



# Solar Energy Systems Value Chain

A Market Study with Potential COVID-19 Impact Analysis

Supporting Resilient Livelihoods and Food Security in Yemen:  
A Joint Programme

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# List of Acronyms

BDS	Business Development Services
ERRY	Enhanced Rural Resilience in Yemen
EU	European Union
GIZ	Gesellschaft für Internationale Zusammenarbeit
INGO	International Non–Government Organisation
MFI	Microfinance Institution
MSME	Micro, Small and Medium Enterprise
NGO	Non–Government Organisation
PV	Photovoltaic
SME	Small and Medium Enterprise
SWOT	Strengths, Weaknesses, Opportunities, Threats
UNDP	United Nations Development Programme
UNOPS	United Nations Office for Project Services
USD	United States Dollar
VC	Value Chain
YER	Yemeni Riyal
YSMO	Yemen Standardisation, Metrology & Quality Control Organisation

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# SOLAR ENERGY LANDSCAPE

Before Yemen's war crisis, Yemen had the lowest access rate to electricity (i.e. 40% of the population) compared with the regional rate of around 85%. The majority of Yemen's supply of electric energy depended on fossil fuels, including Mazot, Diesel, and recently LPG. Energy subsidy was over 7 billion USD per year. The electric grid had over 30% energy loss. Reliance on the indicated fossil fuel for electric generation is not sustainable in the long run.

After the 2015 war crisis, access to energy went down to zero per cent of the population in most districts in Yemen. This has created an enormous demand for solar energy systems. This was also compounded with the severe shortages of fossil fuel that lasted for weeks and months. Prices of solar PV watt/hour reached USD 1 when the international prices were less than 50 cents. While there is no authority to report exact imports of solar energy systems into the country, reports indicate over USD 2 billion worth of solar panels and batteries have entered the country since the crisis erupted. This includes various off-grid systems such as pico systems, solar home systems (SHS), photovoltaic (PV) pumping systems, and even mini-grid systems for residential and non-residential facilities such as schools, health facilities, and the like.

Despite the low access rate of electricity before the crisis, only about half of the population were connected to the public grid, and the other half gains access through private sources including diesel generators which usually operate for few hours for lighting, and less-intensive electric appliances. After the crisis, North Yemen only has access to either solar energy systems or private companies' generators; the south has interrupted electricity, using either solar energy devices or batteries as backup for the interruptions.

Yemen is characterised by hot and clear weather. Temperatures are generally very high, particularly in the coastal and desert areas. Geographically, Yemen is located in the sunbelt area of the world. It is endowed with solar energy radiation ranging between 6.8–5.2 kilowatt-hours per square meter (kWh/m<sup>2</sup>) per day and annual average of daily sunshine ranges between 7.3 and 9.1 hours/day. Even in winter, the daily average of sunshine hours is estimated of more than

8 hours per day. On such ground, Yemen has immense naturally endowed potential. On-grid and off-grid solar energy have the potential to significantly contribute in filling the energy gap in Yemen, especially in remote rural areas.

There are two main applications of solar power supply systems. First, decentralised solar power supply system (on-grid) which typically is produced in large farms, and then fed into an electric grid. Although on-grid technology is by and large not applicable currently as there is no enabling environment to make this market sustainable in Yemen and the necessary rehabilitation of the national grid requires huge investments besides regulations and policies, there is use of on-grid technology for specific purposes in large farms and a few enterprises.

While an on-grid decentralised solar power supply system that feeds into an electric grid is not applicable to Yemen's current national grid, a decentralised off-grid has been adopted by many households, farms, factories, and public service offices. A recent pilot project implemented by UNDP has provided a mini-grid solar energy system that can feed local communities. This model can provide a vast opportunity for Yemen's over 2,000 communities spread all over the country.

The crisis has created a need for solar energy systems. Much of the north could not access electricity generated in the Mareb power station. The severe shortages of fossil fuel prevented the use of electricity generators. In addition, government oil and gas revenues stopped leading to the removal of energy and fuel subsidies. As a result, solar energy systems were the only available option to access energy for a couple of years.

Several International Nongovernmental Organisations (INGOs) have funded solar energy systems to provide energy for health and education facilities, community water pumping, local civil services and authority offices, and the like. This has provided an incentive for many importers/wholesalers to enter the solar energy market.

The main challenge in the solar energy system is the need for electricity at night and the short lifecycle of batteries. In

2017, several private businesses started to provide commercial diesel-generated electricity to households and started to establish their own electricity networks to meet the local demand for reliable electricity.

Investments in the solar PV systems were relatively smaller than their normal usage and when life started to normalise in 2018, households had the choice to make long-term investments in solar energy systems or move to convenient retail commercial electricity or use both.

For many customers, solar energy systems remain more reliable given the crisis; the challenge is access to reliable products and services along with access to capital to cover the long-term investment. Low-income populations still prefer the solar energy system with one-time investment for long-term access to enough energy.

This value chain study focuses on the solar photovoltaic (PV) energy systems market. It looks at the market actors in eight districts in Abyan, Hajjah, Hodeidah, Lahj, and Taiz. The study objectives were to identify the current challenges and opportunities among the value chain actors in these targeted locations. The study is to inform Enhanced Rural Resilience in Yemen (ERRY II) programming and assist in identifying areas for improving the value chain. Data were collected via surveys, focus group discussions, and key informant interviews. A separate synthesis report describes the study methodology and sampling strategy. The study analysis started in December 2019, and with the Coronavirus (COVID-19) pandemic outbreak, opportunities were found to provide insight into the potential impact of the virus crisis on the sector.



# Value Chain Map

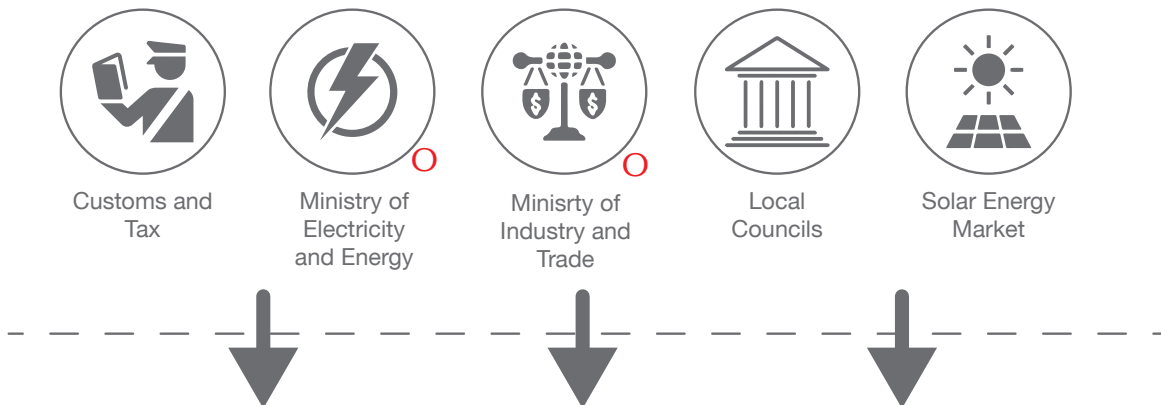
## Solar Energy Systems Value Chain Map

Symbol Key:

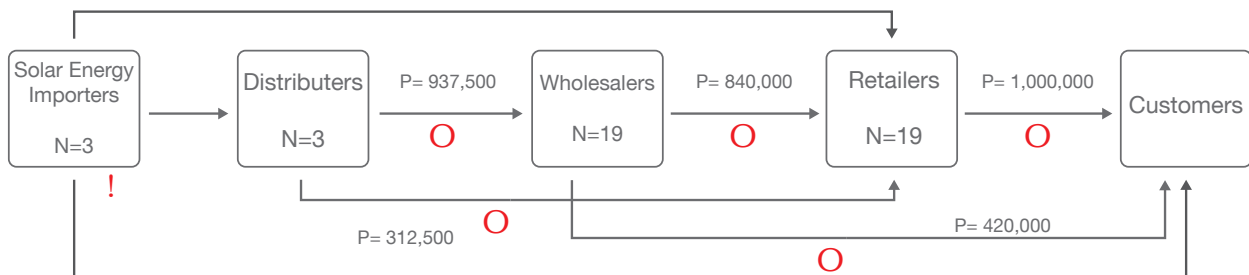
Critical Issue !  
Major Disruption X  
Partial Disruption O

### Market Environment:

Institutions, Rules, Norms and Trends

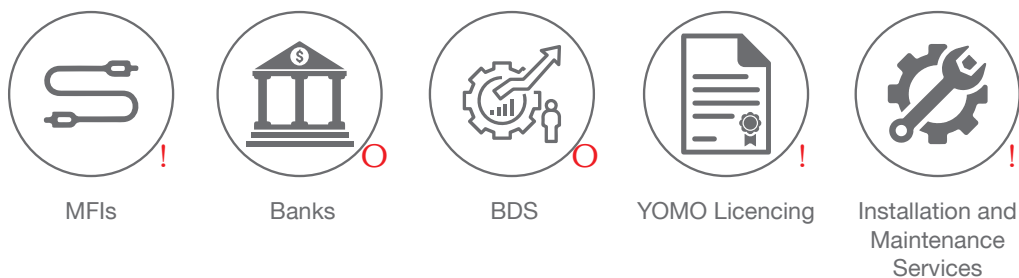


### Market Actors and Their Linkages



\*P= Price (All price amounts are in YER), USD = 500 YER

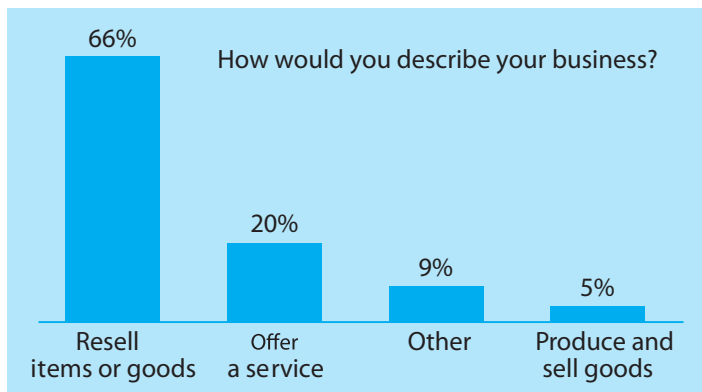
### Key Infrastructure, Inputs and Market Support Services





# Value Chain Actors

66% of the interviewees (importers, wholesalers, retailers) said they resell items or goods, meaning they are working as retailers. 20% of the interviewees said they offer services in solar energy to customers, like solving problems of the solar boards, batteries, solar networks, etc.



The solar energy value chain consists of the following actors in the chain. Governorates targeted by the study are covered by wholesalers, distributors and retailers While districts are penetrated mostly by retailers.

## Importers

They are the most influential and creative actors in the solar energy value chain since they bring solar energy goods, technologies, tools and equipment into Yemen to light it up again after the power outage since 2011. They brought many varied solar energy goods that suit the current Yemeni market's needs for different purposes: lighting, air fans, heating, freezing, cooling, agricultural pumps, etc. with variations of price and quality from various countries: China, European Union, India, United States, etc. Besides the products they provide to their clients, they offer technical assistance and support to ensure that their products are working well with their clients without any problems. Some of them also provide supportive loans or goods for later payment for their clients, in order to dominate the local market with their solar energy goods.

## Distributors

They are the conveying ring between the importers and wholesalers/retailers; most of them are working for importers but some of them are independent. They are very active and have a wide network of wholesalers and retailers in all governorates in Yemen, reaching them by their vehicles and vans.

## Wholesalers

They are a dominant actor in the solar energy value chain, because they have a wide range of solar energy goods from different importers, at different qualities and prices that allow retailers and customers to choose suitable solar energy products that meet the purchasing power and preferences of their final customers. Like the importers, they also provide necessary technical assistance and support to their retailers and clients, if required.

The actors interviewed for this study see wholesalers as the strongest actor in the solar energy value chain because they own many solar energy products from many importers, in different prices and qualities that make it easier for retailers, small shops and distributors to choose according to their financial capacities and their customers' financial purchasing power.

## Retailers

They are the main reference point for all final customers in Yemen. They are very widespread over all governorates, districts, and villages to supply/provide people with different types of solar energy products for different uses, especially for their houses and businesses.

## Customers

Yemeni customers have become very aware of the importance of solar energy benefits as the best current alternative to missing electricity due to the current crisis. They had adapted to the current crisis by installing solar energy systems into the electricity grid in their houses and businesses, especially when the fuel prices got very high. Most Yemenis are now using solar energy products for lighting and for pumping water to irrigate agricultural crops.<sup>1</sup>

<sup>1</sup> The current study has not explored details of consumer demand in terms of classification of consumers (such as from residential and farming sectors) and demand for specific PV products and services.

# Solar Energy Value Chain Environment

## Institutions

There is no institutional entity representing the solar energy sector, but governmental entities in this sector exist – Ministry of Electricity and Power and Ministry of Industry and Trade, in addition to the Yemen Standardisation, Metrology and Quality Control Organisation (YSMO) – and they need to be activated to play their roles in supervising and improving the sector.

## Rules and Norms

All rules and norms that organise and regulate the trading of solar energy sector come from the Ministry of Electricity and Power and Ministry of Industry and Trade and should be supervised and inspected by YSMO, which should prepare the National Specifications for all solar energy products that

enter Yemen to avoid cheating or dumping of the local market with low-quality solar energy products.

## Trends

Yemenis prefer to buy solar energy products at a moderate price with acceptable quality and last for a reasonable time. Yemeni importers try to provide the local market with cutting-edge and latest solar energy products, particularly at affordable prices to be competitive in the dynamic and growing solar energy sector. The average price per watt is around 0.54 cent.

## Sales

The following table provides sample reported quantities and sales prices among study micro, small and medium enterprise (MSME) participants.

Table 1. Sample Products Sold, and Monthly Quantities and Sales of Solar System Products

Product/Service		Quantity Sold per Month	Total Sales per Month (YER <sup>1</sup> )
Solar PV Panels	Product	4–200 Panels	150,000–5,000,000
Solar PV Batteries	Product	4–10	2,500,000
Light Lamps	Product	300	15,000–300,000
Cables and Wires	Product	5	25,000
Maintaining the Solar System for any Client	Service	4 Houses	40,000
Solar Off-grid Inverter and UPS	Product	6	60,000–5,000,000
Solar Charging Controller	Product	15	90,000
Installation of Solar Energy System in Houses	Service	4–5 Houses	120,000
Maintaining Acid and Gel Batteries	Service	4	40,000–60,000
Maintain Solar and Electric Inverters	Service	10–11	20,000



<sup>1</sup> USD = 500 YER

## Marketing Channels

The chart shows the different marketing channels of solar energy items as follows:

79% of the solar energy items go directly to customers in the shop, and this is a high percentage which reveals the importance of a shop to market the solar energy tools and equipment. This reflects the importance of specialisation in this sector, whereas the customers trust sellers who have an obvious outlet to provide what they want in terms of solar energy items.

12% of solar energy items go directly to customers in other public/private locations, which indicates the popularity of solar energy items where they can be found at any sales point at any public/private location. 10% of the solar energy items go to other retailers/shop owners where customers can find what they need/want.

8% go directly to customers in their homes, which indicates that the shop owners or retailers have provided homes with specialised technicians to, for example, install a solar energy system. Technicians bring the required items from those shops. This reflects the importance of relationships between the shop owners and the technicians who work together as product and service providers to the customers. There are also examples of technicians who have their own shops to provide both products and services. The study gives at hand that most customers are satisfied with the services they get from the solar PV technicians. 2% of the solar energy items go to traders from the wholesalers/importers who distribute to other shops and retailers.



## The Infrastructure of Solar Energy Value Chain

### Micro-finance Institutions (MFIs) and Banks

The MFIs' and banks' role in upgrading and supporting this promising sector is pivotal due to the high investment required to obtain the system and the long payback period of such investment. Consumer and agriculture solar systems have been reported as the top financed sectors among MFIs. More awareness programmes are required to penetrate the market.

The agriculture sector has been booming in the country in the aftermath of the conflict as people lost their jobs and went to their villages and started working in agriculture. Solar pumping has been the only way to agriculture due to the interruption of energy in the country and the severe shortages of diesel. The financing schemes provide groups of farmers the finance of a solar pump and farmers have been able to pay back within a year and a half what they used to pay for diesel for the same amount of time.

Among households, salary-based finance was very popular in 2015 and 2016 before the collapse of the government salary payments and the later introduction of commercial electricity. Among medium retailers, a supermarket owner indicated that the cost of financing the required system is more expensive than the average cost of diesel given his current energy needs for current refrigerators, computer systems, security camera, and lighting infrastructure.

### Business Development Services (BDS)

Business development services are very important to facilitate scaling up in the solar energy value chain, especially for importers, wholesalers and retailers, in organised institutions. The BDS market is still unknown to SMEs/actors who are working in the solar energy value chain, especially as regards workforce development and business development aspects in administration, finance, public relations, sales, innovation, creativity, marketing and marketing strategy. Most actors are working traditionally and are really in need to build their organisational, institutional capacities to be able to work effectively and expand their businesses. This will improve the performance of the sector and lead towards prosperous economic growth.

## YSMO Certificates

The Yemen Standardisation, Metrology and Quality Control Organisation (YSMO), a branch of the Ministry of Industry and Trade, has a qualified, experienced core staff to put and prepare the National Specifications of imported solar energy goods and products which will organise the importing the best and affordable solar energy goods and products that suit Yemen context and purchasing power of Yemenis.

## Installation and Maintenance Services

These services belong to after-sales services provided primarily by the importers and wholesalers to their clients. They also play a very important role in the provision of employment opportunities for technicians and youth, to provide such services (installation and maintenance of solar energy products and devices) to customers. Maintenance services need to be offered by importers, wholesalers and retailers. Vocational training can play an important role in building technical capacities of graduates and new technicians, even through specialised training of experienced technicians. Related governmental ministries, INGOs, non-governmental organisations (NGOs), and the private sector are highly encouraged to invest in building technical solar energy institutes and centres that will teach youth and graduates all related aspects of installation and maintenance of solar energy products, devices, tools and equipment at all levels, starting from homes, farms, factories and so on.

Several international organisations such as Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), United Nations Office for Project Services (UNOPS), and UNDP has provided technical training materials through NGOs to support the sector. The University of Science and Technology has established a solar energy unit to support engineers and technicians with the needed technical training to set up solar energy systems. The rush for solar systems in 2015 have allowed many electrical technicians to move from construction work that stopped then and joined the solar energy installation work.

## Transportation

Due to the high demand of solar energy products among all actors of the solar energy value chain, there is a critical need to carry those goods via suitable transportation services with proper handling and packaging to assure the safe delivery of products. The transportation sector in Yemen

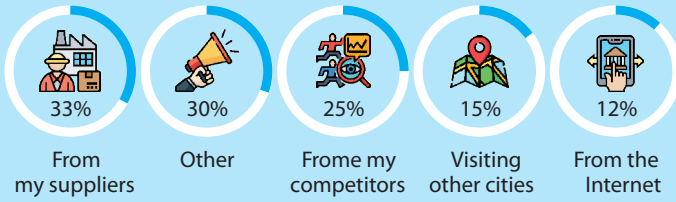
is not organised, except for travel across the governorates, but transportation for the purpose of carrying the goods still needs to be more organised to facilitate carrying services. Local post offices have suspended their logistical services. Ports and airlines have been politicised among the conflicting parties, causing interruption of services and long delays. Even though local authorities have declared customs and tax waivers for renewable energy, in practice much taxes and customs are still in place in other parts of the country.

## Market Information Flow

Market information in-between actors in the solar energy value chain has a variety of sources:

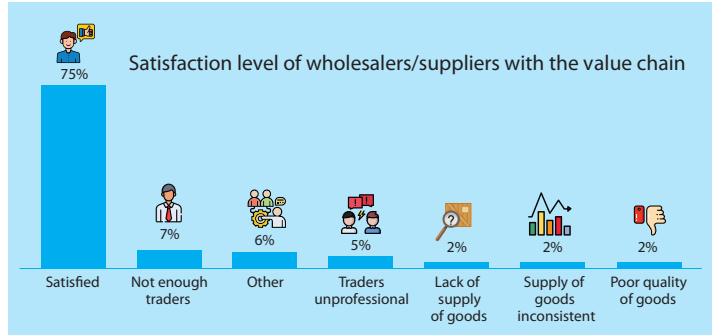
- From the Suppliers (33%)  
Retailers and shop owners get to know from the main importers/wholesalers about the new solar energy tools and equipment that have been imported/reached the Yemeni local market, and how to use and market them.
- From the Competitors (25%)  
Despite the competition between the solar energy value chain's actors, they exchange information about related issues of solar energy tools and equipment, and this is a healthy sign for this important sector.
- Visiting Other Governorates (15%)  
Solar energy value chain actors pay regular visits to different governorates in order to study and explore the potential of each market in those cities to provide the required tools and equipment to potential customers.
- From the Internet (12%)  
Because solar energy is considered one of the most growing technology sectors in the world, there are hundreds of patents and products penetrating the global market with intense competitiveness among the global big solar energy companies that compete in the provision of the best products at affordable prices, especially to developing countries such as Yemen. Many Yemeni companies/importers are in contact with global solar energy companies to import the most suitable and modern solar energy products to Yemen.

### Where do you get information about your market from?



### Satisfaction level of wholesalers/suppliers with the Value Chain

The chart shows that 75% of the interviewees are satisfied with the suppliers/wholesalers of the solar energy products; this means that market information flow and feedback is conceived proper functionality and indicate good relationships between suppliers/wholesalers and other actors like retailers, distributors, and customers.



### Purchasing frequency of SOLAR PV inventory

The chart shows that 36% of the interviewees purchase their stock on a monthly basis, 13% every few weeks and 15% on a weekly basis.



### Employment

In general, access to energy opens several doors for employment if not in the value chain directly, through the energy generated. The agriculture sector is the top employer in Yemen for decades with climate change; access to pumped water becomes access to food and employment. In addition, solar PV systems have allowed decentralised of energy service providing such as mini-grids, support and maintenance services, and potential pay-as-you-go products.

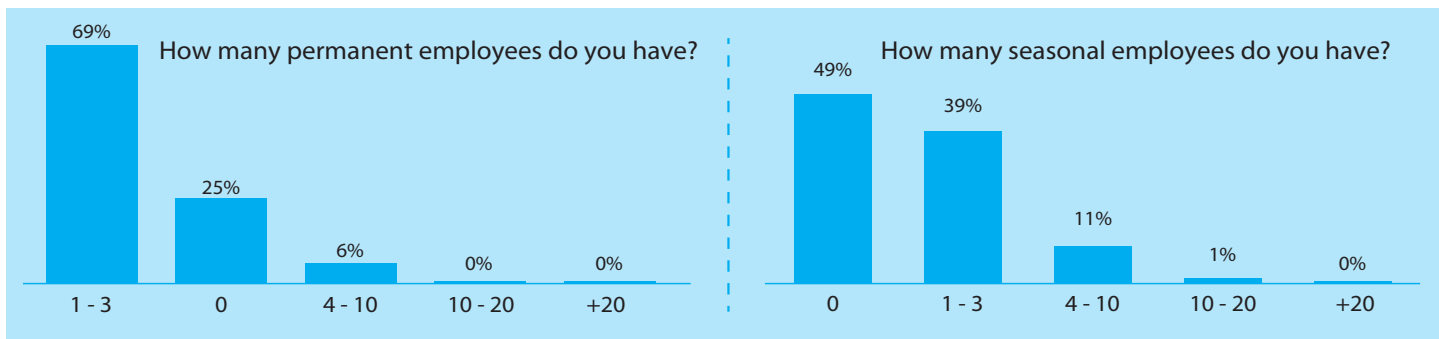
The chart shows the seasonal employment opportunities in the solar energy value chain as follows:

49% said they have no seasonal employees as the nature of solar energy business is not seasonal (working around the

year). 39% said they have 1–3 seasonal employees in peak times of the year, which is winter or when the demand for solar energy products is peaking.

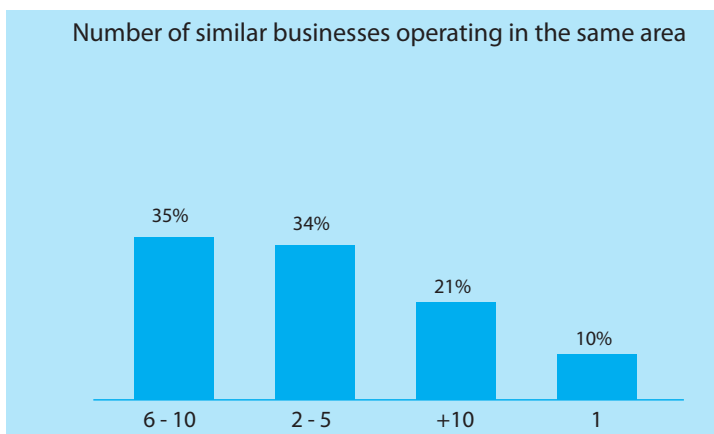
#### Permanent Employment

The chart shows that 69% of the solar energy value chain actors have 1–3 permanent employees. 25% of the interviewees said they have no permanent employees (these are retailers or small shop owners). 58% said their employees have not completed any vocational training yet. 46% of the interviewees said that 1–3 apprentices have been trained in their solar energy businesses.

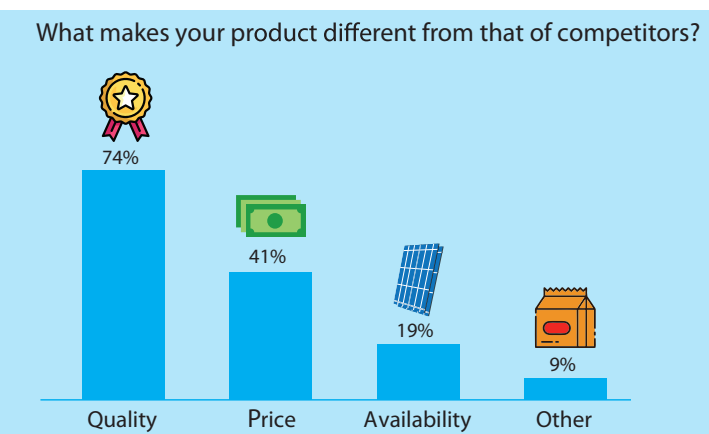


## Competitiveness

The chart shows how many similar businesses are in operation in their areas as follows: 35% said there are 6–10 similar businesses operating in their areas, 34% said there are 2–5 similar businesses operating in their areas, 21% said there are more than ten similar businesses operating in their areas.



74% of the actors interviewed said they compete with high-quality solar energy products even if expensive, and this reveals that their customers are convinced and attracted by high-quality solar energy products. 41% said they compete with affordable and cheapest price for solar energy products.



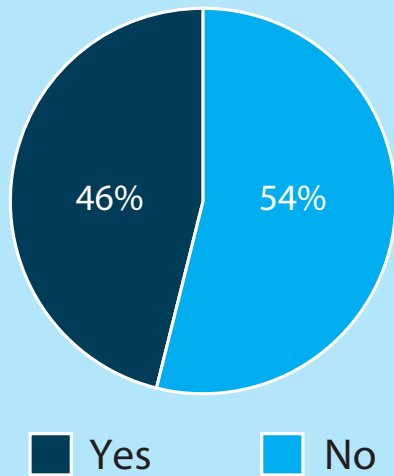
### Reasons for not Meeting Customers' Demands

54% of the interviewees said they are unable to meet the demand of their current or potential customers. Half of the interviewees fail to satisfy customers' demands every few days or every week. The chart above shows the reasons for not fulfilling customers' demands, as illustrated below:

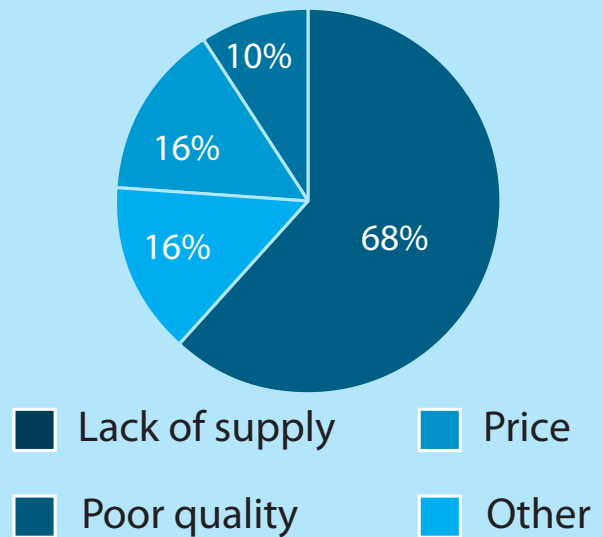
- 68% of the interviewees said the reason is the lack of supply. This means that the retailers and small shops either lack financial resources to pay for solar energy goods

- or that wholesalers/ importers do not have the required solar energy goods. The main reasons for shortage in the provision of required solar PV products are imposed restrictions, high customs and high transportation costs.
- 16% of the interviewees said the high prices of solar energy products prevent them from fulfilling customers' demands. Customers tend to buy the most affordable solar PV products with varied quality.

## The ability to meet customers' demands



## Reasons for not meeting customers' demands

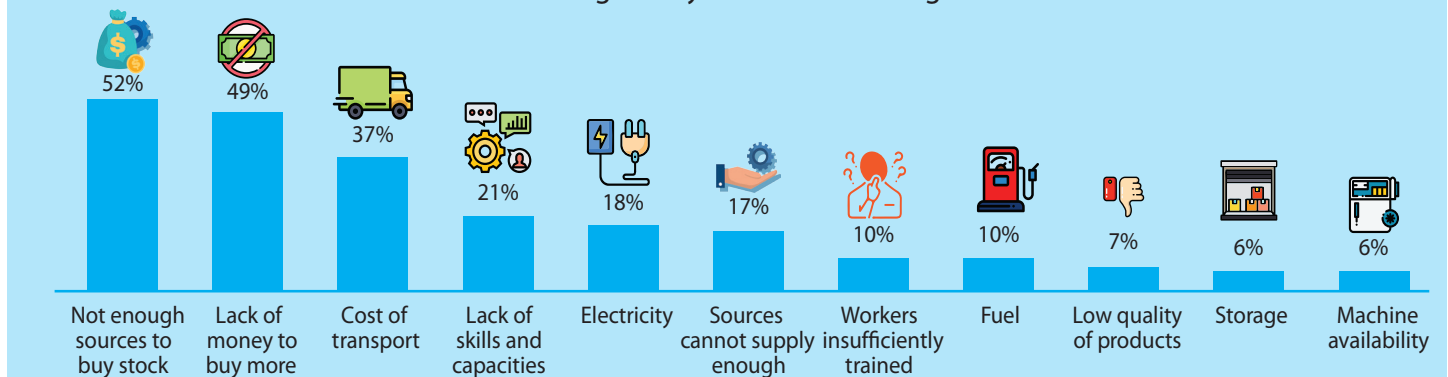


### Main Challenges of not Meeting Customers' Demands

The chart below shows the challenges in meeting customers' demands in the solar energy value chain:

- 52% of the interviewees said they do not have adequate sources to supply the stock
- 49% lack capital to buy sufficient stock of solar energy products
- 37% said the high cost of transportation is considered a challenge to meet customers' demands
- 21% lack marketing and negotiating skills and capacities
- 18% blamed the lack of electricity
- 17% said the wholesalers and importers cannot supply enough
- 10% said the workers are insufficiently trained
- 10% consider the high prices of fuel to be a reason
- 7% referred to the low quality of solar energy products
- 6% lack storage capacity and therefore have insufficient stock to meet customer demand

### What are the main challenges do you face in meeting customer demand?



A conclusion of the challenges above is that the main challenge is the lack of money to satisfy the customers' demand/requirements, and that opens the potential for MFIs to

contribute in eliminating and mitigating challenges to make the solar energy value chain prosper through fulfilling the actors' needs to expand their businesses.

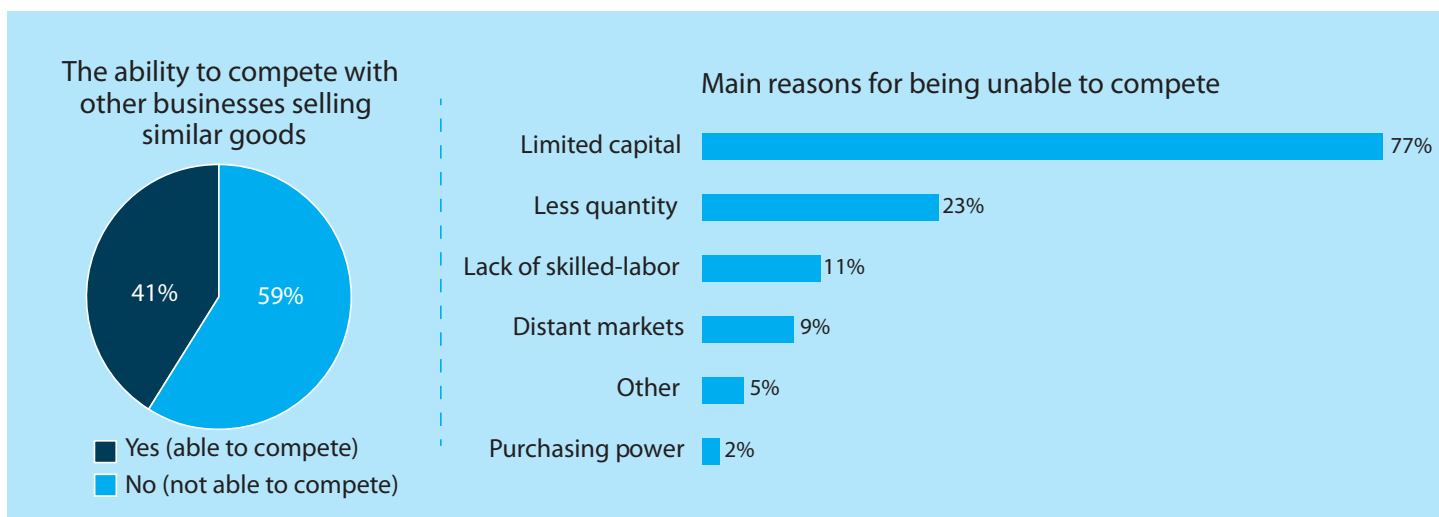
## Main Reasons for Being Unable to Compete

59% of the interviewees said they are not able to compete with other similar businesses. The chart shows that the main reasons of their inability to compete are as follows:

- **Limited Capital:** 77% of the interviewees said that limited capital makes them unable to compete, and this reveals the importance of MFIs to invest in the business. Whilst MFIs have started to finance solar energy investments, a missing point is that they do not have a clear vision of how to support this new economic sector.
- **Less Quantity:** 23% said that having insufficient quantity in stock makes them less competitive, but the di-

rect reason is lack of capital to buy more solar energy products.

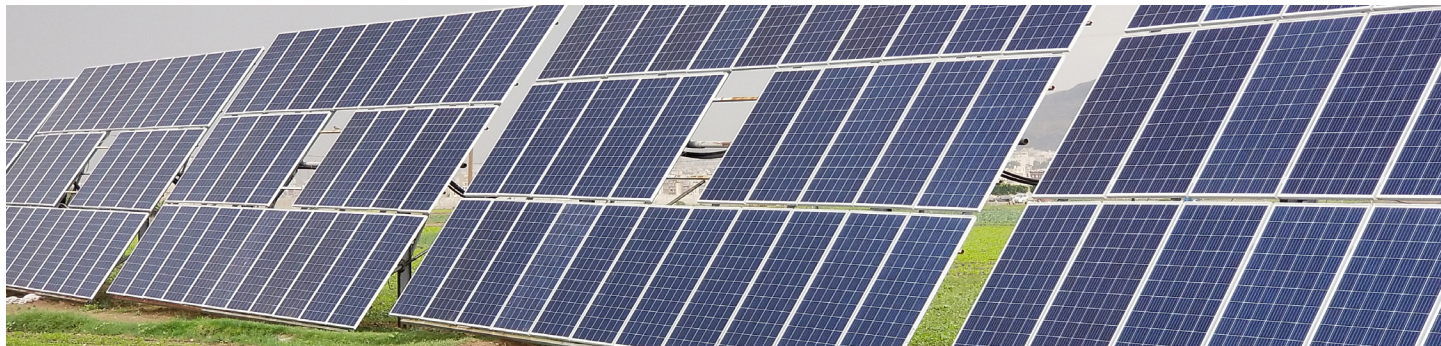
- **Lack of Skilled Labour:** 11% said they lack skilled labour to give cutting edge advantage. The solar PV sector is characterised by rapid technology development and catching up with the latest innovations, this gives the sector a critical vantage point.
- **Distant Markets:** 9% said that the remote markets may require paying more money for transportation, and they prefer to sell only what wholesalers provide them.



91% of the interviewees said that if they get training, they will be better able to compete. The Business Development Services (BDS) can play a vital role in training all actors of the solar energy value chain, especially in marketing, sales, negotiation and public relations, in addition to solar energy modern tools and equipment. Respondents have identified the following required training courses:

- Installation of solar energy systems
- Maintenance of the solar energy systems
- Work ethics
- Business management

- Solar energy sales
- Effective marketing
- Electronic engineering
- Fundamentals of electricity and electronics
- Funding the solar energy projects
- Maintenance of mobiles and screens
- Electrical installation for homes
- MS office
- Accounting
- English courses
- Financial administration



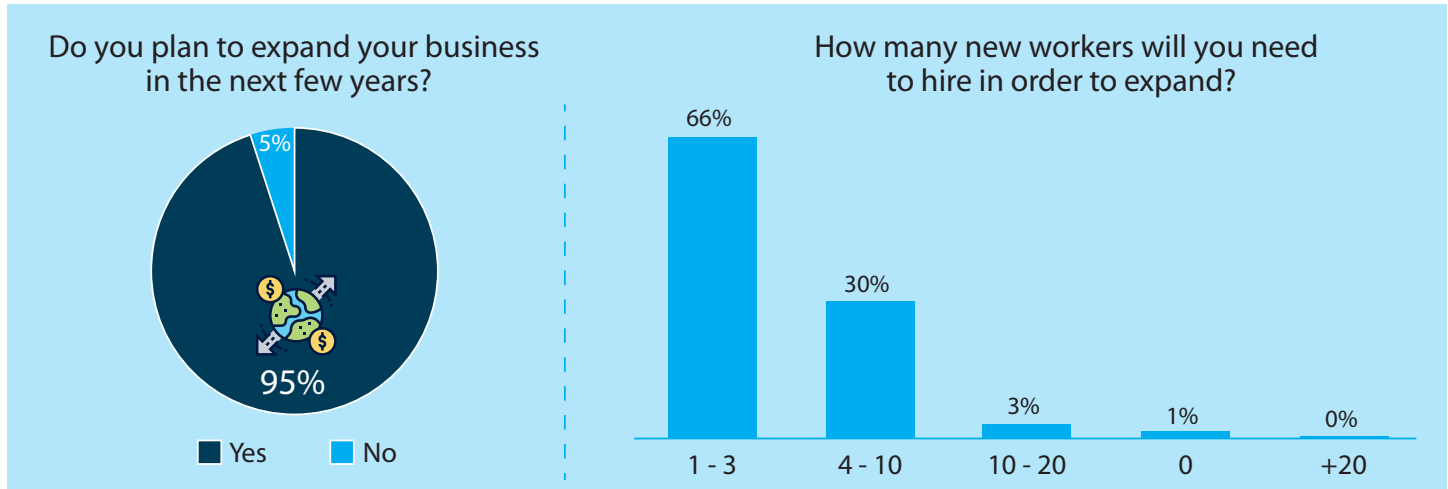


## Business Expansion

95% of the interviewees said they plan to expand their businesses in the next few years. This very encouragingly high percentage of actors who want to expand their business may need MFIs and BDS to help the actors establish this step in a sustainable manner.

The chart shows the potential additional employment in case of expansion of business is as follows:

- 66% of respondents will hire 1–3 employees
- 30% will hire 4–10 employees
- 3% will hire 10–20 employees
- Only 1% will not hire any additional employees



Numbers above are very encouraging and show that solar energy is a promising sector that can offer many employment opportunities for youth; technicians as well as graduates. 82% of the interviewees said that lack of qualified labour is a limitation for business expansion. 90% claimed that new employees they plan to hire in case of expansion need special training and skills, especially in the following fields:

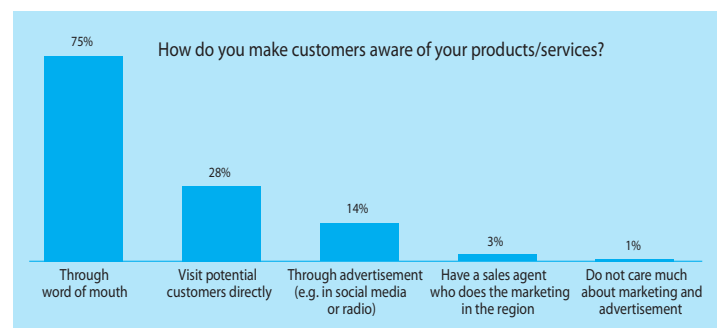
- Skills of selling and buying solar energy products
- Knowledge of high-quality solar energy products
- Procurement management skills
- Maintenance of solar energy systems
- Excellent evaluation of solar energy products before buying
- Effective sales, marketing and promoting their business
- Fundamentals of electricity and electronics
- Skills in installation of home solar energy systems
- Maintenance of home solar energy systems

When asked “If you were to begin a new business, what goods or services would you sell?”, 94% of the respondents

preferred to remain in the solar energy and electricity trade and expand businesses.

## Marketing

The chart shows that 75% of the interviewees said that main marketing and promoting for their solar energy products is through word-of-mouth, reflecting the importance of making customers aware of their products/services and indicating the importance of loyal customers who are indirectly working as mobile marketers.

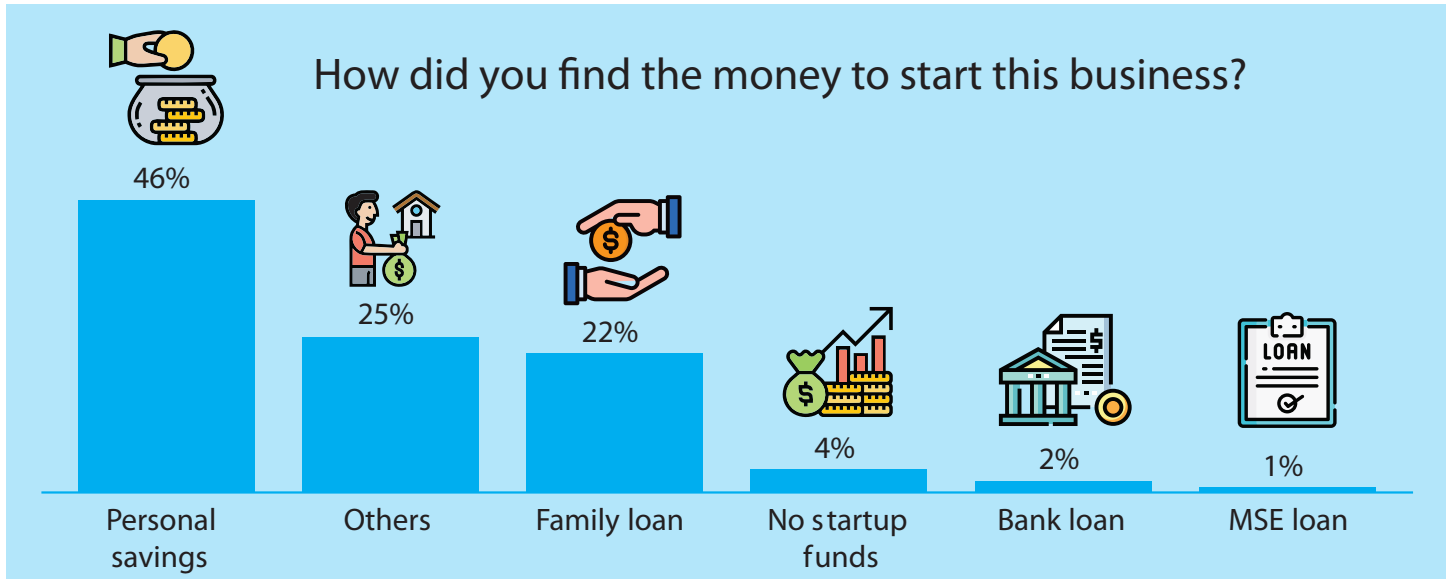


## Finance

### Financial Resources of Starting Solar Energy Business

The chart shows 46% of the interviewees saying they found the money to start a business from their personal savings, and this important feedback highlights a need to support the solar energy value chain actors to manage their savings with MFIs or other suitable financial institutions. 22% said

they got a family loan to start their solar energy business, and this reflects the good nature of Yemeni society where families support each other. Only 2% said that they took a loan from a bank and this, again, points to the acute need of MFIs to step in. MSMEs need an introduction to this sector with proper products to suit MSMEs in the solar energy value chain.

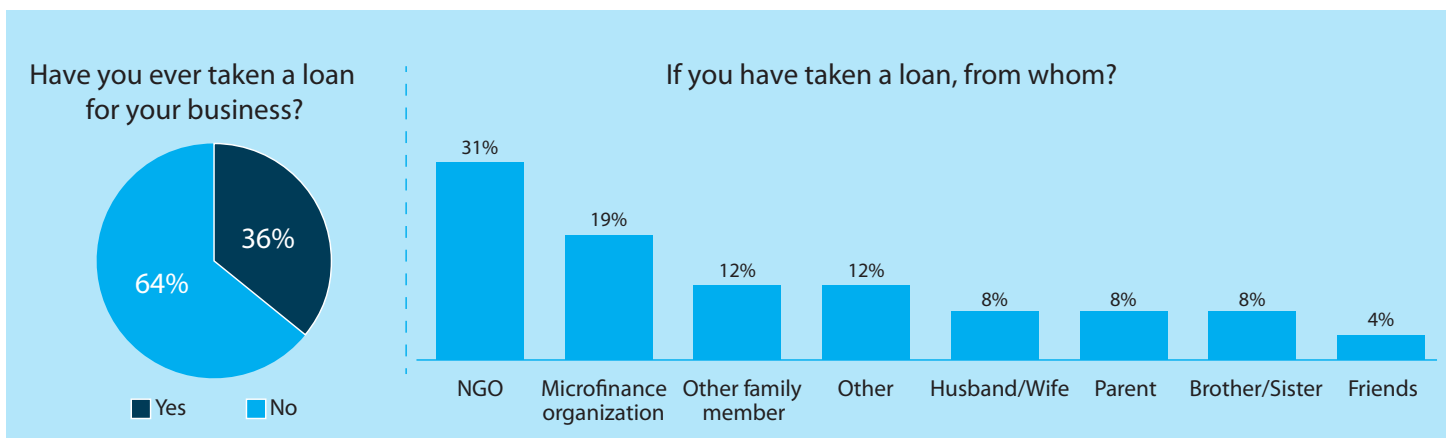


### The Loan Resources

Only 36% of the interviewees said they have taken a loan for their solar energy business. The amounts of loans they took range from YER 300,000 to YER 5,000,000 (USD 600 to USD 10,000).

The chart shows the sources of loans that the interviewees got as follows:

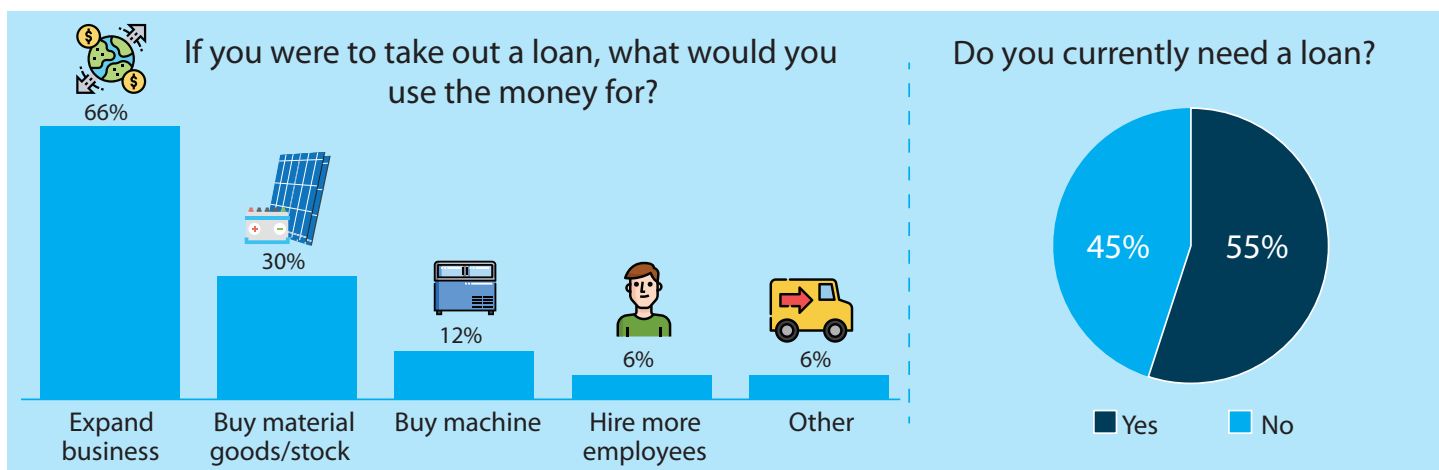
- 31% from NGOs: several NGOs are already providing grants and finance to the sector.
- 19% from MFIs and banks: Compared to other sectors, it seems that banks and MFIs find opportunity in the sector.
- 8% from husband/wife, 8% from parents, 8% from brother/sister, 12% from other family members: this emphasises the role of kinship and family to support each other.



## Options of Spending a Loan

The chart shows that the options of spending a loan, as per opinions of the interviewees, are as follows:

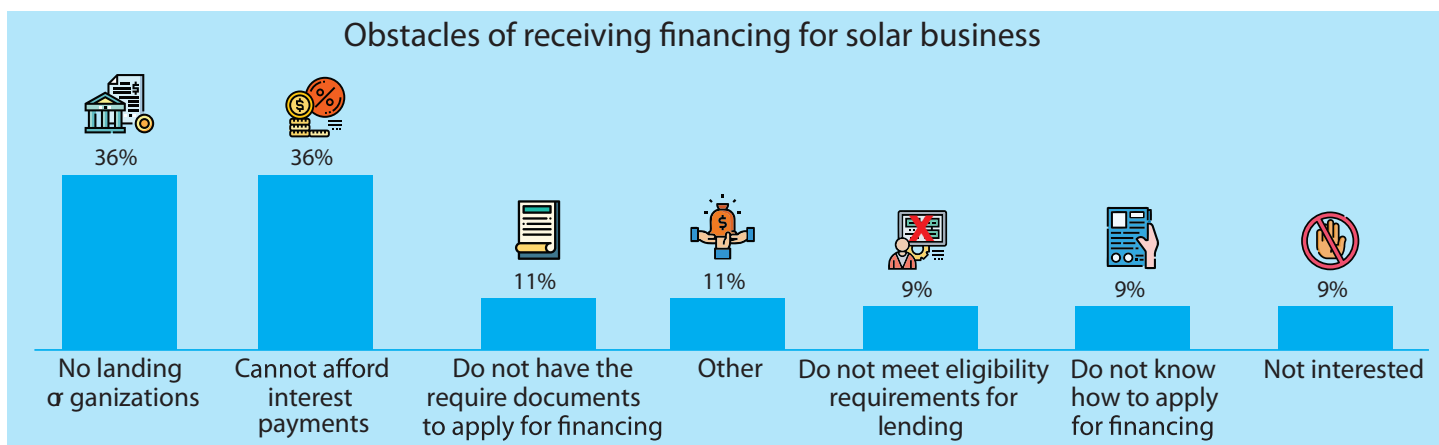
- 66% said they would expand their businesses. This reveals that there is a potential for MFIs and banks to support the solar energy value chain actors in their endeavours to expand business, as long as they are confident of positive returns of their businesses.
  - 30% said they would buy material goods/stock, which provides further opportunity for MFIs and banks to be involved effectively in this sector.
  - 12% said they would buy machinery (assembling machines), which is another way to expand and generate more income for the business.
- 55% of the interviewees claim that they currently need a loan, with the amount they want varying from YER 500,000 to YER 5,000,000 (USD 1,000 to USD 5,000).



## Obstacles of Receiving Financing for Solar Business

The chart shows the obstacles that interviewees encounter or perceive when it comes to receiving funds for solar energy business:

- Lack of credit supply: 36% point to the absence of lending organisations. This is another testimony that MFIs are not present and available for this vital sector.
- Lack of credit demand: 36% claim they cannot afford paying interest. This is a reason why the solar energy actors did not go to MFIs in the first place and points to a need for negotiations with loan providers to offer credit that is affordable and for longer payback periods.
- 11% claim they do not have the required documents to apply for financing: this is a result of MFIs having no effective communication and public relations channels to reach the actors of the solar energy value chain.
- 9% claim they do not meet eligibility requirements for lending: this obstacle should be addressed by the MFIs, or mitigated at least.
- 5% do not know how to apply for financing: this obstacle should be addressed by the MFIs through the promotion of their financial products/services via social media or any marketing method.



All the obstacles mentioned above should be considered by MFIs. There is a need for MFIs, INGOs, NGOs, banks and related entities of governmental financial institutions to collaborate, remove the obstacles, and provide financial products and services that target the solar energy value chain's actors.

## Partnership

93% of respondents indicated they have not established a partnership or joint venture with other businesses. 61% of the interviewees said their partnerships were unsuccessful experiences, related to the disagreement between business partners on how to share workload and responsibilities, as well as share profit and loss.

It is concluded that the fear of ending unsuccessful partnerships is not an obstacle if mitigated under conditions that save the rights for each partner legally. The role of BDS is crucial to provide the actors of the solar energy value chain with full legal advisory services to ensure that relationships among the partners are more encouraging, healthy, full of trust, accountable and transparent. The success partnerships should be communicated among the actors of solar energy businesses to inspire other actors to do the same.

## Institutional Analysis

92% of the interviewees do not know of the Cooperative Union for Solar Energy Businesses, since this sector is new in Yemen. Only 1% are members of any cooperative union or association. The very dynamic growth of the sector indeed warrants an institutional entity to organise and manage the sector. The actors interviewed see the following role for the cooperative union:

- Implement awareness through brochures/flyers/websites/social media for the customers of solar energy products and promote for the members of this union (traders).
- Train the work force of solar energy businesses to make them very skilled and competent.
- Monitor solar energy products' quality standards to protect customers from cheating and ensure efficiency of the solar energy market.
- Represent all the actors of the solar energy value chain vis-a-vis related governmental departments, offices, INGOs and NGOs.

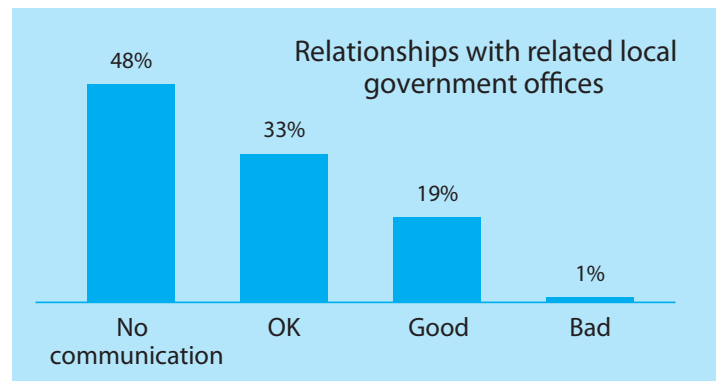
Being asked what they believe the cooperative can do to improve the sector, the interviewees' answers were as follows:

- Provide technical staff to this sector
- Bring in new and modern solar energy devices and systems, such as most efficient lighting, heating and cooling devices, solar PV panels and batteries, and pumping systems for irrigation
- Spread awareness among customers of using solar energy products
- Encourage local production of solar energy products (such as switches, wires, cables, lamps)
- Facilitate exporting
- Provide technical training for whom it may concern
- Provide required funds for youth to start up or expand their solar energy businesses

## Relationships with Related Local Government Offices

The chart shows the status of interviewees' relationships with the related local offices, that is being illustrated below:

- 48% said they have no communication with the related local offices
- 33% said their relationship with them is OK
- 19% said it is good
- 1% said it is bad



Interviewees want support for the solar energy sector and work, to allow expansion, from related governmental local offices. Some expect the government offices to provide financial support, facilitation of import of best quality solar energy products, technical institutes to train youth to work professionally in this sector or assistance to strengthen the relationships between actors in the chain. There are, however, also a few who expect no help to come from government offices.

The absence of institutional building for the actors of this vital sector calls for the related governmental ministries like Ministry of Social Affairs and Labour to study the situation and encourage the most influential actors in the solar energy value chain to create a strong entity (union or association) to build the technical capacities of this sector and organise it well to work properly toward economic growth and sustainability.

In response to the question “What do you think can be done to improve the part of your activity in the value chain?”, the interviewees’ answers were as follows:

- Provision of the required solar energy goods
- Provision of solar energy goods at best price and high quality
- Provision of the required technical training for the employees, and youth
- Facilitation of getting loans
- Encouraging local production of solar energy products
- Encouraging youth and graduates to start their private projects in solar energy businesses

## Challenges and Potential Solutions

### Supply Stage

The main challenges for the solar energy value chain in the supply stage are:

- Bad quality of some solar energy goods
- Rising transportation fees
- Lack of financial liquidity for retailers and small shops to stock their shops with solar energy goods demanded by customers
- Difficulties in importing solar energy products

The causes of those challenges are:

- Lack of national criteria/specifications of solar energy goods, and absence of monitoring of imports of solar energy products
- Rising fuel prices
- No access to credit from MFIs and banks
- Lack of support to this vital sector from related governmental offices

The potential solutions to overcome the challenges in the supply stage:

- 100% of respondents said the solar energy sector needs skills and training to excel and improve business.
- 100% said the solar energy businesses needs to invest in the sector, especially in modern equipment, devices and tools. The most cutting-edge technologies to invest in are related to lighting, heating, cooling and pumping water for irrigation. Linking the actors of solar energy value chain with MFIs and banks would be essential to finance such investment.

- 100% said the solar energy sector needs technology transfer projects and programmes to develop the sector.

No respondent perceived government regulations and policies to be a specific sector need. However, monitoring of the import of solar energy goods and preventing import of bad quality products through formulation of standard specifications of solar energy goods and sharing them with the importers seems to be a critical need. This would support the solar energy sector by facilitating import of high-quality solar energy goods at affordable prices.

The potential growth opportunities in the sector are perceived as follows:

- Prepare and finalise the national specifications for the solar energy goods by Yemen Standardisation, Meteorology and Quality Control Organisation, and sharing it with the customs employees at the borders to permit only goods that comply with those national specifications, and refuse goods that do not comply.
- Encourage local investors to build factories – benefiting from technology transfer projects – to manufacture local solar energy products to compete with imported goods and save hard currency and strengthen the Yemeni economy.
- Encourage related government offices/departments/ministries to build technical institutes and centres for training of youth, graduates and technicians on the modern and new equipment/devices/tools of solar energy, in order to provide the local market with skilled labour and offering many employment opportunities.
- Push MFIs and banks to make strategic partnerships with all actors of the solar energy value chain through

funding start-up solar energy businesses or expansion of current businesses. In addition, to fund agricultural investments that empower farmers to run their farms with clean energy through solar panels and pumps, addressing the problem of high fuel prices.

## Storage Stage

The main challenge in the storage stage is the damage of solar batteries and panels. The cause of this challenge is the bad storage of the solar batteries and panels, as greedy importers and wholesalers tend to store for a long time – to increase prices – leading to damaged batteries and broken solar panels. The potential solution to overcome this challenge is the investment in solar equipment with high tolerance to high temperatures if stored for a long time is the best solution of this problem.

It also appears important to spread awareness of how to store solar energy products correctly by all actors in the solar energy value chain. Related government offices and solar cooperatives/unions<sup>1</sup> can be activated to monitor and supervise the main importers/wholesalers to ensure that solar energy goods are sold in good faith to protect customers and retailers from any potential cheating. Importers/wholesalers should be encouraged to give warranty/guarantee for their sold solar batteries and panels to attract more customers.

The potential growth opportunity is perceived as customers becoming more satisfied with a warranty for solar energy products.

## Distribution Stage

The main challenges in the distribution stage are traditional and not organised distribution, rising transportation costs and remote distances when targeting new areas.

The causes of those challenges are that importers and wholesalers do not have clear plans for modern distribution of the solar energy goods, the increased fuel prices and the difficult topography of Yemen (high mountains, valleys and deserts).

The potential solutions to overcome the challenges are:

- Encourage BDS to target importers and wholesalers of the solar energy sector with specialised training courses

in modern distribution for solar energy goods and strategic planning.

- Encourage the importers and wholesalers to contribute to cover transportation costs of the retailers when they buy solar energy goods from them. If transportation is for shorter distances from governorate to district or from district to sub-district, the cost to cover would be reasonable, especially if the purchase order is large. This kind of incentive would also motivate the retailers to work hard in marketing their solar PV products for larger purchase orders.
- Encourage importers and wholesalers to appoint close sales points for their solar energy goods to enable reaching remote areas more easily.

The potential growth opportunities are perceived as follows:

- Improving of the technical, administrative and financial capacities of importers and wholesalers of solar energy goods through the BDS.
- Spreading the points of sale of solar energy products to cover a wide range of Yemeni areas, particularly remote and hard-to-reach areas (sales from wholesalers to an increased number of retailers).
- Increasing the number of distributors of solar energy products in Yemen (sales from importers to wholesalers).

## Marketing Stage

The main challenges in the marketing stage are:

- Lack of technical knowledge about solar energy products
- Lack of technical skills in marketing solar energy products
- Constant change of price of the solar energy products
- Bad quality of solar energy products even when the price is high

The causes of those challenges are:

- The employees are not qualified enough
- Absence of marketing skills
- Continuous fluctuation of the value of the local currency
- Ignorance of knowing the best quality of solar energy goods due to absence of clear national specifications,

<sup>1</sup> A solar cooperative/union exists in Taiz governorate, but is not active.

and absence of experienced experts and technicians to support all actors of the solar energy value chain

The potential solutions to overcome the challenges are:

- Encourage government and private sector technical training centres/institutes to conduct relevant technical training courses in solar energy engineering and maintenance and nudge importers, wholesalers and retailers to send their employees to learn there.
- Encourage the BDS to conduct effective marketing and sales training courses and target the actors of the solar energy value chain in these courses.
- Compel the importers, wholesalers and retailers to hire at least one specialised technician in solar energy products/systems in order to ensure that customers become more satisfied with the products and accompanied after-sale service. The technicians installing the solar energy system in the house, factory, building or farm should explain to the customer how to use the installed product.

The potential growth opportunities are perceived as improved marketing practices, backstopping expertise and competency, and expansion of the number of solar energy companies/shops to reach more Yemeni areas and customers.

## Consumption Stage

The main challenges in the consumption stage are:

- Shortage of financial liquidity of potential customers
- Remote locations of some of potential customers
- High prices and costs of agricultural solar pumps, especially for the smaller and middle farmers

The causes of those challenges are:

- Suspension of salaries and many programmes due to the war
- The harsh topographic nature of Yemen
- The high costs of batteries, panels and pumps, especially at the initial phase of installation

The potential solutions to overcome the challenges are:

- Focus on rural areas to cover loss of sales in the towns and capitals of governorates.

- Provide poor and low-income people with affordable solar energy products and arrange purchase on credit.
- Penetrate the local weekly village and district markets where all villagers usually come to buy their weekly and monthly needs.
- Encourage MFIs and banks to offer suitable loans with reasonable repayment period and appropriate interest rate to farmers that enable them to install solar energy pumps, as well as credit promoting pay-as-you-go products.

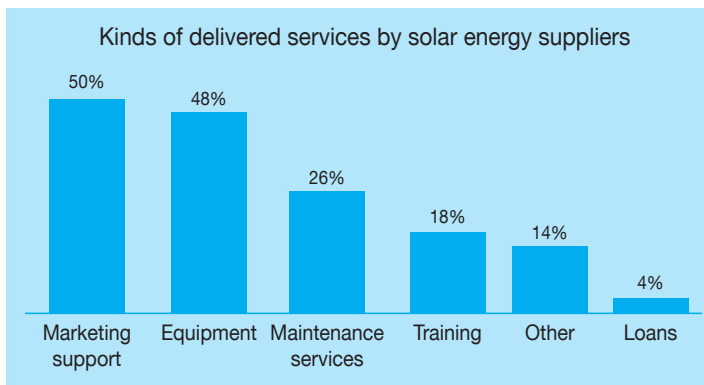
The potential growth opportunities are perceived as follows:

- Through reaching rural areas with solar energy products, inequalities between town and village will be reduced, and this will make the rural areas prosper.
- If solar energy solves the problem of high fuel prices, the agriculture sector will prosper – so the result is more production, more income and cleaner environment.
- Expanding the role and work of MFIs and banks to cover the most important economic sector in Yemen: agriculture.

## Sector Services Delivered by Suppliers

The chart shows all kinds of services delivered by solar energy suppliers to their clients as follows:

- 50% said “marketing support”: that enables the other actors of the solar energy value chain to market their solar energy goods in the most potential local markets.
- 48% said “equipment”: that means the suppliers provide the other actors with some equipment that assists them in marketing their solar energy goods.
- 26% said “maintenance services”: this very important service makes the clients very satisfied with the supplier.
- 18% said “training”: it is important to train employees of the other actors on how to start, run, shut down and maintain solar energy products correctly.
- 4% said “loans”: this to enable clients to buy more solar energy equipment, tools and devices or expand their businesses by opening new branches and shops.



From the list of services above, it seems that the suppliers of solar energy in Yemen are very aware of their businesses and ways of professional management to ensure continuing progress in the local market. This stimulates the competitiveness among suppliers to serve strengthening the sector in the medium and long-term.

69% of the interviewees said they have a long-term standing relationship with their suppliers/clients. 65% of the interviewees said that solar energy suppliers deliver services to them. It seems that the solar energy suppliers do the job of BDS and MFIs, and this may induce BDS and MFIs to contribute in these tasks as specialised providers of services. This could push solar energy suppliers to collaborate with them eventually.

## Marketing Strategy

66% of the interviewees said they did not plan or implement any marketing strategy. This indicates an absence of modern and professional business administration among the actors of the solar energy value chain; they manage their solar energy businesses with traditional mentality despite being in the 21<sup>st</sup> century. This also reveals the absence of the role of BDS to promote organisational and institutional building for the companies. Interviewees who had a marketing strategy developed it as follows:

- Concentrating on the increase in sales and profits
- Focusing on continuous advertisements
- Good behaviour with clients and providing them with details of their solar energy products
- Moving and carrying solar energy goods from town to villages

- Acquiring new skills in maintenance of solar energy products.
- Focusing on high quality solar energy products.
- Reducing product prices to be more competitive.

The interviewees considered quality and price, warranty with an option to return the goods, good selling behaviour, professionalism, integrity and honesty to be their competitive edge.

## Gender Dynamics

87% said they have not employed women in their businesses. This indicates that the solar energy sector is dominated by males. It takes hard work to carry solar energy goods like batteries, panels and so on, and also working in houses, farms, factories and buildings and these activities do not suit women's nature and work.

On the other hand, 51% of the interviewees said women working in the solar energy sector would have an opportunity for income generation. Women need to be encouraged to take this opportunity and advantage, especially in rural areas where women can work beside their men together in such businesses, based on the fact that women in the rural areas work beside the men in the farms and fields.

When asked "What are the challenges that might be faced by women if they are engaged with your activities?", the interviewees' answers were as follows:

- Heavy loads of solar energy products
- Lack of experience
- Lack of commercial experience
- Lack of technical and engineering knowledge and skills
- Harassment in a male-occupied business environment
- Yemeni traditions and customs
- Inability to tolerate the hard work of the solar energy sector
- Inability to move and market the solar energy products easily, especially in the local weekly markets from one governorate to another, and from one village to another

56% of the interviewees said women could not start up their businesses in the solar energy sector, which reflects the previous reasons why women cannot work in a male-centred business.



Have you employed women with your business?



Do you think that working in your sector can be considered an opportunity for income generation?



Do you think your domain could be a good opportunity for vulnerable women to start-up their enterprises?



# SWOT Analysis



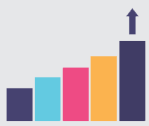
## STRENGTHS

- **Great Potential for Substantial Growth:** The solar energy sector has tremendous potential for growing fast compared with other sectors; it has surpassed all other economic sectors in Yemen in the past few years.
- **Easy Access to Solar Energy Products:** As per the growth of the solar energy sector, any Yemeni can get solar energy products from anywhere in Yemen due to the wide-spread network of retailers in Yemen in all governorates, districts and villages.
- **Cost-effective Solar Energy Products:** Yemeni customers can buy solar energy products at a cost-effective price according to the required quality; this makes some products available for poor people in Yemen as well.
- **High Competitiveness:** There is very stiff competition among solar energy importers to provide cutting-edge technology and the latest solar energy goods that meet the local market's requirements.
- **Excellent Technical Services:** Technicians of solar energy are playing a core role in provision of satisfactory technical services in installation and maintenance of solar energy systems and devices to all the actors of the value chain.



## WEAKNESSES

- **Lack of national specifications for solar energy systems and products:** Despite the growth of this important sector, there are no national specifications that regulate and organise the import of and trading with these products and services. The related governmental ministries, YSMO and INGOs can study countries that import solar energy products and have specifications for import of such products and develop specifications learnt from their experiences.
- **Weak Supervision** of the performance of the solar energy value chain from the related ministries and governmental departments and offices.
- **Bad Storing Practices:** some importers and wholesalers, unfortunately, store the solar batteries for a long time, which results in batteries failure, or selling them in bad condition and without any warranty. This results in damages within a very short period, and this is a kind of cheating that customers complain of. The same goes for solar panels that are stored in bad condition and are easily broken.
- **Inefficiency and Loss of Solar Energy:** some of the unqualified technicians tend to install solar energy systems in houses, enterprises, factories, etc. without any accurate calculation for how much in terms of amperes, watts and volts does each house or enterprise ideally need. That leads to increase in costs of the solar energy system and losses in solar energy due to the difference between what is received from the sun and what is stored in batteries and what has been consumed in the internal solar energy network, which leads to inefficient use of the solar energy. It may also lead to the failure of solar energy batteries and devices within a short time.



OPPORTUNITIES

- **Comparative and Competitive Advantages of Solar Energy:** Compared with other sources of energy, especially diesel engines to irrigate agricultural crops, Yemeni farmers are clearly inclined to replace the diesel pumps with solar energy pumps, particularly after the fuel prices rose insanely. The cost of lighting houses has also become affordable for any poor household in Yemen, compared with the cost of electricity petrol generators, or subscription with private sector companies that provide electricity from the mazut or diesel generators, whether in the urban or in rural areas.
- **Effective Solutions for Supporting other Economic Sectors:** Solar energy proved its adequacy in entering all the life aspects to support many important sectors in Yemen, such as education, health, agriculture, WASH and employment, which make its engagement highly valued as an effective and pivotal instrument for development and growth.
- **Potential Important Role for MFIs and Banks:** To support the solar energy value chain's actors and customers to enhance and consolidate the sector toward more efficiency to serve the Yemeni people in getting access to the most environment friendly and affordable source of energy.
- **Promising Source for Employment:** many graduates and youth opened their new shops as retailers to sell solar energy services and products, in addition to the new companies and wholesalers who expanded their businesses by entering the solar energy division in their previous electrical businesses. Technicians are working individually and directly with the customers or with the other actors as a technical team. Further, there are employment opportunities for potential markets such as pay-as-you-go products, micro and mini grid solar stations.



THREATS

- **Bad Security Conditions Due to the Current Crisis:** Some Yemeni importers and wholesalers complained about seizure of their solar energy goods (batteries and panels) without any convincing legal reasons when carrying them from Al-Maharah governorate to Sana'a. These problems have also occurred for wholesalers and retailers when carrying their solar energy goods, especially near the areas of conflict and war, which has led to a clear shortage of solar energy in the local market and which threatens the supply and performance of the solar energy value chain and the whole sector.
- **Commercial Cheating:** Some of the importers try to import bad quality solar energy goods at very low prices to compete in the local market due to the intense competition, which leads to commercial cheating where Yemeni customers are the victims since they purchase solar energy goods that fail fast. This is happening in the districts and sub-districts of each governorate, which threatens the stability of the solar energy value chain and sector.



# RECOMMENDATIONS

- Work on a national framework and strategy for exploiting and activating the solar energy value chain toward more efficiency of the sector in collaboration with the main stakeholders of the related governmental ministries, INGOs, NGOs and the private sector.
- Work on developing and promoting national specifications for import of solar energy products that suit the local market's requirements and capacities and circulate these at all Yemeni ports (sea ports, airports and borders) to ensure that all solar energy shipments (imports) comply.
- Activate periodic and sudden supervision and inspection at the stores of importers and wholesalers in order to ensure safety and good status of the solar energy goods that would be sold to Yemeni customers.
- Invest in building the technical capacities of youth, graduates and technicians to prepare them to meet the solar energy market's needs through implementing planned and organised training courses in each governorate after evaluating the needs expressed by technicians (This could be implemented through collaboration between governmental institutes/centres, INGOs, NGOs and the private sector).
- Encourage the MFIs and banks to contribute in provision of necessary loans to all actors of the solar energy value chain, whether to buy solar energy products/systems for their homes, farms, enterprises or factories or for opening solar energy businesses as mini-grid energy providers, service providers, retailers or expanding their businesses.



# Solar Energy Value Chain Highlights

<p>Main Difficulties in the Value Chain that Can Be Tackled by UNDP</p>	<ul style="list-style-type: none"> <li>• Lack of national specifications for solar energy systems and products</li> <li>• Inefficiency and loss in the customer use of solar energy</li> <li>• Commercial cheating</li> <li>• Lack of specialised maintenance centres for solar energy products such as: batteries, solar panels, etc</li> <li>• Lack of specialised and advanced training courses for technicians and engineers</li> <li>• Lack of financing to expand and improve solar ventures/businesses</li> <li>• Lack of institutional capacity for all solar energy value chain actors, with a need to be organised into a strong and active association or alliance</li> </ul>
<p>Proposed Interventions</p>	<ul style="list-style-type: none"> <li>• Working on a national framework and strategy for exploiting and activating the solar energy value chain towards more efficiency of the sector, in collaboration with main stakeholders of related governmental ministries, INGOs, NGOs and the private sector</li> <li>• Working on preparing national specifications for importing solar energy products that suit local market requirements</li> <li>• Investment in building technical capacities for youth, graduates and technicians, to prepare them to meet the solar energy market needs</li> <li>• Encouraging MFIs and Banks to contribute in provision of necessary loans for all actors of the solar energy value chain</li> <li>• Investment in technology of the solar energy value chain by putting all actors of the horizontal and vertical value chain into a platform</li> <li>• Encouraging the actors of the solar energy value chain to build their new union, alliance or association</li> <li>• Expanding the benefits of using solar energy to support other economic sectors</li> </ul>
<p>Proposed Training</p>	<ul style="list-style-type: none"> <li>• Training course (theoretical and practical) on how to professionally install solar energy system/devices in houses, factories, enterprises, farms, etc</li> <li>• Training course (theoretical and practical) on how to professionally maintain solar energy batteries, panels, inverters, etc</li> <li>• Effective management of solar energy shop/enterprise</li> <li>• How to take a loan and make it efficient</li> <li>• International, regional and local quality standards and requirements of solar energy products</li> <li>• Effective marketing and sales of solar energy products</li> <li>• Training course (theoretical and practical) on how to be a professional solar energy technician/expert, for graduates, youth and women</li> </ul>
<p>Most Profitable Value Chain Player</p>	<ul style="list-style-type: none"> <li>• The most profitable solar energy value chain actors are wholesalers as they are relatively few players who leverage their capital</li> </ul>
<p>Ways to Increase Value Creation</p>	<ul style="list-style-type: none"> <li>• Since all solar energy products are imported, there is an opportunity to assemble or produce system components locally</li> <li>• Optimised installations with efficient solar PV system quality and pricing</li> </ul>

<p>Macro Level Recommendations</p>	<ul style="list-style-type: none"> <li>• Working on a national framework and strategy for exploiting and activating the solar energy value chain toward more efficiency of the sector in collaboration with the main stakeholders of related governmental ministries, INGOs, NGOs and the private sector</li> <li>• Working on preparing national specifications by YSMO and related ministries for importing the solar energy products that suit local market requirements</li> <li>• Encouraging MFIs and Banks to contribute in provision of necessary loans for all actors of the solar energy value chain</li> <li>• Encouraging the actors of the solar energy value chain to build their new union, alliance or association</li> <li>• Support the development of community mini-grids that can provide sustainable decentralised electricity</li> <li>• Provide incentives to solar system investments and applications such as tax and customs incentives, licenses, subsidies, relaxed regulations, and the like</li> </ul>
<p>Meso Level Recommendations</p>	<ul style="list-style-type: none"> <li>• Investment in building the technical capacities for youth, graduates and technicians, to prepare them to meet the solar energy market needs</li> <li>• Investment in technology for the solar energy value chain by putting all actors of the horizontal and vertical value chain into a platform</li> <li>• Expanding the benefits of using solar energy to support other economic sectors</li> <li>• Support community mini-grid solar farms through knowhow and finance</li> <li>• Consolidate and coordinate efforts to support interventions in solar energy systems among various energy interventions</li> </ul>
<p>Micro Level Recommendations</p>	<ul style="list-style-type: none"> <li>• Assure quality products and installations to assure customer retention</li> <li>• Improve know-how among employees and other VC actors</li> <li>• Provide awareness of energy-saving and efficient appliances among customers and provide follow up maintenance services to maintain renewable energy culture among citizens</li> </ul>
<p>Recommendation for MFIs (What Can Be Financed)</p>	<ul style="list-style-type: none"> <li>• Promote consumer and MSME loans for solar PV systems and energy-efficient appliance</li> <li>• Finance and support solar PV enterprises to expand their businesses</li> <li>• Finance and support community mini-grids, solar pumping for agriculture, private schools and health facilities, among others</li> </ul>
<p>What New Technologies/ Tools/Equipment Can Be Brought in?</p>	<ul style="list-style-type: none"> <li>• The sectors need a research and development institutions that can introduce new technologies such as hybrid systems, on-off grid systems, energy-efficient appliances and equipment, battery recycling and maintenance, associated products and services that can improve installations and optimisation</li> </ul>

# Potential Impact of COVID–19 on the Sector<sup>1</sup>

While there are reports of reduction in supply of solar energy system components due to lockdowns in supplying countries<sup>2</sup>, households' power consumption is expected to increase as people stay at home. In Yemen, the pandemic was accompanied by severe shortage of fuel due to the political conflict. This has put pressure on fossil energy prices to increase, despite global decrease of oil prices. It is possible to see efforts to contain the economic fallout of COVID–19 as an opportunity to accelerate a shift to cleaner energy sources. Lack of access to electricity is potentially to intensify the human catastrophe of the pandemic and slow down recovery. Therefore, renewable energy plays an important role in global efforts to contain the spread of the virus, especially in regions where access to electricity is still a challenge.

## Value Chain

The ramifications of COVID–19 have also reached the Yemeni solar energy market where all prices have changed immediately after observed limitations in the import of solar energy supplies into the country. The solar energy value chain is affected by a disruption in importing solar PV products, especially from China, which has led to a shortage in supply that affects all actors in the value chain.

The most significant gap in the value chain is present at the importing end where limited availability of supply is forming a critical situation for all other value chain actors who are dependent on availability and diversity of imported solar supplies. Transporting solar supplies between countries including their import to Yemen has been affected by COVID–19 restrictions at the borders. Solar energy wholesalers – who are dominant actors in the solar energy value chain – rely mostly on the diversity and multiple options of solar products, offering different qualities and options for retailers and customers. This very important advantage will be significantly affected by the impact of COVID–19 on importers, who are no longer free to import and offer different products from different countries with different qualities.

The importers are now using their existing stock of solar energy products and have very limited access to imports from COVID–19 affected countries due to the applied restrictions. According to some interviewed wholesale traders and retailers, importers are using destructive coping strategies to handle the reduction in supply and their diminished profits, by increasing the price of their remaining stock of products and riding on monopoly advantages of available supplies.

At the other end of the value chain, retailers and small business owners are facing the most difficult challenges as they are reliant on direct selling and marketing in markets, shops and in some places through mobile sellers who move from one village to another to sell solar products to customers.

After analysing data obtained from small retailers in urban and rural areas, it was found that small retailers are facing a shortage of solar energy items such as wires, batteries, and solar panels. This shortage has disturbed the performance of retailers and the trade of solar energy items. The prices of solar products have increased, with variation among the products. Some products such as solar panels and batteries witnessed a price increase of 90 to 100%, while prices of other items including wires, torches, and bulbs increased 30 to 40%.

The profit of retailers has declined and is expected to drop further as a result of the pressure of increased prices from wholesalers combined with customer demand to buy at previous lower prices. Another important impact on retailers is the closure of many small markets in different governorates and districts as protective measures by local authorities to reduce the risk of COVID–19 transmission in crowded markets. This closure of small markets has affected small retailers enormously. They are facing challenges in coping with the new behaviour of customers to avoid crowded stores and locations. Many traders and retailers will have to reduce the number of workers since they will not be able

1 For a more comprehensive analysis of the potential COVID–19 impact on micro, small and medium enterprises in Yemen, see a synthesis report at this link: <https://www.ye.undp.org/content/yemen/en/home/library/a-synthesis-report-on-micro--small-and-medium-enterprises-in-yem>

2 IEA (2020), clean energy progress after the COVID–19 crisis will need reliable supplies of critical minerals, IEA, Paris <https://www.iea.org/articles/clean-energy-progress-after-the-COVID-19-crisis-will-need-reliable-supplies-of-critical-minerals>

to cover their costs as a result of plummeting sales. Social media advertising and marketing is one of the positive coping strategies that some retailers have adopted to cope with the COVID-19 situation. Some retailers offer door-to-door deliveries of solar energy products in small market ranges such as neighbourhoods and mostly through WhatsApp and Facebook.

Customer demand for solar energy products may actually increase as people are staying at home. Home quarantine increases household use of energy and households would, therefore, require more solar energy products and services. Loyal old customers may not be lost, but there are constraints in reaching out to new clients. Decreased household purchasing power may also force the buying of low-price PV solutions.

### MSMEs

As the COVID-19 pandemic forces people to stay at home and leaves MSMEs fretting about the consequences on their businesses, small business owners are wondering what to do about liquidity, debt and staff.

As local authorities' restriction measures become stricter, it is expected that the solar energy sector would face multiple interruptions. The importers are already facing this challenge when importing solar energy products from affected countries. This is directly affecting wholesalers and retailers who are facing delays in their shipments with limited availability of demanded products, as well as the increase in prices.

The pandemic would have severe implications on the lives of the small actors in the value chain and may leave many of them bankrupt. Most of the interviewed small retailers are requesting financial support from relevant agencies to help them face the crisis and withstand the combined supply and demand shock and their impact on their businesses and lives. Almost all small retailers including women-owned businesses would be affected, except those who have alternative sources of income to counter the impact of COVID-19 on their businesses or those who have plans to shift from this sector to another sector with less risk of being impacted by COVID-19 at their location.

Interviewed small business owners state that they have witnessed a 50 to 60% decrease in their sales and profit due to restriction measures, unavailability of solar energy products and the moving of market locations to suburban

areas. Some interviewees are optimistic that the pandemic would soon abate and normal life would return, with regular delivery of solar products and sale to customers, while others are fearing that the situation may get worse and they may lose their business and face bankruptcy as a result of not being able to cope with the challenges they are facing.

Some solar energy business owners, especially small retailers, are thinking of shifting to other sectors to mitigate the risk of bankruptcy. Some interviewed business owners stated that they have closed their solar energy products shops and started to trade in food items instead. The transportation costs have increased, and some businesses are thinking of increasing the size of their orders for the stock of products to last for a longer time. But this requires strong purchasing power, which most of small retailers do not have, as they can only buy with the cash they get from their sales.

Marketing solar energy products through social media has become a trend among small retailers. MSMEs could respond to the crisis by adopting such innovations, sharing ideas and platforms amongst themselves and offering each other support through digital means. MSMEs using digital technology that meets changing customer expectations can quickly adapt their approach to the new environment. As customers are staying at home and with enforced reduction in movement, online marketing and door-to-door delivery is becoming a necessity, and the demand for delivery services is increasing.

Many wholesalers are dealing with retailers through credit purchase. They deliver products to the retailers in advance and take payment later in small instalments. As COVID-19 spreads, the trust between wholesale traders and retailers would erode, in the knowledge that purchasing power of retailers would be affected by the impact of the pandemic on their small business, with the risk that they may not be able to pay their debt to wholesalers.

Most of the interviewed small retailers are requesting financial support from relevant agencies to help them face the current situation, withstand predicted shortage of liquidity and supply of solar products and to keep their staff. Delaying requests of payments to wholesalers and importers and extending the timeline for payments, providing loans, exemption from taxes and financial support to start-up businesses are interventions suggested by interviewed retailers and other MSMEs to be adopted by agencies, in order to support struggling businesses in the sector.



Suggested support includes providing specialised training courses for MSMEs on developing business continuity plans during COVID–19. There are plenty of newly developed courses in supporting MSMEs during COVID–19 which aim to help them assess the level of risk and vulnerability of their businesses and help them develop effective risk and contingency plans. Many MSMEs were facing a struggle with access to financial support already before the pandemic. During the current crisis, it has become even harder to access such support from MFIs and other agencies, and this is expected to worsen in a scenario of increased COVID–19 severity.

Government authorities in Yemen are not expected to respond to the crisis with economic stimuli and other business support, like other countries, since the economy is already facing the most challenging times in Yemeni history and the country is barely standing on its feet to cover essential needs. The country's infrastructure has been destroyed by the conflict lasting five years, national systems are weakened and inadequate to respond to the pandemic.

### Livelihoods

Although solar energy has been seen as a promising sector that is creating new green jobs in the Yemeni economy, the new fears of the effect of COVID–19 on employment make the picture look gloomier. Small marketplaces are now practising reduced working hours, and many markets are being moved to other locations. Solar energy installation and trading businesses hire people with low educational qualification, and they offer very low wages. The employees

in the solar energy value chain are among the poorest in the Yemeni society, and they are at risk of severe consequences that would affect them and their families.

Another potential scenario is that employers would have to reduce their workforce as a coping mechanism to address their profit loss challenges. According to some interviewed wholesale traders, employers would consider reducing the number of their employees by 30 to 50% if no alternative solutions are available. Other interviewed wholesalers mentioned that they would have to apply part–time unemployment for employees in case the severity of the pandemic increases and may have to lay off 50 to 70% of their employees. Putting staff on shorter working hours is also an option.

The wages of employees could be reduced, and vulnerable workers would have no option but to accept a reduction in their wages, especially as they are witnessing current lay–off and suspension of employees in other sectors due to COVID–19. Most of the employees in the solar energy sector are working without contracts that recognise job–related rights, which makes it easy for employers to lay off their staff without notice in case the COVID–19 situation gets worse.

Some recommendations on how to facilitate for MSMEs to respond to and ultimately recover from the COVID–19 crisis are given in the table below. The recommendations are framed based on macro, meso and micro level perspectives.

Solar Energy Sector Recommendations	
<p><b>Macro Level Outlook:</b> Recommended government policies, relaxations and enforcement measures. Also, the role of private sector to support the macro level outlook</p>	<ul style="list-style-type: none"> <li>• Reduce telecommunication costs, especially the Internet, to bring together sellers and customers in online sale platforms</li> <li>• Reduce taxes to help business owners overcome their losses</li> <li>• Facilitate online payments and transactions by local and private banks to support the use of online trade</li> <li>• Stabilise currency fluctuations to avoid changes in prices of merchandise</li> </ul>
<p><b>Meso Level Analysis:</b> Recommended continuity measures to be taken to mitigate the impact, including the need for finance.</p>	<ul style="list-style-type: none"> <li>• Provide financial assistance through MFIs – extending new loans and restructuring repayment of old loans – to assist value chain actors to overcome liquidity challenges</li> <li>• Create a special online platform for solar energy e-commerce and provide online training courses to support sale</li> <li>• Set up a platform of solar energy value chain actors to share ideas and offer each other support</li> <li>• Train MSMEs on risk and contingency plans for business continuity in the face of a protracted crisis</li> <li>• Support MSMEs financially to help them purchase new stocks of products in the face of discontinued credit purchase practice</li> </ul>
<p><b>Micro Level:</b> Recommendations related to preparedness and plans to contain the impact of COVID-19</p>	<ul style="list-style-type: none"> <li>• Learn about online marketing and trade to overcome losses caused by market closure and decrease in demand</li> <li>• Use commonly used social media like WhatsApp and Facebook as a platform for selling products</li> <li>• Establish a network of online contacts with customers for future supply of services and equipment</li> </ul>

## REFERENCES

1. Assessment of the Status of Solar PV in Yemen. (2017) World Bank Project: Republic of Yemen Restoring and Expanding Energy Access. *Regional Center for Renewable Energy and Energy Efficiency (RCREEE)*. Retrieved from <https://rcreee.org/content/assessment-status-solar-pv-yemen>
2. Good Practices and Lessons Learned: Solar Interventions under ERRY Project in Yemen (2019). *UNDP*. Retrieved from [https://www.ye.undp.org/content/yemen/en/home/library/crisis\\_prevention\\_and\\_recovery/good-practices-and-lessons-learned--solar-interventions-under-er.html](https://www.ye.undp.org/content/yemen/en/home/library/crisis_prevention_and_recovery/good-practices-and-lessons-learned--solar-interventions-under-er.html)
3. Prospects of Solar Energy in Yemen, Policy Note (2013). *UNDP*. Retrieved from <http://www.undp.org/content/dam/yemen/E&E/Docs/UNDP-YEM-Prospects%20of%20Solar%20Energy%20in%20Yemen-%20Policy%20Note.pdf>

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