duplicates efforts and disperses resources.

### 19) Proposals to promote the use of renewable energy

After analyzing the proposals submitted by representatives of the public sector, which were based on the existence of a shortage of traditional energy with high prices of oil derivatives and power outages and the especially urgent need of rural areas for renewable energy and the fact that renewable energy is the best solution to the problem of energy shortage, we can classify and organize them under the following axes:

- **Awareness raising and training**
  - a. Training and qualifying young cadres and building local capacities in the field of renewable energy.
  - b. Raise awareness of the importance and benefits of renewable energy.
  - c. Organizing training courses in areas such as maintenance of solar energy systems and operation of wind systems.
  - d. Preparing specialized workshops in technical and vocational institutes.
- **Funding and support**
  - a. Financing small projects by supporting individuals to implement renewable energy projects on a small scale.
  - b. Provide renewable energy systems to the most needy households.
  - c. Abolition of customs and taxes on renewable energy equipment.
  - d. Providing government and civil society organizations with the necessary funding to implement projects in the field of renewable energy.
- **Projects and infrastructure axis:**
  - a. Integration of renewable energy into new service projects.
  - b. Establishing renewable energy factories to achieve self-sufficiency and provide job opportunities.
  - c. Installation of wind turbines taking advantage of the natural potential of the area.
  - d. Determine the ideal locations for installing solar and wind energy systems.

- **Policies and Procedures**

- a. Attract donors to invest in renewable energy projects.
- b. Amendment of regulations, simplification of procedures and simplification of requirements.

- **Cooperation and coordination**

- a. Civil society organizations and the private sector
- b. Networking and linking the concerned authorities to each other.
- c. Providing the necessary facilities for investors.

**20) Proposals to enhance the role of entities in the field of renewable energy**

Based on the proposals submitted by the respondents, they can be summarized to enhance the role of the public sector in the field of renewable energy, which focuses on providing the necessary support to the private sector, building local capacity, developing infrastructure, and encouraging innovation, to ensure the achievement of the objectives of the transition towards renewable energy, as follows:

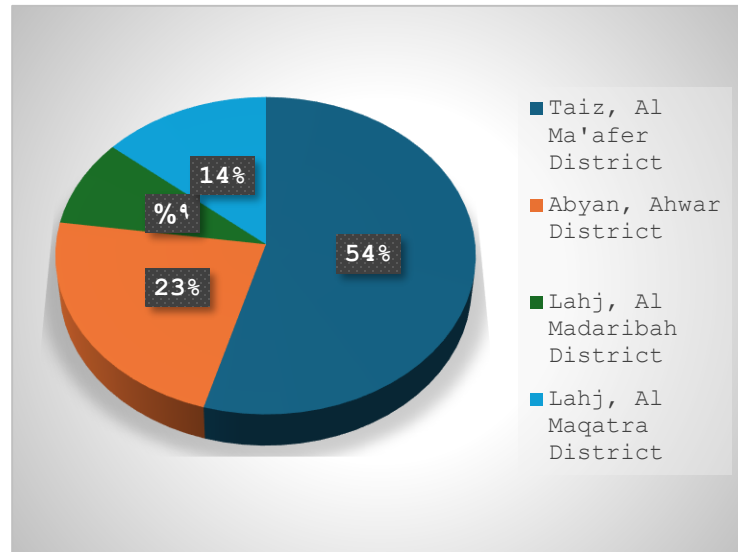
- Training and qualifying young people in the field of renewable energy, and organizing awareness sessions.
- Financing small projects, supporting poor families, and increasing budgets for renewable energy.
- Establishing renewable energy plants, installing wind turbines, and supporting solar water projects.
- The last five years have seen an unparalleled resurgence of civil society actors, including sophisticated policy.
- Facilitate procedures and provide incentives for investment in renewable energy.

## The Fourth topic: Renewable energy needs of international and local organizations and financing institutions

This part of the study aims to assess the extent of intervention by international and local organizations and financing institutions in the field of renewable energy by analyzing opportunities, skills, and challenges. This assessment seeks to identify current gaps in the renewable energy market and identify opportunities to develop innovative solutions that meet the needs of the targeted areas.

### 1- Governorate, District, and Region

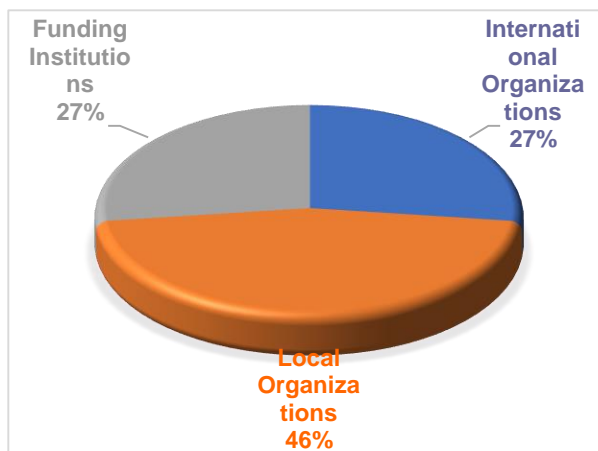
Figure No. (48) shows the distribution of sample members by governorates and directorates



The chart indicates the different geographical areas in which the data were collected, as Taiz governorate achieved a percentage of (55%) of the total sample, and equal proportions for each of Abyan and Lahj governorates, amounting to (23%). This distribution comes according to the presence of the targeted parties, whether local or international organizations, as well as financing institutions. Taiz Governorate has obtained the largest percentage as an inevitable result of the high activity of organizations and financing institutions in it compared to other regions.

### 2. Target Group

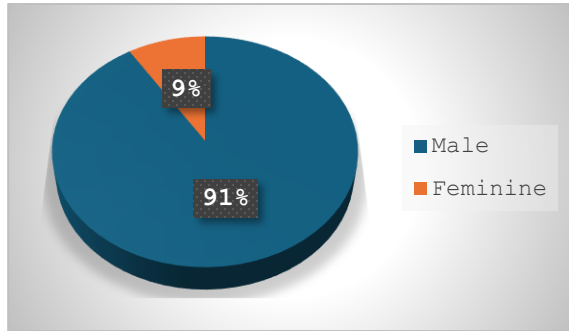
Figure No. (49) shows the distribution of sample members by sample category



The distribution of the study sample indicates a clear focus on local organizations (46%), reflecting the recognition of their pivotal role in local development. On the other hand, international organizations and funding institutions received a lower representation rate (27% each). This distribution makes sense given the large number of local organizations operating in the targeted areas and the diversity of their programs and projects.

### 3. Gender

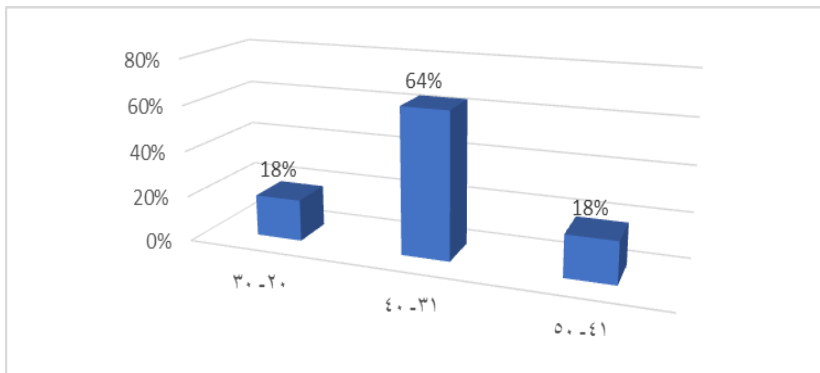
Figure No. (50) shows the distribution of the sample by gender



The data show that there is a clear numerical superiority of males in the study sample, where they constitute (91%), compared to (9%) for females. This unbalanced distribution may reflect gender disparities in the labor market in the region, where the number of females working is less. However, this distribution is similar to the study population and serves its objectives.

### 4. Age

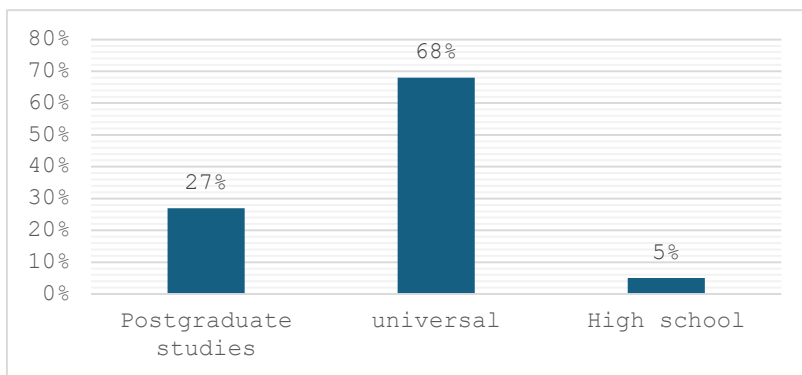
Figure No. (51) shows the distribution of sample members by age groups



The table shows that the majority of the study participants belong to the age group (31-40), where they make up (64%) of the total sample. The other two age groups (20-30 and 41-50) account for approximately the same percentage in the sample, each constituting (18 %)., this distribution indicates that the study focused more on participants with significant experience in the field.

### 5. Educational level

Figure No. (52) shows the distribution of the sample according to the educational level

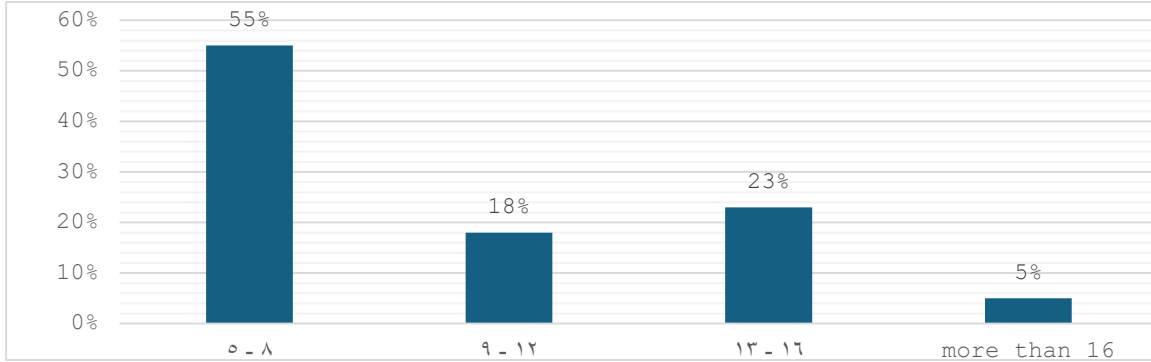


The diagram shows that the majority of the study participants hold a university degree, as they constitute (68%) of the total sample, and there is a good percentage of participants with postgraduate studies (master's or doctorate), as they constitute (27%) of the sample, and those with a high school degree constitute a very small percentage of the sample, as they do not exceed (5%). Job tasks in the targeted organizations and institutions usually

require a high level of education, which explains the high percentage of those with a university degree and postgraduate studies. The high percentage of those with a university degree and postgraduate studies in the study sample greatly supports the objectives of the study.

## 6. Years of experience

Figure No. (53) shows the distribution of the sample according to years of experience

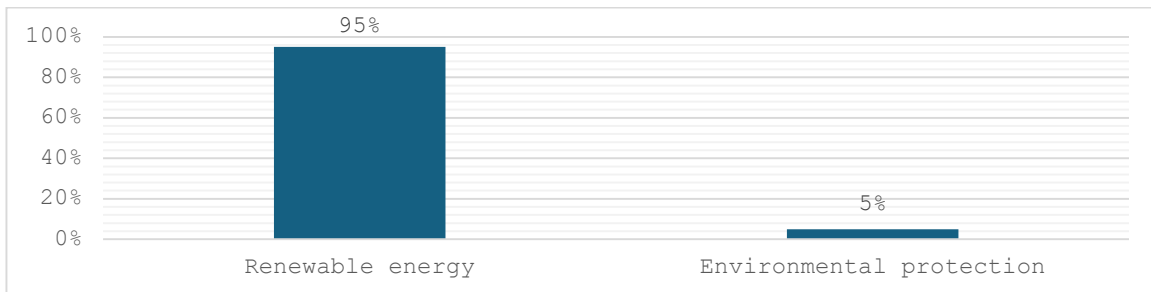


It is clear from the graph that years of experience (5-8 years), make up (55%) of the total sample. The following two age groups (9-12 and 13-16) represent a similar percentage in the sample (18% and 23%) respectively, and individuals with experience (17 years) and more constitute a very small percentage of the sample, as it does not exceed (5) %.

The diagram shows that the majority of the study participants have an average experience ranging between (5 and 8). Therefore, most of the sample have long experience in work. Individuals with long experience usually have deep opinions and views, which contributes to enriching the discussion and expanding the horizons of the study.

## 7. Sectors of interest to organizations and financing institutions

Figure No. (54) shows the distribution of sample members according to the sectors in which organizations and financing institutions are interested



By analyzing the data in the graph, it is clear that the interest of the sample that included the employees of international and local organizations and financing institutions is largely focused on renewable energy, as the number of answers that indicated an interest in renewable energy reached (21) out of (22) answers, which constitutes (95%) of the total answers, based on this high percentage, we can say that there is a great interest in renewable energy. This great interest reflects a clear awareness of the importance of switching towards renewable energy sources in the face of global environmental and economic challenges, and that interest in the environment imposes an interest in renewable energy as one of the means that seek to preserve the environment.

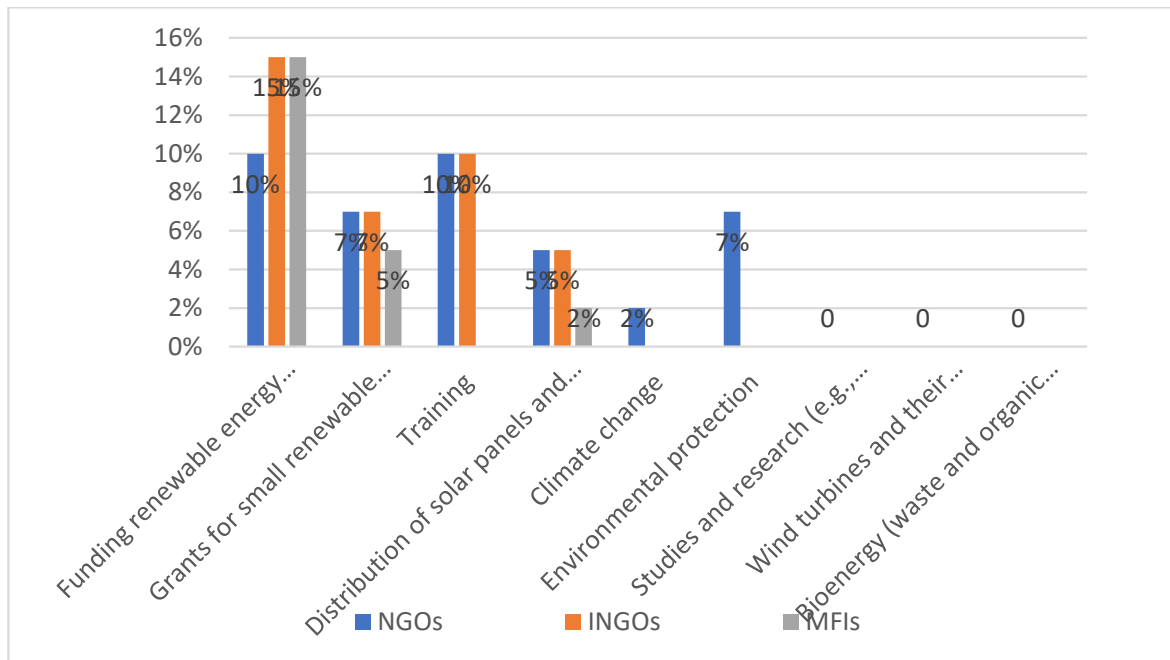
## 8. Renewable Energy Intervention

This section highlights the pivotal role played by financing institutions and local and international organizations in advancing the transition to renewable energy by analyzing the activities of these actors by reviewing a set of key elements, including the types of technologies adopted, the date of the start of the intervention, the beneficiary groups, the target geographical areas, the nature of the interventions,

and the challenges facing these efforts. The reasons behind the lack of widespread adoption of some technologies were also addressed, with the aim of a deeper understanding of the dynamics governing this vital sector.

**a) Area of intervention by category**

**Figure No. (55) shows the distribution of the field of intervention by category**



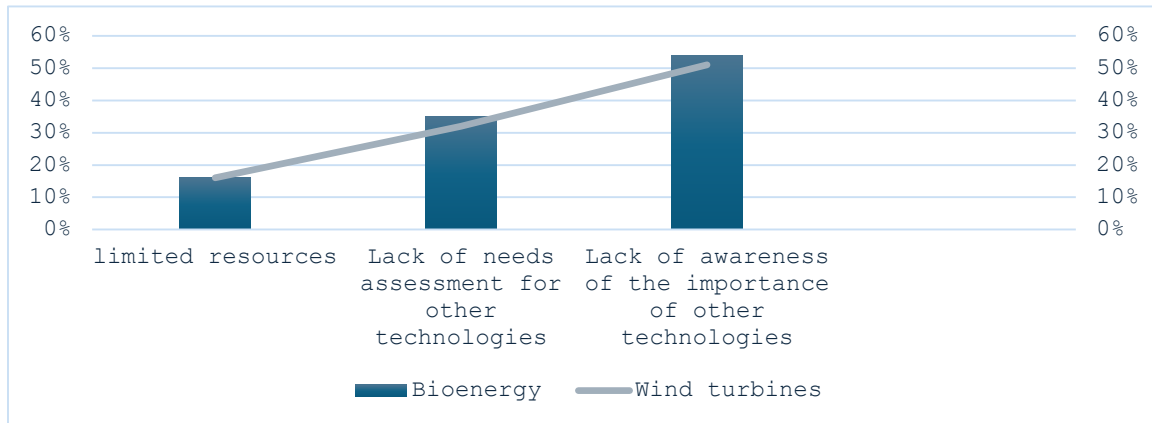
The table shows that the vast majority of interventions focus on financing renewable energy projects, at a rate of (39%), whether large or small projects and this indicates that these organizations and funding institutions see funding as the main driver of change in this field.

Despite the focus on funding, there are also interventions in other areas such as training, at a rate of (10%) for both international and local organizations only. This indicates that these organizations are aware of the importance of building local capacities in the field of renewable energy and distributing solar panels, at a rate of (12%) distributed at an equal rate of (5%) for local and international organizations and at a rate of (2%) for financing institutions, as well as financing small projects related to solar energy at a rate of (8%). This diversity indicates a broader understanding of the role of these organizations in supporting the renewable energy sector.

There is limited attention to climate change, which did not exceed (2%), and environmental protection by (7%), which indicates that these issues are implicitly addressed within the framework of renewable energy projects.

Despite the importance of studies and research and their important role in directing needs, funding and policy development, they have not received attention from actors in the targeted areas, and also the lack of interest in wind turbines, which require the preparation of tribal studies to ensure their economic and social feasibility, and perhaps the cost is one of the determinants of their absence from the arena of these areas, and although the areas where animals are located and their waste is certainly available and used in several aspects, they are absent from the minds of the parties and thinking about their investment in the field of renewable energy.

**Figure No. (56) shows the distribution of the sample according to the reasons for non-interference in other renewable energy fields**



The diagram highlights the main challenges facing the spread of non-solar renewable energy technologies, such as wind turbines and bioenergy, in projects funded by financing institutions and civil society organizations. The main reasons drawn from the table can be summarized as follows:

- Approximately (35%, and 32%) of the sample indicated that there are not enough databases on the potential of non-solar renewable energy technologies, which means that there is a lack of accurate information about the costs, benefits, and risks associated with these technologies.
- Also, an approach ratio for both wind and bioenergy technology. The sample members of the sample responded to the insufficient awareness and knowledge of engineers, technicians, and citizens about these technologies. This affects the ability to design and implement successful projects.
- By (16%, and 11%), the sample indicated that the high initial costs of these technologies constitute a major obstacle.

Compared to solar energy, technologies such as wind turbines and bioenergy require larger initial investments, making them more difficult to access, especially for small projects, in the absence of sufficient financial and legislative incentives to support these technologies makes them less attractive to invest in.

Compared to simple solar technologies, wind turbines and bioenergy require specialized technical expertise and more complex engineering designs. The appropriate conditions for generating energy from wind or biomass may not exist in all regions, which limits the spread of these technologies. There is a lack of awareness of the importance of these technologies and how to benefit from them, which leads to the reluctance of local communities to adopt them. All this is accompanied by the absence of interest of all parties in studies and research that enable them to study the importance of adopting these technologies and the possibility of using them in this social, geographical, and economic reality.

## b) Renewable Energy Financing

Table No. (3) shows the distribution of sample members according to the level of funding of the sample categories of renewable energy in the targeted areas

Category	Financing institutions	Local Organizations	International organizations
Year of Intervention	2010	2014	2015
Beneficiaries	All persons and entities	Displaced, war-affected, and host community	IDPs, war-affected, host community and government facilities
Systemic intervention areas	All Regions	Project Specific Areas	Project Specific Areas
Description of the intervention	Providing solar energy systems	Providing solar energy systems for water projects	Providing solar energy systems for water and government utilities projects
Eligibility Criteria for Utilization of Services	Availability of income and guarantees	There is a need for the area	There is a need for the area
Months	1.5	Over 3 months.	Over 3 months.
Service Availability	Throughout the year	Availability of funding	Availability of funding
Finance Amount	Starting from 100 thousand riyals	By Funding	By Funding
Challenges	Instability of exchange rates - quality of the commodity - difficulty in providing guarantees - and transportation problems	Lack of funds compared to need - quality of goods - lack of sufficient experience of service providers	Difficulty accessing areas - Limited funding compared to the need - Difficulty assessing the need for remote areas

The table shows the participation of a variety of actors, from international and local organizations and financing institutions. This diversity indicates the importance of partnerships in achieving sustainable development goals in the field of energy, and these partnerships contribute to providing the financial and technical resources and expertise necessary to implement projects.

There is an increase in the number of interventions over time. The increase in the number of interventions between (2010 and 2015) indicates an increasing awareness of the importance of renewable energy and the availability of more funding for projects in this field, which indicates an increasing interest in renewable energy projects in remote areas. This development also reflects changes in global and regional policies to support sustainable energy.

These interventions face many challenges, including armed conflicts, difficult geographical conditions, lack of awareness of the importance of renewable energy, and lack of adequate infrastructure.

Funding mechanisms vary between funding institutions and international and local organizations. Funding institutions often link the provision of funding to financial guarantees and fixed income for beneficiaries, which makes access to funding difficult for many individuals and communities. On the other hand, international and local organizations rely on needs studies and technical support, but suffer from lack of funding and difficulty in accessing remote areas.

One of the most important challenges related to the supply chain, which emerged with financing institutions and local organizations related to the quality of systems, transportation problems and the lack of sufficient expertise among service providers. These challenges are common to individuals who are users of renewable energy, shop owners, wholesalers, retailers and service providers. There are significant gaps in the supply chain with the targeted energy. Therefore, building local capacity in the

field of renewable energy is a crucial factor to ensure the sustainability of projects. Emphasis must be placed on training local technicians and engineers on the maintenance and management of systems, as well as raising awareness of local communities of the importance of renewable energy and how to use it efficiently.

**c) Microfinance:**

**Table No. (4) shows the distribution of the sample according to the financing of small projects**

<b>Category</b>	<b>Financing institutions</b>	<b>Local Organizations</b>	<b>International organizations</b>
<b>Year of Intervention</b>	2010	2023	2015
<b>Beneficiaries</b>	low-income individuals	Youth	IDPs, war-affected, host communities, and farmers
<b>Systemic intervention areas</b>	All Regions	Project Specific Areas	Project Specific Areas
<b>Description of the intervention</b>	Providing solar, irrigation, and industrial power systems	Training and provision of project supplies	Improving livelihoods by providing solar energy systems for water and lighting projects
<b>Eligibility Criteria</b>	Availability of income and guarantees	Unemployed	There is a need for the area
<b>Months</b>	1.5	Month	Over 3 months.
<b>Service Availability</b>	Throughout the year	Availability of funding	Availability of funding
<b>Finance Amount</b>	Starting from 500 thousand riyals	By Funding	By Funding
<b>Challenges</b>	Beneficiaries' inability to provide the required documents	Quality of materials - Lack of consultation with young people about materials - Lack of awareness of appropriate project areas	Limited funding compared to need - lack of awareness of the importance of renewable energy

Through the table, it is clear that the situation of financing institutions does not differ from them when providing the renewable energy system or financing projects, as they focus on guarantees and provide income for the applicant. As for local organizations, their focus in small projects is on unemployed youth and providing them with training services, then they finance them with project materials and requirements. The situation does not differ much with international organizations. Here, you find a reference to the importance of helping young people identify appropriate projects that correspond to the needs of the areas in which they live. As it was clear from the areas of intervention, the a lack of interest of groups of financing institutions and organizations in the preparation of studies and research. This gap

is reflected in the existence of deficiencies in small projects. It was clear from the challenges that the sample members confirmed the existence of problems in the quality of materials and the lack of awareness of appropriate project areas.

#### d) Training

Table No. (5) shows the distribution of the sample according to training

Category	Local Organizations	International organizations
Year of Intervention	2019	2021
Beneficiaries	Youth	Technical and utilities that have been supplied with solar energy - Water Projects Committees
Systemic intervention areas	Project Specific Areas	Project Specific Areas
Description of the intervention	Training in renewable energy and solar energy	Renewable Energy Training
Training Topics	Installation, operation, and maintenance of solar energy and project management	Renewable Energy Installation, Operation, Maintenance and Management
Training cost	ÜCRETSİZ	ÜCRETSİZ
Requirement of Participant	N/A	Residency - Age - Secondary Educational Level - Experience
Challenges	Quality of training materials - lack of funding - lack of training period and time	Lack and weakness of technical staff - transfer of funding - difficulty in obtaining trainers and consultants - customs and traditions that prevent women from entering this field
Include gender in training	Yes	Yes
Have females been targeted with training	Sewing, embroidery, and renewable energy	Awareness, installation, maintenance, and testing of renewable energy
Difficulties facing women in the field of renewable energy	Lack of knowledge of solar energy - customs and traditions - difficulty in integrating women into the labor market	Difficulty accessing training centers - customs and traditions - women's belief that this field belongs to men

This table aims to explore the views of representatives of local and international organizations on training in the field of renewable energy, with a special focus on the role of women in this field, as it shows that the role of local organizations appeared before international and local focus on youth and include women in training programs, while international organizations focus on the service side, especially for government facilities and tighten in the selection of trainees compared to local. Women also participate in training. The vision of local and international organizations is similar in terms of free training and interest in renewable energy, and customs and traditions are one of the most important challenges facing women in entering the field of renewable energy and entering the labor market. Most representatives also agreed on the need to empower women through providing training and rehabilitation opportunities and changing the societal view of the role of women in the labor market.

**e) Distribution of solar panels and accessories**

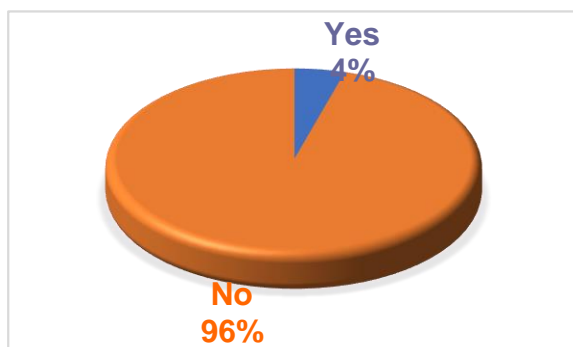
Table No. (6) shows the distribution of the sample according to solar panels and their requirements

Category	Financing institutions	Local Organizations	International organizations
Year of Intervention	2025	2023	2021
Beneficiaries	low-income individuals	Unemployed people, individuals and communities	IDPs in camps
Systemic intervention areas	All Regions	Specific Regions	Specific Regions
Description of the intervention	Providing loans for solar energy systems	Providing solar energy systems for water projects	Providing solar energy systems

Comparative analysis data with the previous tables reveal that there is a clear similarity in the mechanisms of distributing solar panels and associated supplies and between the mechanisms of financing renewable energy systems. Both sides focus on the category of low-income and needy people, and financing institutions provide loans under specific conditions, while organizations base their distribution on assessments of the actual needs of beneficiaries.

**f) Intervention through climate change**

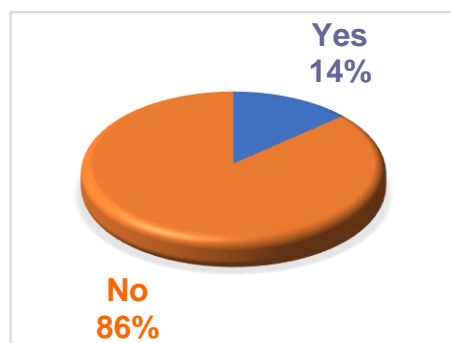
Figure No. (57) shows the distribution of the sample according to the intervention through climate change



The above table shows that only 4.5% of the intervention was carried out by paying attention to climate change, by one of the local organizations. The target group was community members in Taiz Governorate. The intervention was carried out through the implementation of bathrooms and pits, the construction of firewalls and bumpers to protect homes and agricultural land, the implementation of diversionary dams, surveyors, canals, the reclamation of agricultural land, and many other interventions in 2018.

**g) Environmental conservation**

Figure No. (58) shows the distribution of the sample according to the intervention through environmental protection



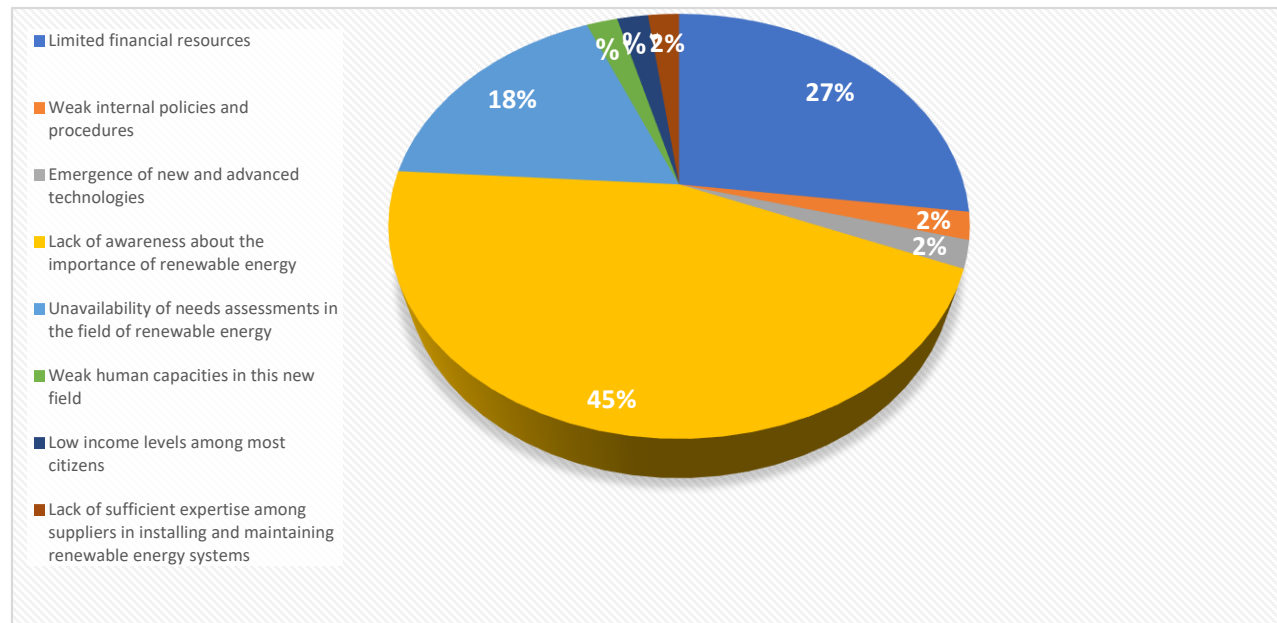
The above table shows that (86.4%) of the sample have no interest related to the environment, while (13.6%) were intervened by local organizations to protect the environment between the years (2012-2108- 2020), where the target group was community members and displaced people in Taiz, Hodeidah, Tor Al-Baha, Taban, Qubaita, Al-Houta, Al-Mudaraba, and Karsh.

Through the implementation of bathrooms and ponds, the construction of firewalls and bumpers to protect homes and agricultural land, the implementation of diversionary dams, mops

and canals, the reclamation of agricultural land and many other interventions such as suction ponds in camps, the suction of water catchment swamps in markets and cities, the work of bumpers, gabions, ferries and firewalls, as well as the implementation of awareness programs and the establishment of training courses.

### 9. Challenges in renewable energy

Figure No. (59) shows the distribution of sample members according to the challenges facing organizations and financing institutions

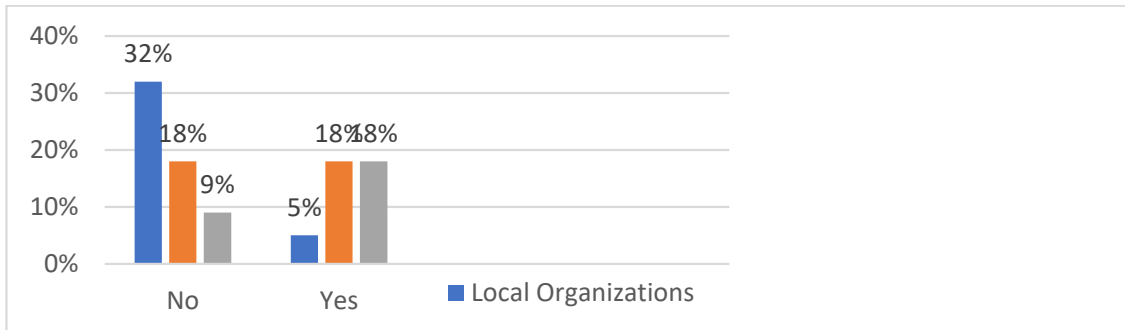


The results of the table revealed that the main challenges facing renewable energy projects in remote areas are the lack of awareness of the importance of these technologies (43%), the lack of funding (26%), and the lack of comprehensive needs assessments (17%). The study also showed that weak policies and infrastructure, in addition to social and economic challenges, contribute significantly to the complexity of these projects. The challenges can be summarized as follows:

- Lack of funding: Includes lack of financial resources and insufficient grant value.
- Lack of awareness: Includes lack of awareness of the importance of renewable energy, and lack of training and awareness courses.
- Poor infrastructure: includes remote and inaccessible rural areas, lack of necessary assessments.
- Weak policies: Includes the absence of an institutional role and the absence of supportive policies.
- Technical challenges: includes lack of appropriate technologies, and difficulty in maintenance and repair.
- Socio-economic challenges: This includes the low level of income of citizens and dependence on traditional energy.

## 10. Purchase of renewable energy technologies and supplies

Figure No. (60) shows the distribution of the sample according to the level of purchase of renewable energy technologies and supplies by organizations and financing institutions

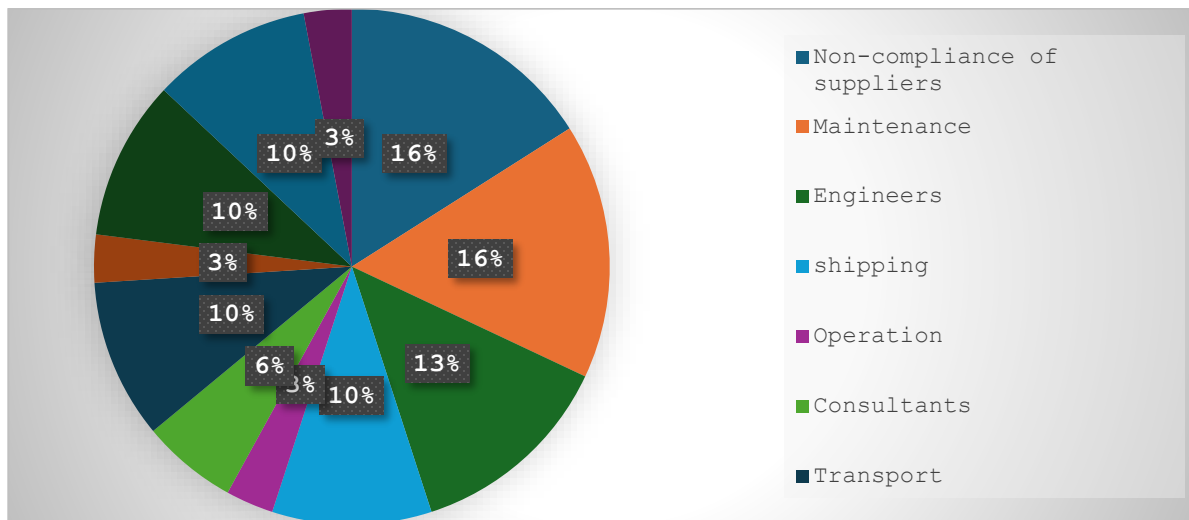


From the table, it is clear that the largest percentage of buyers of renewable technologies is represented by international organizations and financing institutions, reaching (18%) each. In doing so, international and local organizations play a vital role in the dissemination and adoption of renewable energy technologies at the local level, to understand their priorities and needs. While the percentage of local organizations did not exceed (5%). Local organizations may have difficulty securing funding to purchase these technologies.

As for not buying, a large percentage of organizations did not buy technologies, as the percentage reached local organizations (32%), international organizations (18%), and funding institutions (9%).

## 11. Challenges faced by organizations and financing institutions when purchasing renewable energy supplies

Figure No. (61) shows the distribution of the sample according to the challenges faced by organizations and financing institutions when purchasing renewable energy supplies



Based on the chart, the high rates of "non-compliance of suppliers" and "maintenance", which appeared in both challenges (16%), indicate that there are significant problems in the supply chain. This may be due to several reasons, including a lack of local suppliers who have sufficient experience in the field of renewable energy, and the difficulty in importing the necessary equipment and materials due to the sanctions and the blockade imposed on Yemen. Shipping and transport costs may also be very high,

which increases the cost of projects. The high percentage of "lack of engineers and consultants", which appeared to both of them (19%), indicates an urgent need to train national cadres in this field.

Indicators of the same percentage (10%) have emerged due to the weak experience of the Foundation's employees, which confirms the need for organizations and funding institutions to develop the capabilities of their employees in managing projects related to renewable energy. And also for "shipping" and "transportation" which refers to the logistical difficulties facing the projects, which may be caused by poor infrastructure and the deterioration of the security situation. The same percentage of "quality" among organizations regarding the quality of materials used in projects.

The graph shows the same percentage (3%) as a challenge to the procurement decision for both operation, training and procurement procedures, which shows that there are gaps in the supply chain and the required skills in the targeted areas.

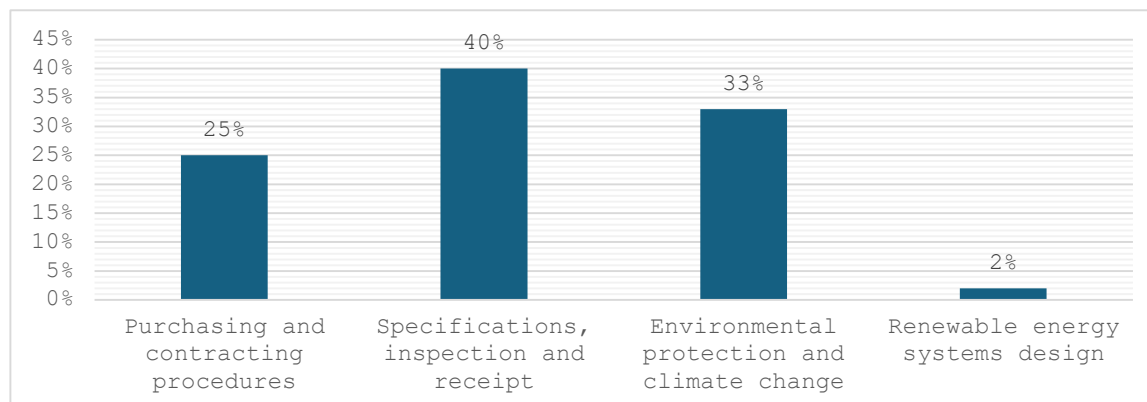
To address the challenges that emerged, the sample members proposed several recommendations represented in the following:

- **Training and qualifying local cadres:**
  - Focus on building the capacity of national cadres in the field of renewable energy through intensive training programs.
  - Covers aspects of design, installation, and maintenance, as well as project management.
  - Providing practical training opportunities in cooperation with specialized companies and academic institutions.
- **Operationalize Local Industry Development (LID) unit**
  - Encourage local industries to produce the necessary equipment and components for renewable energy projects.
  - Provision of financial and technical support.
  - Developing the necessary infrastructure for manufacturing.
- **PARTNERSHIPS AND COLLABORATION**
  - Promote cooperation between governmental and private organizations and civil society.
  - Develop uniform quality standards and facilitate licensing procedures.
  - Providing the necessary funding for projects.
- **Developing supportive policies:**
  - Develop government policies that encourage investment in renewable energy.
  - Import formalities
  - Evaluate the quality of imported materials and equipment.

## **12. Trainings that contribute to addressing challenges**

### **a) Training at the level of staff of organizations and funding institutions**

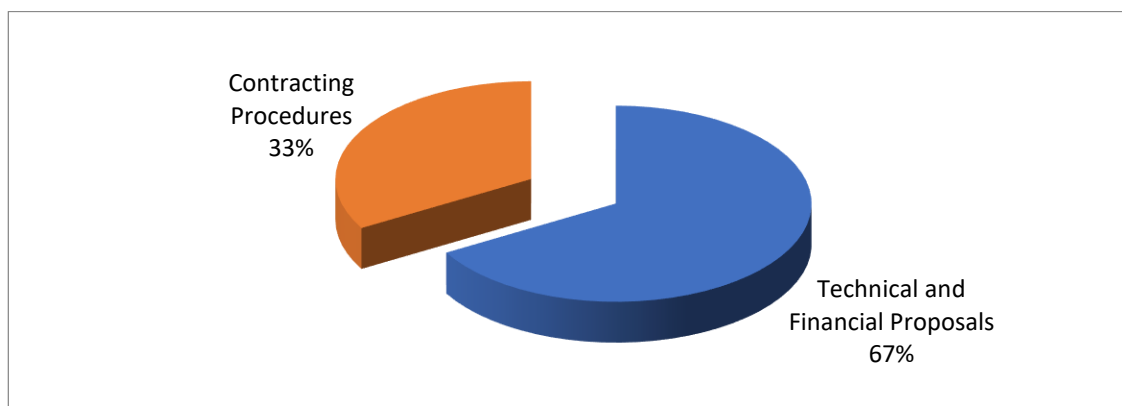
**Figure No. (62) shows the distribution of sample members according to training for the staff of organizations and financing institutions**



The results of the chart revealed a gap in the knowledge and skills of the employees of organizations in the field of renewable energy, as the largest percentage of participants (40%) indicated the urgent need to train employees on inspection and receipt processes. The results also showed that there is a great interest in developing environmental awareness among employees, as (33%) of them demanded training in the field of environmental protection and climate change. The results also highlighted the importance of training on administrative and procurement procedures related to renewable energy projects, as it reached (25%).

#### **b) Renewable Energy Supplier Level Training**

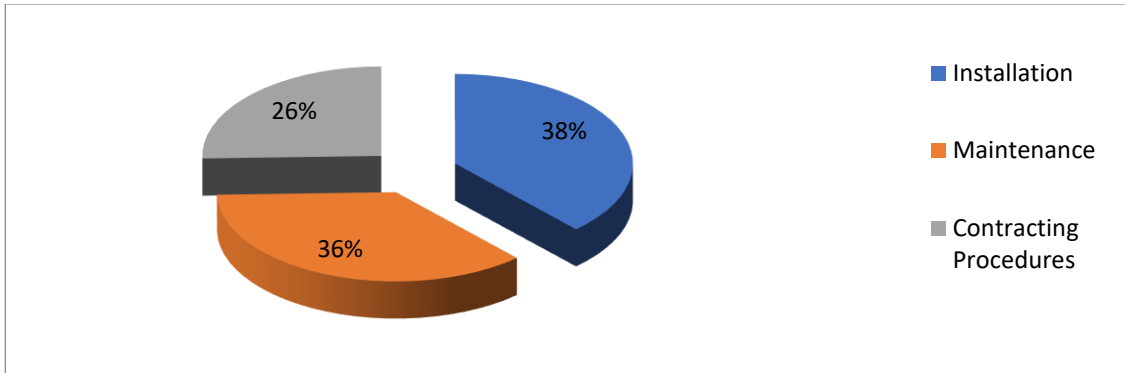
**Figure No. (63) shows the distribution of sample members according to training at the level of renewable energy suppliers**



The chart revealed a gap in the knowledge and skills of suppliers in the field of renewable energy, as the largest percentage of participants (67%) indicated the need for intensive training on the preparation of technical and financial offers, which contributes to raising their efficiency and improving the quality of the offers submitted, while (33%) expressed interest in training on contracting procedures.

### c) Provider-Level Training of Service Providers

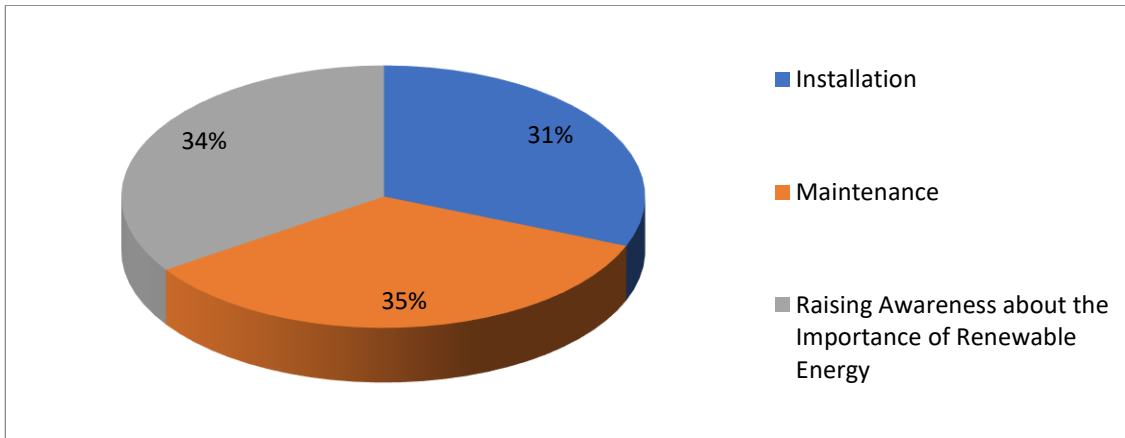
Figure No. (64) shows the distribution of sample members according to the level of training of service providers



The chart shows that there is a large gap in the skills of service providers, as (38%) of the participants indicated the importance of training on installation work, (36%) stressed the need for training on maintenance, and the remaining (26%) showed an urgent need to train service providers on contracting procedures. These results indicate a lack of competencies necessary to provide high-quality services in the field of renewable energy.

### d) Provider-Level Training of the beneficiaries

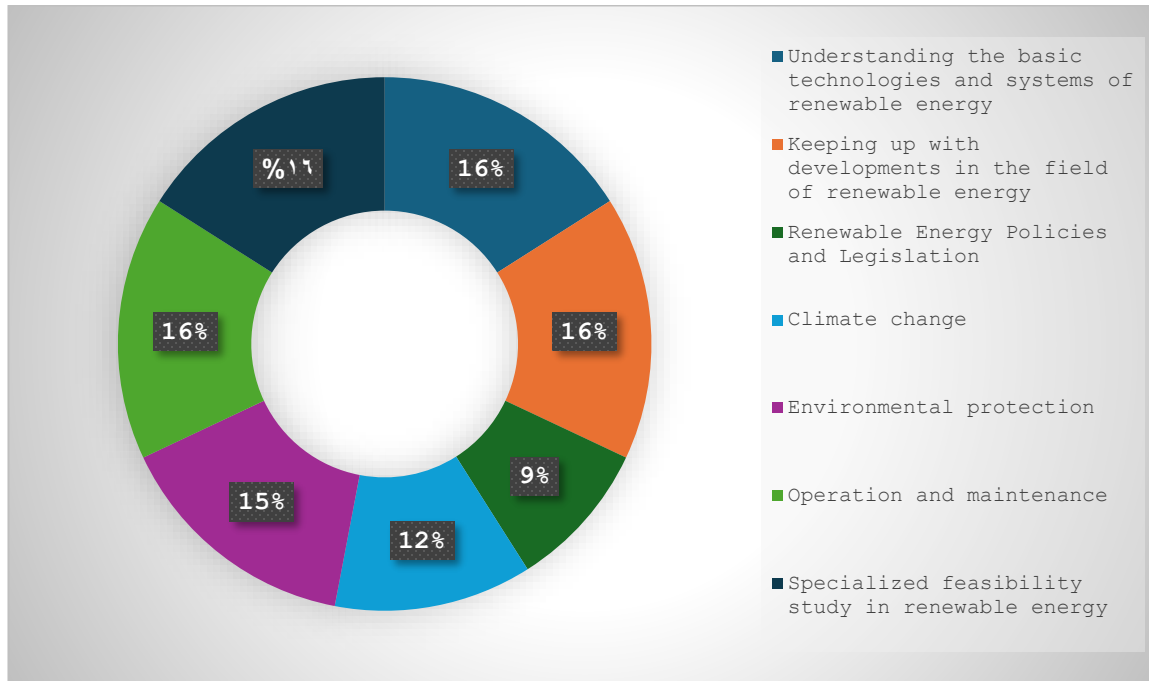
Figure No. (65) shows the distribution of the sample according to the level of training of the beneficiaries



The indicators of the chart showed that the respondents believe that the training programs related to the beneficiaries should focus on practical skills, as (31%) of them expressed interest in training on installation, and (35%) requested maintenance training, and the indicators also stressed the importance of raising awareness of the importance of renewable energy and its benefits, as it reached (34%). From these findings, there is a need to develop comprehensive training programs that meet the needs of the market and contribute to the development of the renewable energy sector.

### 13. Knowledge and skills required in the field of awareness and training in renewable energy

Figure No. (66) shows the distribution of the sample according to the most important knowledge and skills required in the field of awareness and training in renewable energy



The diagram shows that there is an urgent need to train and qualify cadres working in the field of renewable energy, to fill the gaps in the necessary skills. The results indicated that there is an almost equal distribution between technical skills (understanding technologies, keeping pace with developments, operation and maintenance, and feasibility study by (16% each). In addition, the results stressed the importance of environmental skills (15%), understanding climate change (12%), and knowledge of policies and legislation (9%). These results emphasize the importance of designing comprehensive training programs covering these areas.

### 14. Job opportunities in the renewable energy sector for men

Figure No. (67) shows the distribution of the sample according to the available job opportunities in the renewable energy sector for men and women

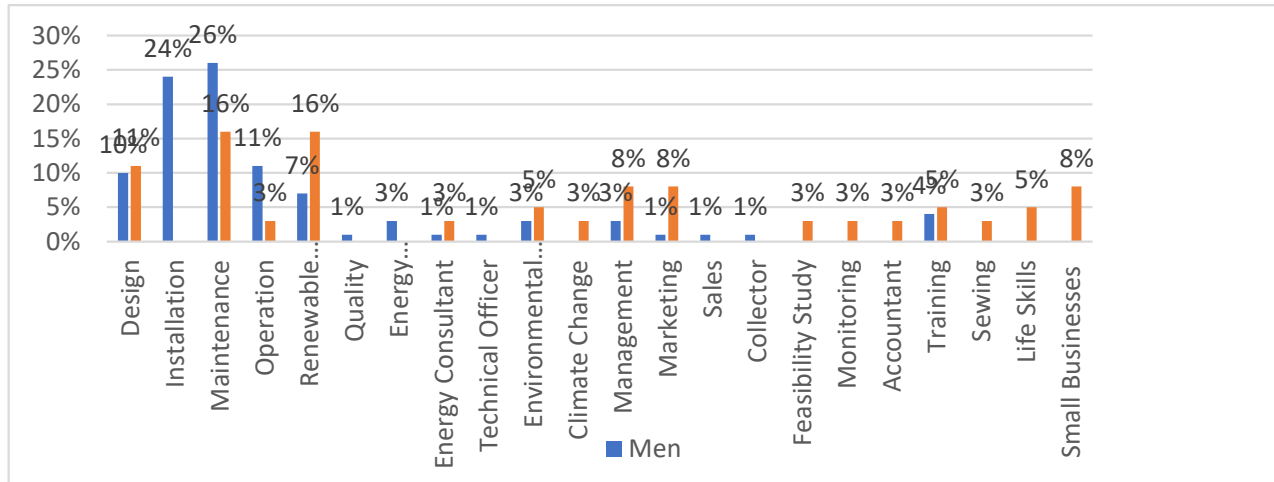
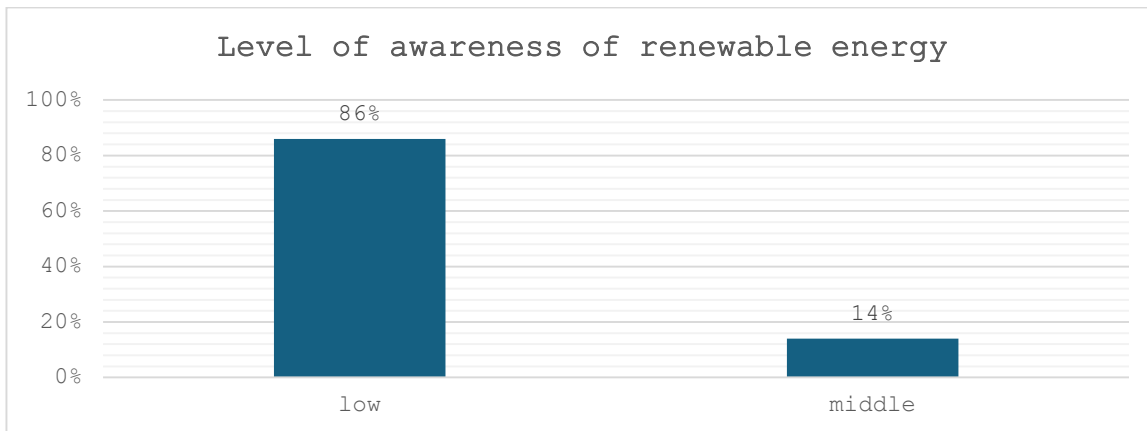


Table data show that there is a clear disparity in the job opportunities available to men and women, especially in some areas such as "design", "installation", "maintenance", and "operation", where men have a greater percentage of job opportunities in these areas compared to women, and that work that depends on effort and communication is attributed to men without women, such as collection, sales, quality, and technical officer, while the opportunities available to women are concentrated only in the fields of control and accounting.

There is also a common interest between the sexes in most opportunities, which indicates a common awareness of the importance of these works. The existence of gaps between men and women may be the result of stereotypical perceptions about gender roles, which limit women's employment opportunities in certain areas. Lack of awareness of job opportunities available to women in the field of energy, especially in technical fields, is one of the main reasons for this disparity, in light of women's lack of support from families, society, and institutions to develop their skills and engage in this field, as well as structural obstacles such as lack of training and professional development opportunities for women, or the existence of inappropriate work environments for women, which limits their participation.

**15. Level of awareness of renewable energy in the community where you work**

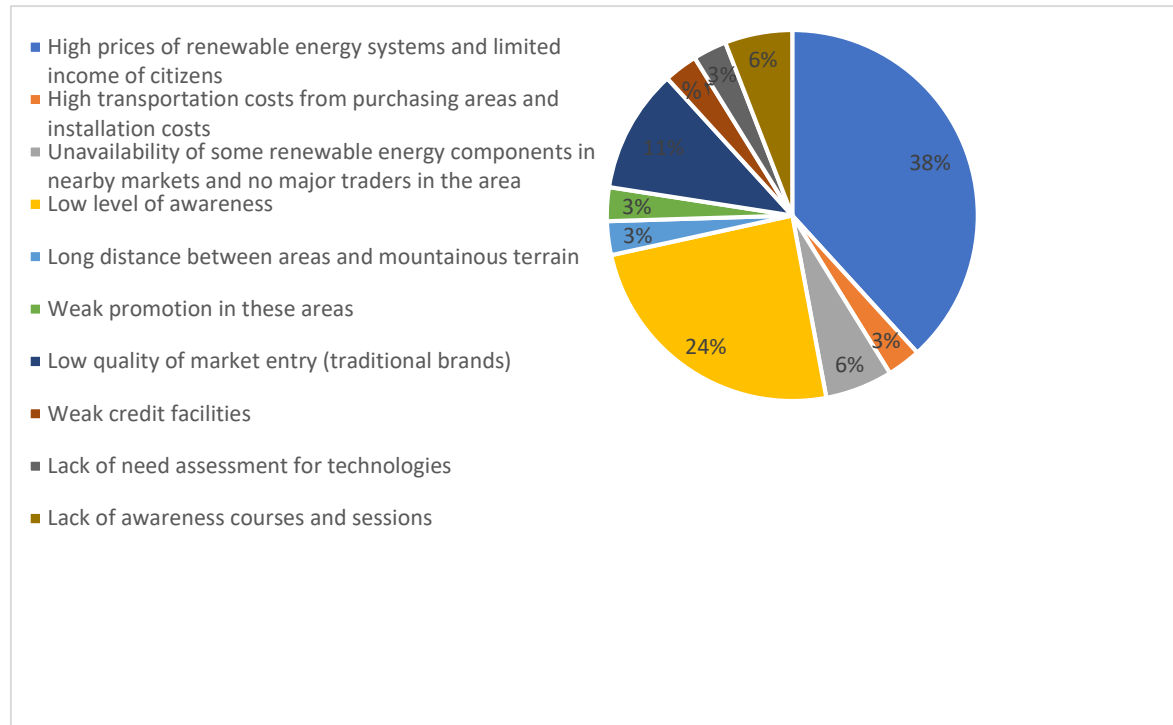
Figure No. (68) shows the distribution of the sample according to the level of awareness of renewable energy in the community in which you work



The diagram shows that a large percentage of community members (86%) have limited awareness of renewable energy, which creates a large knowledge gap. This gap, despite being a challenge, represents at the same time a golden opportunity to intervene. By organizing training workshops and apprenticeship programs, it is possible to raise awareness among community members and enable them to participate effectively in the transition toward renewable energy.

### 16. The most prominent obstacles facing the spread of renewable energy in the areas of interventions of organizations and financing institutions

Figure No. (69) shows the distribution of the sample according to the obstacles facing the spread of renewable energy in the areas of interventions of organizations and financing institutions



Through the table, it is clear that the economic obstacles with a total percentage of (45%) top the rest of the obstacles facing the spread of renewable energy in the areas of the presence of organizations and financing institutions. They appeared at a rate of (39%) due to the high prices of renewable energy systems and the limited income of citizens, (3%) weak credit facilities, high transportation expenses from the purchase areas, and the cost of installation at a rate of (3%). In second place are the social obstacles with a total percentage of (26%), which is represented by the lack of awareness of the members of society of the importance of renewable energy (25%), and the weak promotion of these areas (3%).

In third place are the technical obstacles (17%) represented in the low quality of entering the markets (traditional brands) (11%), and the lack of some components of renewable energy in the nearby markets and there are no major traders in the region by (6%).

In the fourth place are obstacles related to policies with a total percentage of (9%), which is represented in the poor promotion of these areas by (3%), and the lack of courses and awareness sessions by (6%), and in the last place are obstacles related to infrastructure represented in the distance between areas and mountainous terrain by (3%).

## **17. The most prominent opportunities for the development of the renewable energy sector**

Through the responses of the respondents, it is clear that there are opportunities for the development of renewable energy by focusing on identifying the driving factors and available opportunities that can be used to promote the spread and development of renewable energy in these areas, which are as follows:

### **a) The urgent energy needs in the targeted areas are among the most important indicators:**

- Rising prices of conventional fuels are a significant burden on households and institutions, increasing the attractiveness of alternative solutions such as solar energy.
- Many areas in these governorates suffer frequent or complete power outages, increasing the need for independent and reliable power sources.
- There is an urgent need to provide energy for water, health and education projects, which contributes to improving the quality of life and services provided to citizens.

### **b) The possibilities available in the regions are as follows:**

- These areas feature high solar radiation, making them ideal for solar power generation.
- Other natural resources such as wind and waves can be exploited in some areas to generate power.
- Vast areas of untapped land are available, which can be used to create large solar power plants.

### **c) Community support and the desire for change:**

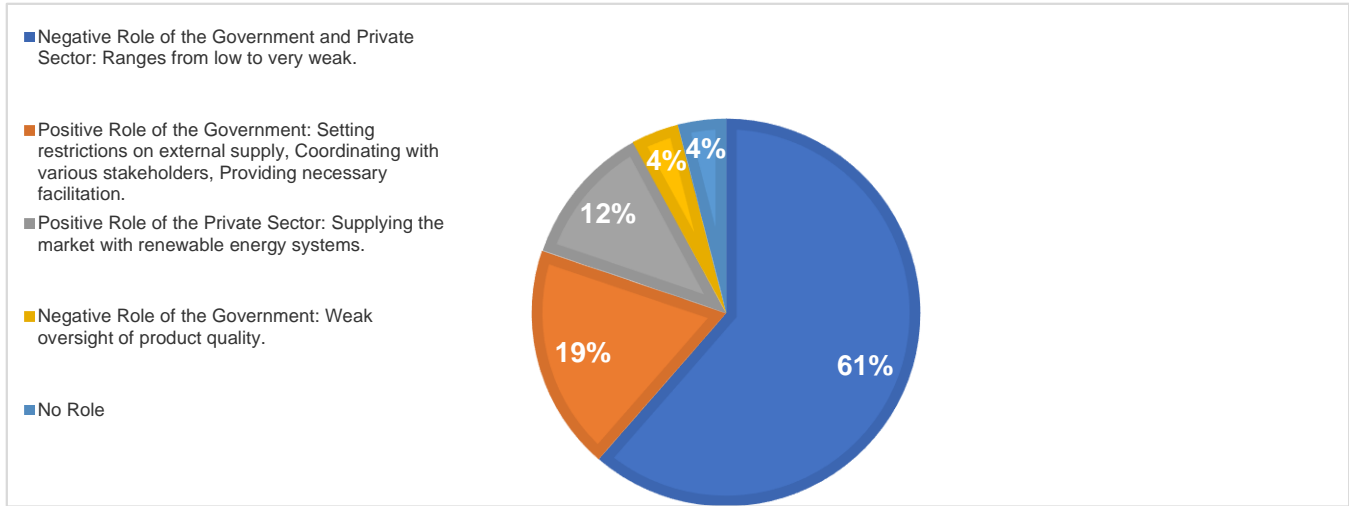
- The respondents' proposals show a strong societal desire for renewable energy, indicating a promising market for these technologies.
- There are indications of potential government support for renewable energy-related projects, such as government facilities and investment promotion.

### **d) Economic Development**

- The renewable energy sector can create new jobs in manufacturing, installation, maintenance and operation.
- Renewable energy can contribute to the development of the local economy by reducing dependence on imports and providing affordable energy.
- The renewable energy sector can attract domestic and foreign investments, contributing to the development of the region.

## 18. The role of government and the private sector in supporting renewable energy

Figure No. (70) shows the distribution of the sample according to the role of the government and the private sector in supporting renewable energy



In general, the table shows that the governmental and private role in supporting the renewable energy sector in Yemen is between low and very weak (62%). The weak governmental role may be due to reasons related to the absence of clear policies, the lack of adequate financial support, and the weak control over the quality of products. Despite the existence of some private initiatives, the role of the private sector in this field is still limited, due to many factors, such as political and economic instability, and the absence of an attractive investment environment. (19%) of the participants believe that the government has a positive but limited role. (12%) of the participants believe that the private sector has a positive role in supporting renewable energy, and (4%) of the participants believe that there is no clear role for either party, which shows that there is an urgent need to strengthen cooperation between the government, the private sector and civil society to develop the renewable energy sector in Yemen.

## 19. Good Practices Noted in Renewable Energy

Through the responses of the participants, a set of good practices that have been applied in the field of renewable energy in Yemen were highlighted. These practices can be summarized in the following points:

- Much effort has been directed towards rural areas that suffer from a lack of access to conventional energy.
- Solar energy was the most common technology in the mentioned projects, due to the abundance of solar radiation in Yemen.
- Projects were directed toward vital sectors such as water, agriculture, health, and education.
- The importance of partnerships between the government sector, the private sector, and civil society in the implementation of projects was emphasized.
- Part of the effort has been dedicated to training and educating communities on the importance of renewable energy and how to use it.

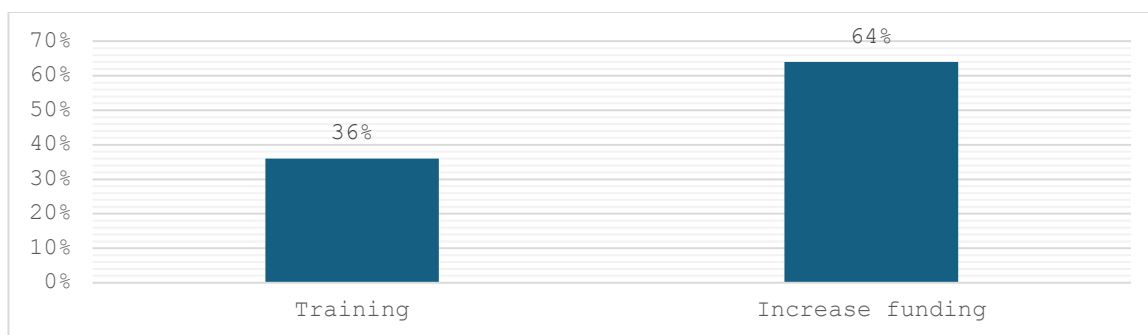
## 20. Interventions that organizations and institutions consider necessary to enhance their role in the field of renewable energy

Based on the proposals made by the representative of civil society organizations and local and international financing institutions to enhance their role in the field of renewable energy in Yemen, they can be summarized as follows:

- Focusing on training young people and women on modern technologies in the field of renewable energy, and qualifying cadres working in various sectors.
- Providing the necessary financing for the implementation of small and medium-sized projects in the field of renewable energy, and providing grants and soft loans.
- Building institutional capacity and developing the necessary infrastructure to encourage investment in renewable energy.
- Spread awareness of the importance of renewable energy and its benefits, and encourage society to adopt these technologies.
- Promote partnerships between the public and private sector and civil society organizations.
- Focus on supplying vital sectors such as water, health and education with renewable energy.

## 21. Tools and services needed by the organization to strengthen its capabilities in this area

Figure No. (71) shows the distribution of the sample according to the tools and services needed by the organization to enhance its capabilities in this field of renewable energy

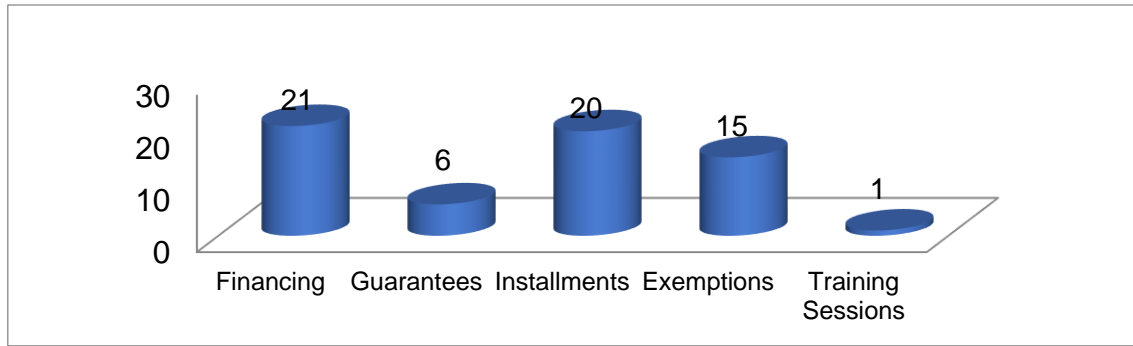


The chart shows that the vast majority of organizations and funding institutions surveyed (64%) believe that increasing funding is the most important tool or service to enhance their capabilities in the field of renewable energy. This indicates that there is a significant shortfall in funding allocated to this vital sector.

Although the percentage of participants identified is lower (36%), this need cannot be ignored. Training builds local capacity and increases efficiency in project management. There is a reasonable balance between the need for funding and training, which indicates that both aspects are complementary and indispensable.

## 22. Policies and incentives that can be offered to encourage citizens to use renewable energy technologies

Figure No. (72) shows the distribution of the sample according to the policies and incentives that can be provided to encourage citizens to use technology

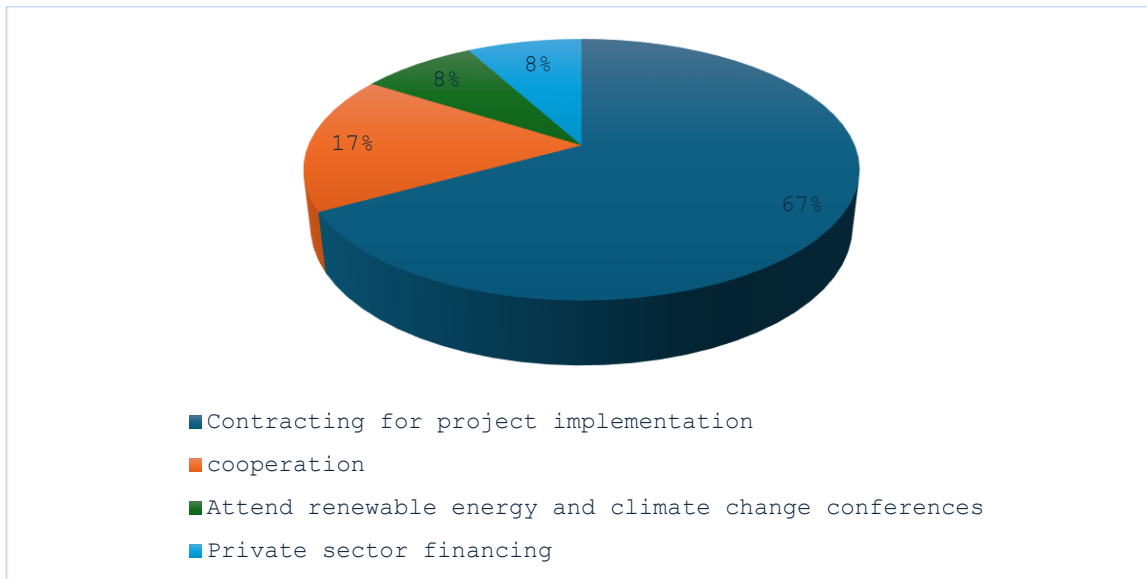


From the chart, direct financing (such as loans and grants) constitutes the largest share of the answers, at (21%), which reflects the urgent need for financial support to enable individuals to invest in renewable energy technologies. Installments, which have achieved (20%) of the most important incentives for citizens to adopt renewable energy systems as a result of poor income and low standard of living in the targeted areas, come with exemptions, and by (15%), as a third motivating factor, which indicates the importance of economic incentives to encourage the adoption of this field. And a simple percentage of (6%) to ease the guarantees as it is a burden on the beneficiaries. As for the training service, although it received a lower percentage, (1%), the need for training courses indicates the importance of capacity building in this field.

### 23. Partnerships built with the private sector to promote renewable energy

#### a) Private sector partnerships

Figure No. (73) shows the distribution of the sample according to the partnerships that have been built with the private sector to promote the field of renewable energy

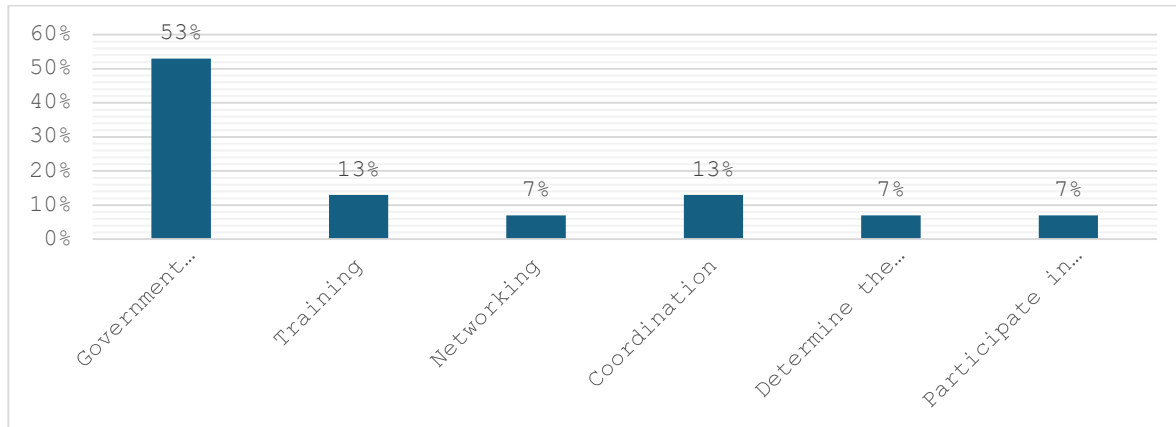


The diagram shows that contracting for the implementation of projects constitutes the largest percentage of the types of partnerships, amounting to (67%), which indicates that there is a clear understanding of the importance of formal partnerships to achieve tangible results on the ground, although the percentage of cooperation is less, amounting to (17%), but it plays an important role in building confidence, building capacity and exchanging knowledge among partners. The existence of funding for the private sector indicates the recognition of the importance of investing in renewable energy and the desire to participate

in these efforts, and the involvement of the private sector in relevant conferences enhances partnerships in this field and creates supportive prospects between the various parties.

**b) Partnerships with Government**

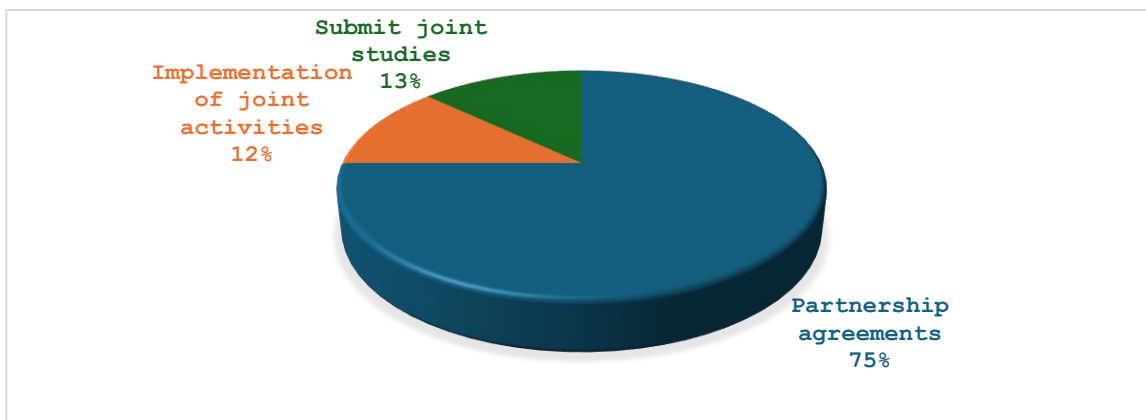
**Figure No. (74) shows the distribution of the sample according to the partnerships that have been built with the government to promote the field of renewable energy**



The diagram shows that most partnerships are focused on financing projects by (53%), which indicates that there is an urgent need for the government to provide financial support for the implementation of projects in the field of renewable energy, followed by training and coordination by (13%), each of which emphasizes the importance of cooperation between the two parties as well as building human capacity in this field. The remaining 7% are equally distributed among partnerships related to networking, participation in implementation, identifying needs, and providing studies and consultations.

**c) Partnerships with partner institutions**

**Figure No. (75) shows the distribution of the sample according to the partnerships that have been built with partner institutions to promote the field of renewable energy**

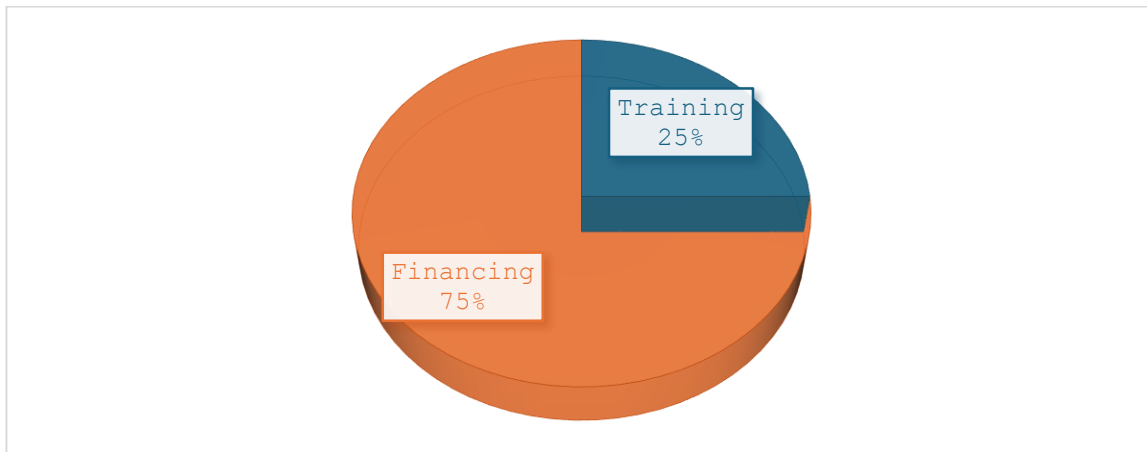


The graph shows that the vast majority of partnerships between CSOs and RE finance institutions in Yemen are focused on partnership agreements (75%). This means that partners prefer to conclude formal agreements that define the rights and responsibilities of each party, define the desired objectives and mechanisms for the implementation of projects. The presence of (12%) of partnerships related to the implementation of joint activities indicates the cooperation of entities with common goals in the field of renewable energy. The emergence of (13%) of partnerships related to the submission of joint studies

confirms that partners understand the importance of studying needs and cooperation to ensure the success of projects in the long term.

#### d) Partnerships with individuals

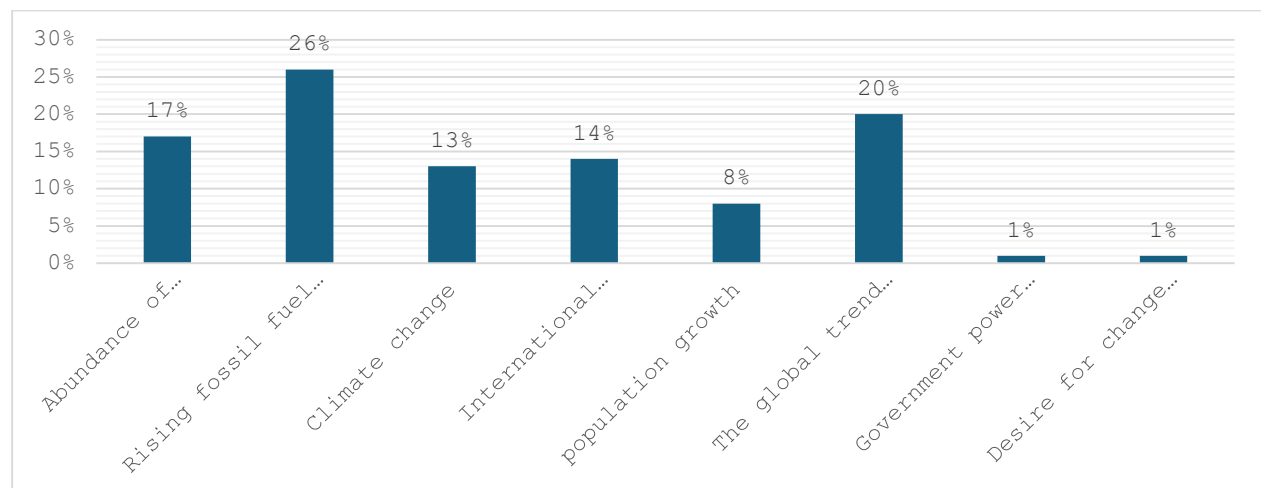
Figure No. (76) shows the distribution of the sample according to the partnerships that have been built with individuals to promote the field of renewable energy



The chart indicates that the majority of partnerships with individuals in the field of renewable energy in Yemen are focused on providing financing to individuals by (75%), while only (25%) are directed towards training. This indicates that efforts are mainly focused on enabling individuals and communities to adopt renewable energy solutions at the level of their homes and small projects and empowering them, and raising their awareness of the importance of renewable energy.

#### 24. Factors that contributed to the creation of renewable energy opportunities in Yemen

Figure No. (77) shows the distribution of the sample according to the factors that contributed to creating opportunities in the field of renewable energy in Yemen



The above figure shows that the respondents (26%) stressed the high prices of fossil fuels, which undoubtedly increased the cost of traditional power generation, making renewable energy an attractive economic alternative, and (20%) believe in the importance of efforts to promote sustainable energy at

the local and international levels to promote the use of renewable energy, including providing financial and technical support.

The abundance of natural and climatic resources, which achieved (17%), confirms that Yemen has great potential for generating renewable energy, especially solar, and profitability, which provides a solid base for the development of this sector. On the other hand, the increasing energy demand, which achieved (14%), proves that population growth and economic development led to an increase in energy demand, which created new opportunities for the development of the renewable energy sector, while (13%) indicated that climate change represents a great threat to Yemen, which increased awareness of the importance of moving to clean and sustainable energy sources. Other factors achieved by (10%) include the desire for change and development, government power cuts, population growth, the global trend towards sustainable energy, and other factors that contributed to creating opportunities in this sector.

## **25. Future Outlook for Renewable Energy in the Region**

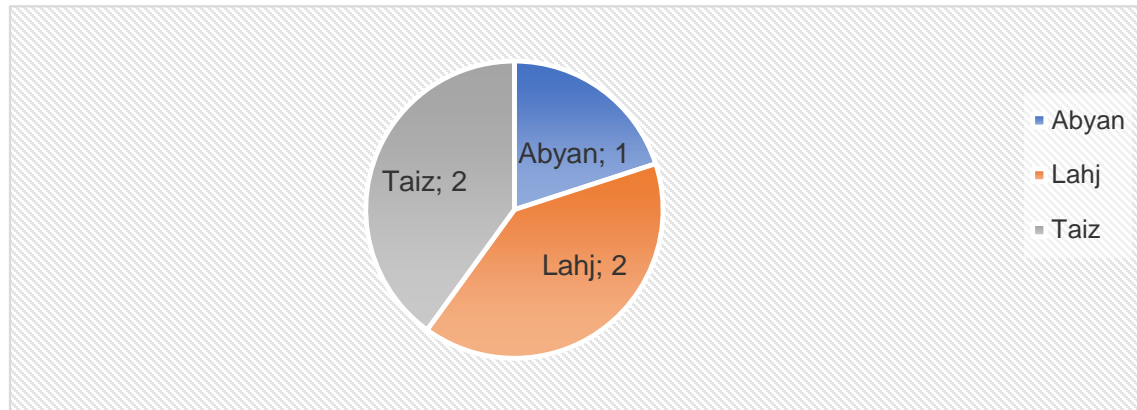
Through the expectations of representatives of international organizations and financing institutions about the future of renewable energy in the region, the following is clear:

- The majority of projections point to a significant increase in reliance on renewable energy in Yemen, for several reasons, including high fossil fuel prices, climate change, and the pursuit of environmental sustainability.
- The Outlook emphasizes the pivotal role that civil society plays in advancing the transition to renewable energy, through community outreach, capacity building, and support for small-scale projects.
- Forecasts indicated that there are many challenges facing the renewable energy sector in Yemen, such as conflicts, economic crisis, and lack of infrastructure.
- The expectations emphasized the importance of the government's role in supporting and encouraging investment in renewable energy through the development of appropriate policies and laws and the provision of financial incentives.
- Experts predicted the spread of the use of modern technologies in the field of renewable energy, such as solar energy and live irrigation, in addition to energy storage technologies.

## The sixth topic: Renewable energy needs with focus groups

### 1- Samples distributed to focus groups

Figure No. (78) shows the distribution of the sample according to the samples to which the focus groups were distributed



The diagram shows that Abyan Governorate, Ahwar District, has implemented one focus group, which includes (1) individuals, while in Lahj Governorate, the Mudaraba and Muqatariyah District includes (2) individuals, while in Taiz Governorate, the Maafarah District includes (2) individuals and traders.

### 2- Summary of discussions in focus groups

Focus group discussions provide valuable insights into the state of renewable energy in Yemen, with a particular focus on the potential of solar energy and the systemic challenges that hinder its growth. Natural resources in Yemen are a factor that makes solar energy the most renewable option, as sunlight is abundant throughout the country, yet wind and hydropower remain untapped due to infrastructure problems and geographical constraints.

Solar energy is widely accepted and particularly needed due to its long-term availability and sustainability, however initially high costs, lack of financing options, and low community awareness hinder its widespread uptake.

Economic challenges faced by consumers - such as inflation, low purchasing power and currency depreciation - are major impediments to the expansion of the renewable energy sector, with many participants expressing difficulty in affording solar systems that are expensive due to dependence on imports and lack of local manufacturing capacity.

Moreover, the quality of products is a concern, as low-quality batteries and solar components often lead to systems failures, and weak regulatory oversight exacerbates these problems, as the market is flooded with poor-quality products, which increases costs for consumers in the long run.

Service providers also face challenges due to the economic and political instability in the country. The conflict has led to the deterioration of infrastructure and made long-term business planning difficult. The lack of qualified manpower to install and maintain systems is an additional challenge, as many installations are carried out in rural areas unprofessionally, leading to inefficiency or equipment damage. Participants stressed the need for technical training programs to address this gap, which can also create job opportunities for local youth, especially in rural areas.

In this context, the value chain of renewable energy remains fragmented, with gaps in supply, production and access to the end-user, and most renewable energy products are imported, which increases costs

especially as the Yemeni riyal continues to deteriorate. The limited presence of local supply networks also means that consumers in rural areas often need to travel to large cities such as Aden or Taiz to purchase solar systems, and this logistics challenge, coupled with high transportation costs, limits access to these products.

Despite these challenges, there is optimism about the future of renewable energy in Yemen. We find that the demand for solar energy is high, especially in rural areas where traditional sources of energy are scarce. Focus group participants expressed their satisfaction with solar energy solutions, noting that they are cheaper and more sustainable compared to traditional energy sources.

However, to fully realize the potential of renewable energy, targeted interventions are needed, and financial support programs, such as microcredit programs and graduated payment models, can help alleviate the economic burden caused by high upfront costs. In addition, the expansion of technical training and community maintenance centers can enhance the sustainability and deployment of solar systems.

The focus group discussions also highlighted the need for gender integration in the renewable energy sector. Although men are more involved in technical roles such as installation and maintenance, there are great opportunities for women in the areas of selling, marketing and training. Encouraging more women to take on technical roles through targeted training programs can lead to a greater balance of participation in the sector.

There is no doubt that the renewable energy sector in Yemen holds tremendous potential, but systemic challenges must be addressed, ranging from financial constraints and weak infrastructure to a shortage of skilled workers. Focus group discussions emphasized the importance of government intervention in establishing regulatory frameworks, improving the quality of products, and enhancing financial incentives to adopt renewable energy.

With the right interventions, including investing in local manufacturing, technical training, improving access to finance, and raising awareness of other types of renewable energy and how they are used, Yemen's renewable energy market can grow exponentially, providing sustainable energy solutions and employment opportunities for both men and women.

## The seventh topic: The analytical framework for renewable energy in the targeted areas

The analytical framework of this assessment includes a multidimensional approach to understanding the solar energy landscape in Yemen as follows:

- 1) Analytical technologies
- e) SWOT Analysis

The following table provides a clear and structural overview of the key strengths, weaknesses, opportunities, and threats of the renewable energy sector in the key target areas, based on the results of the discussion.

**Table No. (7) SWOT Analysis**

Strength point	Weaknesses
<ul style="list-style-type: none"> <li>• High potential for solar energy thanks to abundant resources.</li> <li>• Positive perception of solar energy as a cost-effective and environmentally friendly option.</li> <li>• Strong demand for solar products such as panels and batteries.</li> </ul>	<ul style="list-style-type: none"> <li>• The initial high cost of purchasing and installing renewable systems.</li> <li>• Lack of technical expertise in installation, maintenance, and repair.</li> <li>• Poor quality of products, especially low-quality batteries in the local market.</li> <li>• Weak supply chain and heavy dependence on imports, raising costs and limiting access to rural areas.</li> </ul>
Opportunities	Threats
<ul style="list-style-type: none"> <li>• The possibility of youth employment and skills development through technical training programs.</li> <li>• Provides opportunities to expand financing models (e.g., microfinance, step-by-step payment model) to make solar energy more accessible.</li> <li>• Significant market growth potential, especially in underserved rural areas.</li> <li>• Partnerships between government and NGOs through incentives and financial support can promote large-scale adoption of solar energy.</li> <li>• The potential for job creation, especially for young people in the installation and maintenance of solar energy.</li> </ul>	<ul style="list-style-type: none"> <li>• Political and economic instability disrupting supply chains and business planning.</li> <li>• Inflation and currency deterioration increase costs and reduce consumers' purchasing power.</li> <li>• Weak regulatory framework leading to substandard product flow and reduced consumer confidence.</li> <li>• Limited awareness of other renewable energy sources such as wind and hydropower.</li> </ul>

### f) PESTEL Analysis: Renewable Solar Energy in Target Areas

PESTEL's analysis highlights the external factors affecting the solar market in the target areas and provides insights into the strategic considerations needed to expand renewable energy adoption.

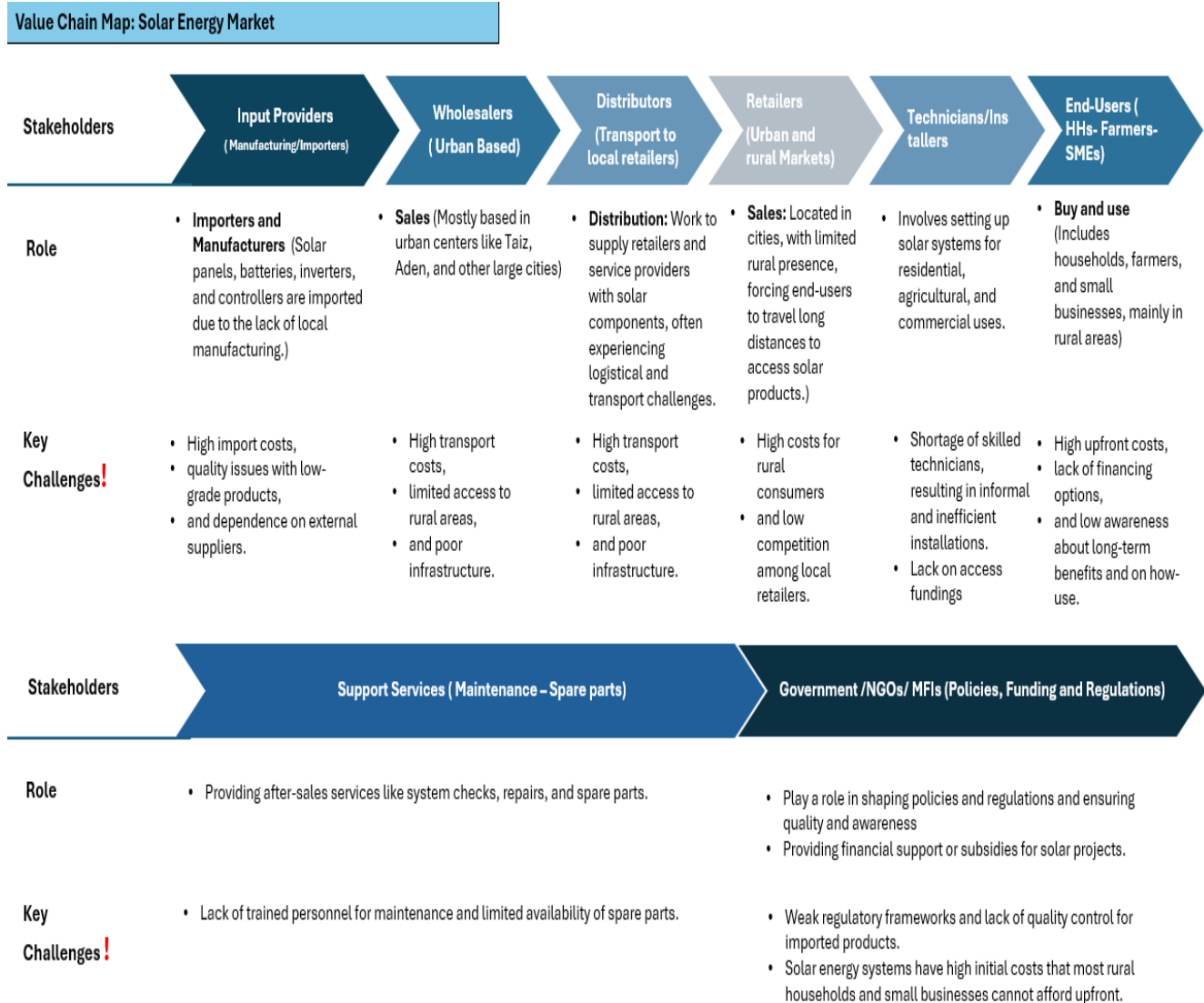
**Table No. (8): PESTEL Renewable Energy in the Target Areas**

The Factor	Description
<b>Political</b>	<b>Political instability:</b> Ongoing conflict is disrupting infrastructure development and limiting access to key areas for renewable energy deployment.
	<b>Government initiatives:</b> There are possibilities for projects supported by the government and international agencies to promote renewable energy.
<b>Economic</b>	<b>Cost barriers:</b> High initial investment in renewable energy systems, especially for low-income households and businesses.
	<b>Currency deterioration:</b> Inflation and the weakening of the Yemeni rial can lead to higher costs for imported renewable energy components, making adoption less expensive.
<b>Social</b>	<b>Job opportunities:</b> Renewable energy provides great potential to create job opportunities, especially for young people and women heads of household through training programs on the installation and maintenance of renewable energy.
	<b>Awareness gap:</b> Rural communities may lack awareness of the long-term cost-saving benefits of renewable energy.
<b>Technology</b>	<b>Lack of technical expertise:</b> The lack of professionals trained in the installation, maintenance, and repair of renewable systems limits the growth of the sector.
	<b>Technological advancements:</b> Advances in solar panels, storage systems and low-cost wind turbines can contribute to less dependence on imports and reduce costs.
<b>Environmental</b>	<b>High potential for solar energy:</b> The abundant availability of sunlight in Yemen is a great opportunity to adopt renewable energy in rural and disadvantaged areas.
	<b>Environmental sustainability:</b> Renewable energy reduces reliance on diesel-powered generators, which reduces carbon emissions, however, awareness programs or specialized companies must be developed for maintenance, recycling or destruction.
<b>Legal</b>	<b>Absence of legislation:</b> Lack of clear legislation to control the quality of solar energy products in particular and renewable energy in general leads to the flow of low-quality products, which damages consumer confidence.
	<b>Lack of incentives:</b> There are few government policies or incentives that encourage the use of renewable energy.

## 2) Value Chain Analysis: (Supply Chain for Target Areas)

This analysis helps to understand all the activities that contribute to the introduction of solar energy, from production to distribution.

**Figure No. (79) Renewable Energy Value Chain**



### 3) Stakeholder Analysis

Stakeholder analysis is a vital component of this study, helping to identify who will be affected by the project, positively or negatively, and how to manage their relationships.

**Table No. (9) Analysis of the key stakeholders**

Name of stakeholder	Group	Key interests	Level of Impact	Level of concern (interest)	Potential Risks	Dealing Strategy
Locals	Local community	Access to reliable energy, job opportunities, improved standard of living	Average	High	Project resistance, negative impacts on the environment	Community participation, providing installment programs, providing humanitarian assistance programs for the poor, awareness programs
Local Authorities	Government Sector	Sustainable development, improving services, promoting stability	High	High	Delay of proceedings, corruption	Build strong relationships, provide logistical support
Ministry of Electricity	Government Sector	Improving the efficiency of the electrical network, diversifying energy sources	High	High	Lack of resources, coordination difficulties	Close cooperation, providing technical support
Companies working in the field of renewable energy	Private Sector	Making profits, expanding its business, contributing to development	High	High	Price volatility, difficulties in accessing finance, difficulty in supply chains	Providing investment incentives, facilitating procedures
Financial Institutions	Private Sector	ROI, Reduced Risk	Average	High	Political instability, credit risk	Provide government guarantees, provide comprehensive feasibility studies
Local, national, and international organizations.	International organizations	Achieving the Sustainable Development Goals, Building Local Capacities	High	Average	Changing priorities, lack of funding	Build long-term partnerships, provide technical support

Suppliers (Merchants)	Private Sector	To get profits	Average	High	Payment Delay, Competition	Providing fair contract terms, building long-term relationships
Service Provider (Consultants, Engineers, Technicians)	Private Sector	Obtaining contracts, building a good reputation, developing the skills of employees	High	High	Delayed payments, competition, non-payment	Pay their dues on time, provide clear contracts, and build long-term relationships.

#### 4) Business opportunities in the field of solar energy for youth:

- a) **Installation and sale of small solar systems in rural areas:** Young people can benefit from the demand for affordable solar energy by establishing businesses that sell and install small solar systems in rural areas, this opportunity is especially valuable in places that lack access to electricity.
- b) **Solar Water Pumping Services:** Installation and maintenance services for solar water pumps can help meet irrigation and potable water needs, linking businesses to water scarcity interventions in remote areas, although capital investment is higher, it can be reduced through partnerships or community funding.
- c) **Small Grids in Local Markets/Small Communities:** Establishing small solar grids in local markets and small communities can provide consistent energy for businesses, vendors, and household use supporting economic and social activity in rural communities by ensuring a reliable energy source for commerce and homes.
- d) **Training and education programs on solar technology:** Youth-led training programs can enhance awareness of solar technology and technical skills, creating job opportunities and strengthening communities to adopt solar solutions effectively, such as training the employees of wholesalers and retailers on sales and marketing of energy systems as well as on maintenance and installation and providing consultations on energy systems by providing trainers from other regions and coordinating the implementation of programs in the targeted areas with local expertise that achieves sustainability and business.
- e) **Mobile maintenance services for solar systems:** The development of mobile maintenance units for solar systems in remote areas ensures the continuous and efficient operation of solar installations, which enhances long-term confidence in solar energy.
- f) **Manufacturing and assembly of solar systems:** Young entrepreneurs can explore manufacturing and assembly of solar system components, and integrate them with other technologies, this sector has growth potential, especially with the increasing demand for locally manufactured systems.
- g) **Solar home systems:** Young people can start microfinance-supported businesses focused on solar home systems, and these businesses can be linked to microfinance institutions, providing better support for “pay as you go” models.
- h) **Solar charging stations:** These stations can provide battery charging and maintenance services, along with repair and reuse of solar equipment, and solar waste management treatment helps promote sustainability.
- i) **Design and implementation of renewable energy:** By doing the necessary calculations to accommodate the actual needs (energy consumption analysis) and design the required needs and installation of energy systems.

- j) **Sales and marketing of renewable energy solutions:** Providing commercial services and building relationships with customers requires several skills, the most important of which are: communication skills, negotiation, understanding technologies related to renewable energy, and knowledge of business fundamentals.
- k) **Maintenance and Repair Services:** Providing maintenance and repair services for existing solar energy systems and selling spare parts for renewable energy systems.
- l) **Transportation and delivery services:** Transportation and delivery services can be provided between wholesalers, retailers, customers, and maintenance and installation engineers.
- m) **Battery maintenance service:** Through this service, energy storage systems can be maintained, usually sold or renewed.
- n) **Innovative projects through renewable energy:** By making ovens that work on solar energy and also windmill projects using wind energy and pumping water from the wells to the farms.
- o) **Consulting and studies offices:** It is possible to establish offices that include experts specialized in renewable energy and provide studies on investment in this sector.

A distinctive feature of the renewable energy sector is the close overlap between different disciplines and skills. Working in this field often requires an individual's ability to combine deep technical knowledge in areas such as electrical and mechanical engineering, and soft skills such as communication, negotiation, and teamwork. Rapid technological progress in this sector encourages a multiplicity of roles, as an engineer, for example, can participate in the design, management and even marketing of the system. This interlocking nature of working in renewable energy opens wide horizons for professionals and makes them able to develop diverse and fruitful career paths.

#### **Main considerations**

- Feasibility study is essential for the success of these projects and can be addressed during the training and project planning stages.
- Establishing projects in partnership requires a structured management framework to ensure proper coordination and sustainability, and it is advisable to conduct detailed feasibility studies for each solution.

## **Section Four: Findings, Recommendations, Outputs, References and Appendices**

### **The first section: Results**

- The study showed that there is a high demand for renewable energy in the areas surveyed in Yemen, especially solar energy. However, the high cost, lack of knowledge, and difficulty in accessing funding are the main challenges to their proliferation.
- The results of the study showed that there is a great focus on the use of solar energy systems among the sample, whether individuals or shops, by up to (100%)
- The study showed the absence of the use of other renewable energy technologies such as: heaters, solar furnaces, and turbines, which represents promising investment opportunities in the targeted areas.
- The results indicated that participants see ease of use as the most important factor when choosing a renewable energy system.
- The study revealed a lack of awareness of the importance of renewable energy and a significant gap in consumers' technical knowledge, which limits their ability to make informed decisions.
- Most consumers rely on self-financing to purchase renewable energy systems, suggesting the need for concessional financing programs.
- The high cost of purchasing renewable energy products the high cost of maintenance, and the lack of specialists, and technicians trained in the design, operation, and maintenance of renewable energy systems.
- Most consumers are not experienced enough to evaluate different technologies or accurately identify their needs, consumers prefer straightforward solutions that do not require much effort, and there is a growing demand for specialists who can provide technical support to consumers throughout the life cycle of the system.
- Projects face difficulty in obtaining the necessary funding and these are the main challenges, and clients suffer from limited financial resources.
- Companies have a hard time getting spare parts at affordable prices and high quality.
- Traders face complex bureaucratic procedures to obtain the necessary licenses and approvals, and the lack of wholesalers in most of the targeted areas.
- The study showed that the target areas rely on local and international organizations to provide renewable energy in public facilities (health, agriculture, education, and schools).
- The work of the public sector in those areas was limited to preparing plans for the regions' need for renewable energy and submitting them to the state.
- The weak purchasing power of community members and high inflation in the local currency prevents people from buying solar energy.
- Weak encouragement and interest from the government side regarding renewable energy to fill the deficit due to the lack of electricity.
- Due to the lack of control by the state, poor-quality products flooded the market.
- Investors are reluctant to invest in those areas due to the lack of facilities for the crisis by the government.
- The study showed that there is a need for renewable energy projects such as solar and wind energy (100%) due to the lack of electricity, but there is poor coordination between the public and private sectors and organizations to provide this need in an integrated manner.
- The study showed that the sectors in which organizations work in the field of renewable energy and solar energy, as well as in environmental health and climate change, what financing

institutions are working in providing loans to small projects and in the agricultural field, as well as opening bank accounts for customers.

- The study showed that the target groups of renewable energy projects include almost all groups of society, including individuals, the public sector, the private sector, farms and factories, and the various strata of society, including residents, displaced, marginalized, and those affected by war. This confirms and enhances that all members of society need renewable energy products.
- The results of the study showed that there is a great focus on training or financing interventions in solar energy systems among international and local organizations and financing institutions at a rate of (100%).
- The study showed the weakness of involving women in renewable energy projects due to the beliefs of society.
- The study showed that there is no reliance on studies and research in the field of renewable energy intervention and weak intervention in climate change and environmental protection.
- The results indicated that participants see financing, traditional power outages, and global trends as the most important factors when choosing a renewable energy system.
- The study showed that the challenges faced by organizations and financing institutions when purchasing renewable energy products are in the distribution of renewable energy requirements, operation, and training, procurement procedures, weak experience of the institution's employees, transport and shipping, consultants, quality, supplier commitment, and maintenance.
- The study showed that a high percentage is encouraged through financing and then comes through guarantees, installments, exemptions, and courses in the field of renewable energy.
- The study indicated that the field of renewable energy is promoted through partnerships with the private sector through contracts for the supply of products and between the public sector through agreements and involving them in designs to implementation and operation and that the partnerships that have been built with partner institutions to promote the field of renewable energy through joint agreements to promote renewable energy, and provide studies with important projects in the field of energy and provide them to institutions and international support bodies, and for members of society there are no partnerships with them.

### **The second Section: Recommendations**

- The renewable energy sector in the targeted areas relies heavily on self-financing, which limits its ability to grow and expand, so increasing support from organizations and financial institutions is essential for the development of this sector and the achievement of sustainability goals.
- Designing tailored financing programs to support renewable energy projects in these regions, with a focus on retailers and SMEs.
- Simplify bureaucratic procedures and provide tax incentives to encourage investment in the sector.
- Promote public-private partnerships to develop the necessary infrastructure for the renewable energy sector.
- Providing training programs to qualify national cadres in the field of renewable energy.
- The government should develop policies that encourage investment in the renewable energy sector and facilitate access to finance.
- Invest in local capacity building through the provision of training and qualification programs in the field of renewable energy.
- Procedures related to the import and distribution of spare parts should be simplified.
- Public-private partnerships and international organizations should be encouraged.
- Renewable energy research and development should be supported to develop new and innovative technologies.

- Expand the sample to include areas where wholesalers are present.
- Provide government facilities to encourage suppliers and traders to introduce renewable energy in those areas, and enhance the role of quality control of products imported from abroad.
- Supporting the entire supply chains in the field of renewable energy in those areas to create equal opportunities.
- The remote areas of Yemen and their geographical and climatic conditions are an ideal environment for investing in multiple renewable energies, especially in light of the lack of public electricity and the urgent need for energy in various activities of social and commercial life, which achieves opportunities to invest in renewable energy systems, including:
  - Solar Systems
  - Solar energy Ovens.
  - Wind turbine.
  - Biogas: Production of methane gas from organic residues for use in cooking and heating.
- Investment opportunities in the targeted areas:
  - **Establishing local maintenance centers and spare parts:** Centers specializing in the maintenance and installation of renewable systems and providing the necessary spare parts can be established, especially in remote areas.
  - **Spare parts assembly and distribution:** Companies specializing in the assembly and distribution of spare parts can be established, which contributes to reducing costs and improving the efficiency of supply chains.
  - **Development of local products:** Local industries can be developed to manufacture some spare parts, reducing dependence on imports.
  - **Provision of training services: Training** services can be provided to maintenance and installation technicians, contributing to local capacity building.
  - **Selling and marketing centers for new energy technologies:** New renewable energy products such as wind turbines, solar heaters, solar furnaces, and bioenergy furnaces can be provided.
  - **Installment selling centers: Installment selling** centers can be provided by forming networks between wholesale and retail merchants and consumers and benefiting from merchants' currencies in exchange for collecting debts from consumers.
  - **Centers for providing electricity service through renewable energy:** After choosing the appropriate technology for the geographical and residential conditions of the areas, whether solar or wind turbines, networks can be established to provide residential and commercial communities with electricity services.
  - **Battery maintenance centers:** These centers work on maintaining batteries as well as selling damaged batteries for recycling.
  - **Centers for transportation and delivery:** Centers can transfer and connect renewable energy technologies between related parties (wholesalers - retailers - consumers - service providers - and engineers (installation and maintenance).
- Opportunities and technical skills required to work in the field of renewable energy: used on the field study and the challenges faced by remote areas in Yemen, the technical jobs and the required skills are determined in the following:

**a) Maintenance Technician**

- **Systems Maintenance and Installation Skills:** The technician must be able to install and maintain solar and wind systems, including solar panels, batteries, transformers, wind turbines, and other components.
- **Dealing with extreme conditions:** The technician must be prepared to work in harsh environments, under changing weather conditions, and lack of resources.
- **Troubleshooting skills:** Must have the ability to diagnose and repair faults quickly and effectively.
- **Basic knowledge of electricity:** Basic understanding of electrical circuits and how electrical systems work.
- **Resilience:** The ability to adapt to unexpected changes and challenges.

**b) Technical Consultant**

- **Engineering background:** The consultant must be a specialist renewable energy engineer, with a deep understanding of technology and design.
- **Knowledge of the Yemeni environment:** Understanding the climatic and geographical conditions in Yemen, and how they affect the selection and design of systems.
- **Data Analysis Skills:** Ability to analyze data related to solar radiation and wind speed to determine the best solutions.
- **Communication skills:** Ability to communicate effectively with customers, donors and the local community.
- **Ability to develop innovative solutions:** Ability to design renewable energy systems that meet the specific needs of remote areas.

**c) The marketer:**

- **Deep understanding of the renewable energy market in Yemen:** knowledge of the specific needs and interests of the target market.
- **Communication and marketing skills:** The ability to communicate effectively with potential customers, and make persuasive offers.
- **Negotiation skills:** Ability to negotiate prices and terms with suppliers and customers.
- **Ability to build relationships:** Build strong relationships with customers and partners.
- **Flexibility:** The ability to adapt to changes in the market and regulations.

**d) Trainers:**

- **Experience in renewable energy:** The trainer must be an expert in renewable energy, with deep knowledge of the basic principles and practical applications.
- **Coaching and Mentoring Skills:** Ability to deliver effective training to learners from different backgrounds.
- **Communication skills:** The ability to explain complex concepts in simple and clear language.
- **Ability to develop training materials:** Ability to develop training materials appropriate to the educational level of the learners.
- **Patience and motivation:** The ability to motivate learners and encourage them to learn.

## Local experiences and success stories

### The first story: Noor

#### **Success Story: Eco-Friends Solar Power Plant in Abs**

**Location:** Hajjah, Abs – Al-Ghazi District

**Number of partners:** 9 Partners

**Project Manager:** Director of the Friends of the Environment Station

**Capital at the beginning of the project:** 10 million Yemeni riyals

**Current capital:** 25 million Yemeni riyals

**Supporting entity:** UNDP and the European Development Union through the Enhancing Resilience in Yemeni Rural, implemented by the Sustainable Development Foundation

**Duration of the project:** Since 2019 until now

#### **A Brief about the Project**

Eco-Friends was established as an initiative to generate solar energy and provide a sustainable and environmentally friendly energy source, with the aim of helping the local community in Abs to meet energy challenges and enhance the economic independence of women in the region. The project started with limited funding and grew thanks to the strong will and shared vision of its partners.

#### **Strength point**

- **Confidence and will:** We faced cultural challenges and customs that see women as unable to work outside the home or manage projects.
- **Community solidarity:** By educating the community about the importance of solar energy, we were able to gain the respect and appreciation of the community and motivate girls to aspire and achieve financial independence.

#### **Weaknesses**

- **High maintenance costs:** Difficulty in accessing solar engineers in the region has raised maintenance costs.
- **Lack of specialized training:** The lack of specialized research or training centers in the field of solar energy has led to a lack of technical expertise.

#### **Challenges**

When we started the project, we faced a rejection from the community for women to take over the tasks of solar energy management, as a “men's” area. The opposition reached out to some family members to boycott us. But we broke this barrier by persevering, educating the community, and sharing successes until society's perception of us shifted from ridicule to respect and inspiration.

#### **Opportunities and Achievements**

- **Global recognition:** We received the title of “Most Inspiring Woman around the World” and the International Ashden Award in 2020.
- **Achieving sustainable income:** The project contributed to providing sustainable income for us and our families, and enhanced the self-reliance of some other women in society.

- **Social impact:** We helped other girls launch their own businesses, such as sewing clothes and selling perfumes and incense, enabling them to achieve financial independence and serve their families.

### **Environmental and Social Impact of Materials**

Eco-Friends contributed to providing eco-friendly electricity to subscribers, which reduced pollution and contributed to creating a healthy and safe environment to live in.

### **Story II:**

Saber Dairy Factory Success Story

Location: Lahj Governorate, Tibn District, Sabr District (Hosh Agriculture Office)

Partners: 12 women, started the project through a collective provident fund, which allowed the purchase of the necessary tools and equipment.

Managing Partner: Balqis Abdo Ahmed Ali Al-Sharabi

### **Financing:**

- Capital at inception: 208,000 YR.
- Current capital: 1,500,000 riyals, with continuous reforms in which part of the capital has been used, currently amounting to 400,000 riyals
- 5 yr lifetime
- Supporting entities: FAO and UNDP, where contributed to the provision of some assets and a solar energy system.

### **Project advantages**

- **Specialization and experience:** The team consists of graduates of the Faculty of Agriculture who specialized in the food industries, which raises the quality of production.
- **Environmental sustainability:** The solar energy system has helped reduce costs and continue production in light of power cuts, and has also contributed to reducing the environmental impact.

### **Challenges:**

- **Lack of milk:** As a result of the exposure of cows to diseases, the laboratory faces a shortage of milk during manufacturing periods.
- **Protection and transportation:** There is no barrier to protect the plant from wind and animals, and the project lacks a refrigerated transport vehicle.

### **Opportunities:**

- **Expanding livestock production:** Some members have farms that can be used to raise cows, which helps provide milk.
- **Infrastructure:** Provide enough space to build a fence that protects the plant from wind and animal encroachments.

## **Regional experiences in renewable energy**

Today, the world is witnessing an increasing trend towards the use of renewable energy in sustainable projects, as part of efforts to address environmental and economic challenges. This trend has led to a regional rapprochement between many countries, especially in regions with rich natural sources of renewable energy such as solar, wind, and hydropower.

### **1. Regional cooperation in renewable energy:**

Regional rapprochement between countries enhances the exchange of experiences and technologies used in renewable energy generation. For example, North African countries, such as Morocco and Egypt, which enjoy strong sunlight, can cooperate with European countries seeking to expand their investments in this field. The Desertec project shows an example of this type of cooperation between Europe and the countries of the Sahara to generate electricity from solar energy.

### **2. Regional initiatives to promote sustainability:**

Several regional initiatives are promoting the use of renewable energy. One of these initiatives is the “electricity interconnection” between countries, where surplus electricity generated from renewable energy is exchanged between neighboring countries. An example of this is the electricity interconnection between the GCC countries, which allows the exchange of solar and wind energy.

### **3-Challenges and incentives:**

Despite these efforts, challenges to this convergence remain, including financial and technical constraints, as well as inconsistent legislative frameworks between countries. However, the increasing global demand for clean energy, and the continued decline in the costs of renewable energy technology, represent strong incentives to strengthen regional cooperation in this area.

### **4. Benefits of Regional Convergence:**

- **Reduce reliance on fossil fuels:** By uniting regional efforts, countries can reduce their dependence on fossil fuel imports and increase the use of renewable sources.
- **Achieving energy security:** The exchange of renewable energy between countries can provide stability in energy supplies, especially during peak or emergency periods.
- **Promoting economic development:** Investing in renewable energy projects creates new jobs and promotes innovation in the green technology sector.

### **5. Successful examples of regional cooperation:**

#### **❖ "Egypt-Saudi Arabia Electricity Interconnection" Project:**

This project is one of the largest electricity interconnection projects between countries in the Middle East region. It aims to exchange electricity between Egypt and Saudi Arabia with a capacity of (3,000 MW). Egypt has huge potential in the field of solar energy, while Saudi Arabia benefits from the potential of solar and wind energy. The project enhances the stability of energy supplies and gives both countries the ability to use renewable energy more efficiently<sup>1</sup> .<sup>9</sup>

---

<sup>1</sup> <https://ecss.com.eg/47530/>

### ❖ **International Solar Alliance (ISA):**

This alliance is a global initiative that brings together more than 120 countries, the majority of which are developing countries located between the equator and the Tropics of Cancer and Capricorn. The alliance aims to promote cooperation in the use of solar energy and the exchange of experiences and technologies, in addition to financing joint projects. The main goal is to make solar energy available and affordable, especially in areas with strong solar radiation<sup>2</sup> .

### ❖ **Desertec Solar Project:**

Desertec project is one of the most prominent examples of regional cooperation between Europe and North Africa. The project aims to exploit desert areas in North Africa, such as the Sahara Desert, to generate solar energy and export it to Europe through electrical interconnection systems. If fully implemented, the project can provide up to (15%) of Europe's energy needs<sup>2</sup> .

### ❖ **African Renewable Energy Initiative (AREI):**

This initiative was launched in 2015 and aims to increase the renewable energy capacity on the African continent to 300 gigawatts (GW) by 2030. The initiative calls for regional cooperation among African countries to develop renewable energy infrastructure, especially in the fields of solar, hydro and wind energy. Many African countries have started to implement huge renewable energy projects thanks to this initiative, which contributes to improving energy supply and sustainable development on the continent<sup>2</sup> .

### ❖ **"Renewable Energy in the Red Sea Countries" Project:**

States bordering the Red Sea, such as Egypt, Saudi Arabia and Jordan, are promoting cooperation in renewable energy. Saudi Arabia, for example, has a vision (2030) that aims to diversify energy sources and rely on solar and wind energy. On the other hand, Egypt is developing huge solar energy projects in the desert, and this cooperation can promote the use of clean energy in the entire region<sup>2</sup> .

The Food and Agriculture Organization of the United Nations (FAO) works to support and develop renewable energy projects in many countries around the world, as part of its efforts to achieve sustainable development goals. Renewable energy is an important element in the organization's plans to combat poverty, improve food security, and promote environmental sustainability, especially in rural and agricultural areas.

### ❖ **Bioenergy project from agricultural waste :**

FAO is promoting the use of bioenergy as a means of providing renewable and sustainable energy in rural areas. A successful example is a project in Ethiopia to convert agricultural waste into bioenergy, where crop waste and animal manure are used to generate biogas for cooking and heating. This project

---

<sup>2</sup> <https://ar.wikipedia.org/wiki/%D8%A7%D9%84%D8%AA%D8%AD%D8%A7%D9%84%D9%81%D8%A7%D9%84%D8%AF%D9%88%D9%84%D9%84%D9%84%D8%B7%D8%A7%D9%82%D8%A9%D8%A7%D9%84%D8%B4%D9%85%D8%B3%D9%8A%D8%A9>

<sup>2</sup> <https://ar.wikipedia.org/wiki/%D8%AF%D9%D8%B2%D8%B1%D8%AA%8A%D9%D9%83>

<sup>2</sup> <https://www.afdb.org/ar/news-and-events/mano-river-union-phase-ii-gets-go-ahead-improving-more-roads-and-transportation-in-countries-18510?page=35>

<sup>2</sup> <https://www.giz.de/en/worldwide/36643.html>

improves the lives of farmers by providing a clean and sustainable energy source, and reduces dependence on fossil fuels<sup>2</sup> .

4

#### ❖ **Solar Energy for Irrigation Improvement:**

FAO is developing solar irrigation technologies in several African countries. In Kenya and Niger, for example, FAO has implemented projects to provide farmers with solar-powered pumps to irrigate their fields. These projects not only provide water necessary for agriculture, but also help reduce carbon emissions resulting from the use of traditional fuel pumps. The technology also reduces operating costs and increases agricultural productivity<sup>2</sup> .

5

#### ❖ **Renewable Energy Programme in Conflict Areas:**

In areas suffering from armed conflicts such as South Sudan, FAO is working to provide renewable energy solutions to improve the living conditions of the local population. The organization has installed solar energy systems in communities suffering from electricity shortages, which helps to provide the energy necessary to operate agricultural equipment, health care facilities, and clean water sources. These projects help reduce dependence on diesel generators and contribute to improving the living conditions of the population in crisis areas<sup>2</sup> .

6

#### ❖ **Waste to Energy in North Africa:**

In countries such as Egypt and Morocco, FAO is working with farmers to convert agricultural waste such as rice straw and olive residues into bioenergy. These initiatives help reduce pollution caused by burning agricultural waste, and provide clean and free energy sources for farmers. For example, in Egypt rice straw has been converted into biofuels used in cooking, which reduces the use of traditional gas<sup>2</sup> .

7

The United Nations Development Programme (UNDP) is one of the leading institutions in supporting renewable energy projects around the world, and works to promote sustainability and combat climate change by providing clean energy solutions in many countries. Here are some examples of UNDP's experiences in the field of renewable energy, along with sources of information for each example:

#### ❖ **Solar Energy Project in Yemen**

In light of the ongoing humanitarian crisis in Yemen, UNDP is working to provide renewable energy solutions to communities suffering from severe electricity shortages. Solar energy systems have been installed to provide electricity to hospitals and health centers, helping to save lives and improve health care. Solar energy is also used to operate agricultural water pumps, which enhances farmers' ability to irrigate and increase food production<sup>2</sup> .

8

#### ❖ **Solar Energy Initiative in Palestine**

In **Palestine**, UNDP has installed solar energy systems on the roofs of schools, hospitals and government buildings, with the aim of reducing reliance on traditional energy sources and improving

---

<sup>2</sup> [FAO-Ethiopia Renewable Energy Projects](#)

<sup>2</sup> [FAO in Kenya | Food and Agriculture Organization of the United Nations](#)

<sup>2</sup> [FAO in South Sudan | Food and Agriculture Organization of the United Nations](#)

<sup>2</sup> [Home | Regional Office for Africa | FAO](#)

<sup>2</sup> [Yemen | United Nations Development Programme \(undp.org\)](#)

the provision of electricity in remote and deprived areas. This initiative contributes to providing sustainable energy and reducing carbon emissions in an environment that lacks adequate infrastructure<sup>2</sup> .

9

#### ❖ **Waste to Energy Project**

In Lebanon, UNDP supported a project to convert organic waste into bioenergy (Biogas) in rural areas, where agricultural waste and food waste are used to generate energy that is used in the operation of agricultural activities and homes. This project reduces the amount of solid waste and improves the efficiency of the use of natural resources<sup>3</sup> .

0

---

<sup>2</sup> <https://rolhr.undp.org/annualreport/2021/arab-states/state-of-palestine.html>

<sup>3</sup> Lebanon | United Nations Development Programme (undp.org)

## References

- ✓ Dawood Al Ansari, Claudia Kimvert, Hashim Al Kahlani “Solar Energy in the Yemeni War, Developments, Challenges and Opportunities” January (2019) (Development and Energy Program)  
[https://eadp.eu/uploads/WP201902\\_Yemen\\_Solar\\_EN.pdf](https://eadp.eu/uploads/WP201902_Yemen_Solar_EN.pdf)
- ✓ Dr. Omar Al-Saqqaf, "Solar Energy Uses in Yemen, Present and Future" (2017 ) (Center for Studies and Economic Media).
- ✓ UNDP, “Summary of the Investment Plan in Combined Renewable Energy in Yemen,” May (2024).
- ✓ Sabil Rakbel Arson, Julia Terabon, Marwan, Abdul Rahman Babrik “Sustainable Transformation of the Energy System in Yemen” May (2022) <https://library.fes.de/pdf-files/bueros/jemen/19520.pdf>
- ✓ Munther Yousef Mohammed Al-Sharman, “The Legal Concept of Renewable Energy Contracts” (2018) (Middle East University).
- ✓ Wind Energy Feasibility Study for Water Supply in Yemen (20-5-2024 DRRS)
- ✓ Wikipedia: Detailed articles on districts and governorates in Yemen contain a list of districts of the Republic of Yemen – Wikipedia.
- ✓ [https://ar.wikipedia.org/wiki/%D9%82%D8%A7%D8%A6%D9%85%D8%A9\\_%D9%85%D8%AF%D9%8A%D8%B1%D9%8A%D8%A7%D8%AA\\_%D8%A7%D9%84%D8%AC%D9%85%D9%87%D9%88%D8%B1%D9%8A%D8%A9\\_%D8%A7%D9%84%D9%8A%D9%85%D9%86%D9%8A%D8%A9](https://ar.wikipedia.org/wiki/%D9%82%D8%A7%D8%A6%D9%85%D8%A9_%D9%85%D8%AF%D9%8A%D8%B1%D9%8A%D8%A7%D8%AA_%D8%A7%D9%84%D8%AC%D9%85%D9%87%D9%88%D8%B1%D9%8A%D8%A9_%D8%A7%D9%84%D9%8A%D9%85%D9%86%D9%8A%D8%A9)
- ✓ Knowledge: A site that contains encyclopedic information about Yemen and its directorates.
- ✓ [https://m.marefa.org/%D9%82%D8%A7%D8%A6%D9%85%D8%A9\\_%D9%85%D8%AF%D9%8A%D8%B1%D9%8A%D8%A7%D8%AA\\_%D8%A7%D9%84%D8%AC%D9%85%D9%87%D9%88%D8%B1%D9%8A%D8%A9\\_%D8%A7%D9%84%D9%8A%D9%85%D9%86%D9%8A%D8%A9](https://m.marefa.org/%D9%82%D8%A7%D8%A6%D9%85%D8%A9_%D9%85%D8%AF%D9%8A%D8%B1%D9%8A%D8%A7%D8%AA_%D8%A7%D9%84%D8%AC%D9%85%D9%87%D9%88%D8%B1%D9%8A%D8%A9_%D8%A7%D9%84%D9%8A%D9%85%D9%86%D9%8A%D8%A9)
- ✓ National Information Center: Contains administrative and statistical information about governorates and districts in Yemen. Governorates - yemen-nic.info
- ✓ <https://yemen-nic.info/yemen/gover/>
- ✓ A review of Yemen's current energy situation, challenges, strategies, and prospects for using renewable energy systems | Environmental Science and Pollution Research – Springer Link 21 June 2022-)

- ✓ renewable energy investment are key to boosting sustainable development in Yemen  
<https://www.undp.org/yemen/press-releases/private-sector-engagement-and-renewable-energy-investment-are-key-boosting-sustainable-development-yemen>

## 2024

- ✓ <https://fycci-ye.org/upload/1720626523.pdf> " " Dr.Mansoor Allbashiry-sana 'a-June 2024
- ✓ Social and Economic Developments in Yemen, Issue 83) - December (2023 [EN/AR]  
[https://devchampions.org/uploads/publications/files/RYE\\_25\\_PolicyBrief\\_Scaling-up\\_Solar\\_Energy\\_Investments\\_in\\_Yemen\\_AR-1.pdf](https://devchampions.org/uploads/publications/files/RYE_25_PolicyBrief_Scaling-up_Solar_Energy_Investments_in_Yemen_AR-1.pdf)
- ✓ <https://www.youtube.com/watch?v=htjRUL3neMg>
- ✓ Sharaf, market assessment