ECONOMIC RESEARCH FORUM

Sudan Qualitative Report

The Role of MSMEs in Fostering Inclusive and Equitable Sustainable Economic Growth

in the Context of the Clean Energy Transition in the MENA Region

Sudan Case Study
Qualitative Data Collection Report

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Country Qualitative Reports provide a deeper look into qualitative analysis and narrative of the qualitative survey conducted under the project. To complement the quantitative findings, the project team conducted qualitative surveys, including in-depth interviews with experts and relevant stakeholders, alongside focus group discussions specifically with MSMEs. These qualitative reports offer insights into local challenges, sustainable practices, and employment opportunities, emphasizing inclusivity and gender equity. The qualitative data reports for Egypt, Jordan, Tunisia and Sudan provide a focused perspective on the contributions of MSMEs to an equitable clean energy transition across the MENA region.

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1. Introduction

The prospects for the post-conflict adoption of renewable energy in Sudan depend on various factors, including political stability, economic conditions, international support, and political commitments. Some factors that can influence the adoption of renewable energy in Sudan include: international support, the rate of post-conflict recovery, developments in energy access, investment in infrastructure and the post-conflict regulatory and institutional frameworks that arise.

The conflicts in Sudan have led to significant disruptions in energy infrastructure. The post-conflict period provides an opportunity to rebuild and invest in modern, sustainable energy infrastructure, including renewable energy projects. International organizations and donor countries often play a crucial role in supporting post-conflict recovery. If there is substantial international support, it could include assistance for the development and implementation of renewable energy projects. Investing in renewable energy can contribute to energy security by diversifying the energy mix. Reducing dependence on fossil fuels can make the energy sector more resilient and less vulnerable to external shocks. Renewable energy projects can contribute to economic development by creating jobs and attracting investment.

The post-conflict period may provide an opportunity to focus on sustainable economic activities, including the development of the renewable energy sector. Sudan, like many African countries, faces challenges related to energy access. Adopting renewable energy, particularly in remote and underserved areas, can help improve access to electricity and promote social and economic development. The development of a supportive policy and regulatory framework is crucial for the success of renewable energy adoption. Clear and favorable policies can attract private investment and facilitate the integration of renewable energy into the national energy mix. Advances in renewable energy technologies, along with decreasing costs, make these solutions more attractive and feasible for countries looking to develop their energy infrastructure.

It's important to recognize that the successful adoption of renewable energy requires a comprehensive and coordinated effort from the government, private sector, and civil society. Political will, institutional capacity, and stakeholder collaboration are key to overcoming challenges and implementing effective renewable energy strategies. More importantly, the institutional structures will determine the feasibility of the different financing mechanisms highlighted in this report.

2. Research design

The research design was chosen to understand the nuances of the energy transition in a developing country context. The qualitative approach uses two data collection methods: focus group discussions with owners of MSMEs as the participants and key informant interviews with various experts. Through the focus group discussions, we hope to discern the challenges that MSMEs face with regards to access to energy and the potential solutions provided by renewable energy technologies. The key informant interviews are an ideal way to understand the structural and institutional challenges for an energy transition to manifest in a country like Sudan. The study methodology was chosen because it allowed the researchers to access to understand better the challenges facing MSMEs and their attitudes towards the clean energy transition as well as the experience of MSMEs with renewable energy technologies across different sectors and states in Sudan.

The selection of participants in the study was conducted to fulfil several criteria. For the focus group discussions, participants were chosen to be representative of firm size, gender, sector of operation and renewable energy use. In all states, the sector of operation of participants was chosen to reflect the dominant sector in each state. For example, where agriculture is the dominant economic activity, such as in Gedarif, Kassala and Sennar states, all participants were chosen from the agricultural sector. In states where agriculture is not the major economic activity, as is in Red Sea, River Nile and Northern states, all participants were chosen from non-agricultural sectors.

In all states, the proportion of participants operating micro, small and medium enterprises were chosen, as much as possible, to reflect the distribution of firm sizes. Therefore, 50% of participants operated micro enterprises, 30% small and 20% medium. The study design aimed for a 50-50 gender split between participants where possible. Unfortunately, in Kassala state, it was difficult to recruit female participants, so the focus group discussion participants were all male. Finally, the study aimed to understand the differences in perceptions of the benefits of renewable energy from those who use it and those who don't, therefore, the choice of participants was initially designed to include a split between MSMEs that use renewable energy technologies and MSMEs that rely on grid electricity or other sources of energy.

2.1. Key informant interviews

For the key informant interviews, participants were chosen to represent different sectors, including the private sector, academia, public sector and non-governmental organisations.The sample of participants included 25 individuals, including:

- Private sector (32%): this group includes members of the private sector in Sudan operating in the design, sale and maintenance of renewable energy systems, and investors in infrastructure projects.

- Finance and banking (9%): this group includes experts in finance for infrastructure and renewable energy projects; some experts operate in the microfinance sectors and provide valuable insights into finance for small renewable energy projects.
- Non-governmental organisations (36%): participants from non-governmental organisations provide a perspective on the available support for renewable energy adoption at the global level.
- Public sector (14%): participants in this group include experts from public sector institutions who have policymaking experience and experience in state owned enterprises operating in the energy sector.
- Academia (9%): experts from academia give a research perspective on the opportunities and limitations of renewable energy adoption, and the prospects of a transition in the existing socio-economic and political context.

The various experts ensure that all perspectives are represented in our analysis. While there are no operators of MSMEs included in the key informant interviews, they are well represented in the focus group discussions. Combining focus groups discussions with operators of MSMEs with key informant interviews allows for a unique look at the difference between expert opinion and reality on the ground. In addition, they will highlight the relevance of the solutions proposed by experts and the experiences of those whose activities and livelihoods will be affected by policies, legislations and investment.

2.2. Focus group discussions

Focus group discussions were conducted in 8 states across Sudan: Red Sea State, River Nile State, Gedarif State, Kassala State, Sennar State, Blue Nile State, White Nile State and Northern State. The initial project planning included Gezira State, but after the expansion of the conflict in December 2023 into Gezira State, data collection efforts were redirected to Blue Nile State instead. In total, 135 participants attended 16 focus group discussions, 2 in each of the 8 states in the sample.

Of the 135 participants, 73 were male and 62 were female. Of the total number of participants, 64% operate MSMEs in the agricultural sector and 36% in non-agricultural activities. Figure 1 shows the characteristics of the participants in the focus group discussions.

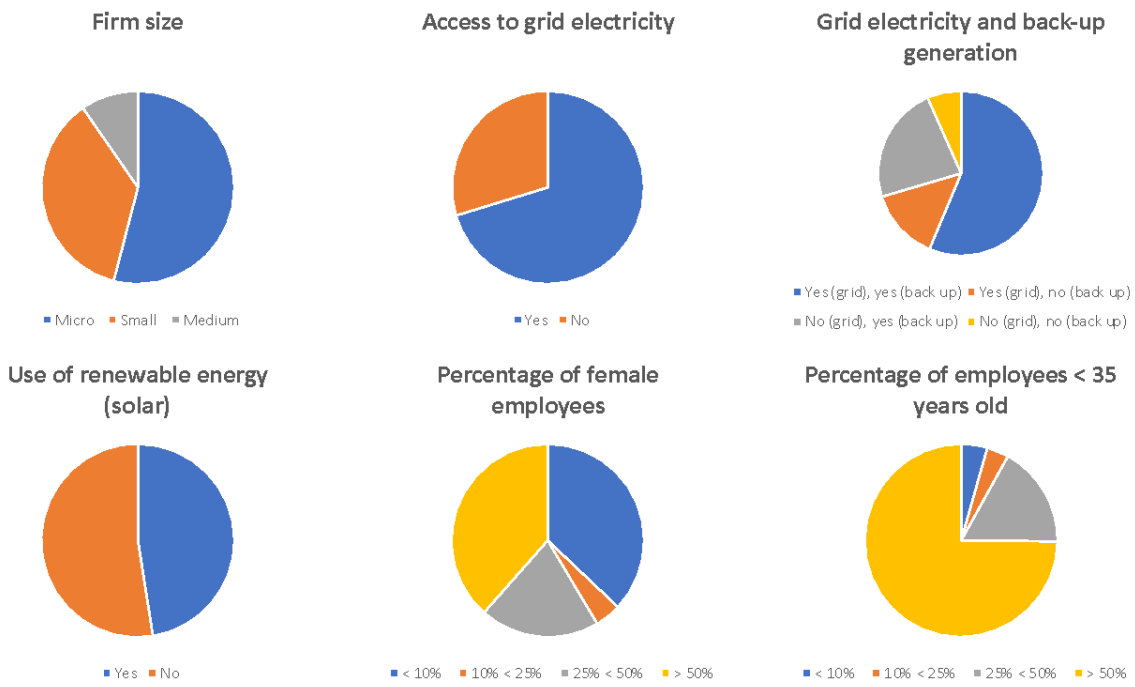

Figure 1 - Characteristics of participants in the focus group discussions.

2.3. Data collection

2.3.1. Focus group discussions

The qualitative data collection aims to get a more detailed understanding of the opportunities and barriers for an energy transition. The data collection exercise includes two approaches: expert interviews and focus group discussions.

The focus group discussions brought together different groups of entrepreneurs, business owners, and private sector players from different sectors and regions to discuss their experiences with environmental degradation and climatic variability, their respective energy access challenges, and their views on the likelihood of an energy transition and the opportunities it opens up for them.

The Economic Research Forum contracted DataQ to organize and conduct focus group discussions in 8 states in Sudan. The aim of the FGDs was to understand MSMEs' access to energy, the challenges and barriers to transition to clean energy, and the effect of energy access and environmental degradation on their business activities. The data was collected from samples of participants in each state, ensuring sufficient representation of women, micro, small and medium-level enterprises, and users of clean energy. The discussions included participants who were local to the state where the study was being conducted and participants who relocated to the same state. DataQ's trained researchers facilitated the meetings to foster an

open discussion space and capture all points of view. DataQ's supervisors closely monitored and evaluated the collected data at all stages to ensure its quality.

Focus group participants were asked to fill out a pre-workshop questionnaire that included questions on the size of the firm they operate, whether they have access to electricity, whether they use renewable energy, the number of female and youth employees and the impact of the conflict on their cost of inputs, energy and labour.

A detailed breakdown of the sample of participants in the focus group discussions is provided in the Appendix.

2.3.2. Key informant interviews

A detailed interview guide was developed. The objective of the in-depth interviews is to tease out expert opinions from various stakeholders on the potential for an energy transition and the necessary policies, legislative amendments and infrastructure investments that could enable a transition to cleaner energy. Another objective is to understand the types of challenges that MSMEs face when trying to transition to clean energy sources. The interview guide included questions on: the most appropriate renewable energy technologies for Sudan, and their potential to contribute to economic growth; existing laws and regulations that are conducive to an energy transition, and the institutional barriers; the prospects for adopting a decentralized energy system and its potential benefits; the advantages of decentralized renewable energy systems in a fragile conflict setting over conventional infrastructure; and the potential impacts of the energy transition on private sector firms, labour markets and on women and youth.

2.3.3. Limitations

The main limitation in this research exercise is that data collection was confined to the states with no active conflict. Therefore, no focus group discussions were conducted in the Khartoum, Gezira, the five Darfur states and the three Kordofan states. The conflict also meant that data collection costs were prohibitive, and, therefore, firm surveys were not conducted. There were other conflict-related limitations in data collection and in conducting the expert interviews. These are listed below.

Focus group discussions

Impact of militant activities and the security situation:

- Activities in Sennar state were disrupted after the militant activities in Medani. Many residents in Sennar were affected by the influx of Gezira IDPs, which led to Sennar's Small and Medium focus group discussion (FGDSE2) to be held in Sinja, with an impressive representation of renewable energy users but the sample found was majority males. The micro focus group discussion (FGDSE1) was held in a village in Sennar with a majority female sample who do not use renewable energy, as compensation.
- Finding renewable energy users and persuading them to participate proved challenging due to curfews and security concerns.

- The project team exerted tremendous efforts for over two consecutive weeks to recruit participants for the second group according to the required criteria in the Red Sea state. Unfortunately, participants' response was very weak, leading to the cancellation of the discussion twice. The project team faced a significant challenge in completing the project on time, hindered by the non-formation of the second group in the Red Sea state. Due to the critical security situation in the Red Sea state, many participants have declined attending the second FGD due to the unknown consequences, despite providing explanations about the session's nature. This has significantly delayed the session and, consequently, the complete delivery of project requirements.

State-specific constraints

- In three focus group discussions: Sennar (FGDSE2), Northern State (FGDNS2), and Red Sea (FGDRS2) last minute apologies by participants (including the backup) led to a 7- and 6-person discussion rather than the required 8 person minimum.
- In White Nile State, the data collection team encountered challenges in recruiting participants for the medium-sized projects category. This difficulty was primarily due to the notably low energy usage in the area, as revealed by the field survey conducted by the supervising researcher and the project team. Consequently, this led to a shortage of participants who met the necessary criteria for the state's discussion groups. Several challenges related to participant recruitment existed. For example, in focus group 1 in River Nile state, participants were eager to leave the discussion to get back to work. This resulted in a lower-than-average group discussion time and less nuanced responses to questions.

Key informant interviews

Impact of the conflict:

- Most of the experts contacted were displaced by the conflict, especially those who worked in the public sector and in state-owned energy companies. For example, one expert who was contacted in October 2023 responded in early February 2024, agreeing to an interview. Experts who were still in Sudan had no electicity and/or internet access which impacted the quality of the calls or prohibited them from participating all together. Due to this limitation, expert interviews have not reached the target of 35 that we had initially planned for.
- Some of the views expressed by experts were affected by the current conflict. For example, most experts thought that solar energy use is likely to increase due to reduced capacity due to the conflict. While this view is positive regarding the transition away from fossil fuels, it does not reflect the state of the energy transition in Sudan pre-conflict.
- Additionally, the conflict instilled a sense of fatigue and hopelessness amongst these experts, and it has created a disconnect between them and the structural view of energy policy.

3. Main findings

The focus of the data collection was on the feasibility of an energy transition for MSMEs and the potential benefits to economic growth and development, therefore, climate change was central to most discussions. While the causes and long-term implications of climate change were not particularly well understood by most participants in the focus group discussions, their lived experiences revealed that they recognized changes in weather patterns and their impacts on operations, even if they didn't specifically use the term "climate change" to describe these phenomena. The fact that they do not use the term "climate change" but are heavily impacted reveals a significant gap in awareness regarding the root causes of climate change and the necessity for a structured response. Implementing out-of-context interventions may be detrimental, particularly for poorer communities. It is imperative that MSME owners and broader communities in Sudan have a comprehensive understanding of their circumstances, the associated impacts, and the available options for response.

Environmental degradation has been observed on multiple occasions, particularly with heavy rains, leading to cholera and other diseases for the first time in certain areas, resulting in the need for isolation centres. This environmental degradation has affected operations, causing disruptions and posing health risks. The analysis revealed the themes of environmental degradation and resource scarcity as a critical challenge affecting agricultural lands and infrastructure. Participants mentioned the encroachment of deserts and depletion of groundwater as critical issues impacting agricultural sustainability. The impact of desert encroachment on vegetation and housing was highlighted, emphasizing the need for sustainable land management practices to combat environmental degradation and preserve natural resources in the region. Participants noted changes in weather patterns, such as early summers, heavy rains, and unsteady temperatures, indicating potential environmental shifts in the Northern State.

Discussions also touched upon environmental degradation, with mentions of occurrences like cholera possibly linked to weather changes in Port Sudan, highlighting the urgent need for sustainable energy solutions to mitigate climate impacts. Below the main findings are organized thematically to present a comprehensive picture.

3.1. Challenges with energy accessibility

Challenges in energy accessibility were prevalent, marked by fuel price volatility, transportation disruptions, and inconsistent electricity supply. These issues mainly affected micro-enterprises who work on handcrafts, food making, leading to direct income losses. Participants pinpointed frequent power outages as a significant hurdle, disrupting effective resource planning and business operations. A participant from White Nile maintained that:

> *“The instability in electricity supply over recent years has significantly impacted companies, including ours. The need to constantly navigate through power outages and fluctuations has posed challenges to our growth strategies. This instability has*

> *influenced our decisions regarding hiring practices, as uncertainties in power supply have made us cautious about expanding our workforce*."

This sentiment is echoed across states. In addition to employment considerations and growth strategies for the firm, in River Nile state, one participant claimed that unstable electricity supply "*decreased [firm] productivity*." A female participant in River Nile decried the scarcity issue and how it impacts her cost of running the business: "*I am having issues with fuel supply and the scarcity of it, which forces us to buy fuel from the market at very high costs instead of from the oil stations*." Fuel scarcity and high fuel prices made things worse for most firms, leading to reduced production and challenges in obtaining necessary resources. For some firms, the instability in the electricity supply led to layoffs.

Despite solar's many advantages, including the flexibility to operate both on- and off-grid, perceptions about its reliability favour diesel generators. One participant in River Nile state who runs a medium-sized enterprise confirmed this view:

> "*The reliability [is a challenge]. We have cellular stations that always need high reliability because the work cannot afford to stop, so we always have a backup. Our work is mainly based on diesel in many stations; in Atbara, we use mainly electricity, and our backup is generators and UPS.*"

In the agricultural sector, where electricity is mainly supplied through diesel generators, one major challenge to accessing energy is financial. In Blue Nile state, fuel scarcity and the subsequent price increases hit micro-enterprises particularly hard. One participant emphasised the constrained choices those operating in the agricultural sector have to contend with: "*[When] there is [fuel], its price is high, and people are unable to afford it, which leads to the deterioration of agriculture*." Another participant corroborated this point, who emphasised that there's an opportunity cost when farmers can't afford fuel: "*When there's no fuel, you are busy ploughing [the fields] all day*." In some cases, the increases in fuel prices eat away at the savings farmers use to purchase seeds and other agricultural inputs for the next farming season. Yet, it is not only the absolute cost of inputs that is challenging, volatility is a major challenge in some areas. A female participant who runs an agriculture micro-enterprise in Kassala state mentioned that, "*Currently, we want to farm and we are producing, but the barrel of [diesel] we used to buy costs [SDG 280,000]. [Now], it has reached almost [SDG 800,000]*." She added that, "*For us, prices are not stable at all*."

Describing the challenge of persistent fuel shortages during the last few years, a male participant gave an example of the negotiations involved in acquiring fuel and how this made it more difficult for female participation in the labour market or as business owners:

> "*There is now way for 6 barrels, we will give you 3" then they will give you 3. I mean the topic is tiring for the women, I mean we as men can handle it but for the women it is very difficult' this in the context of existing societal expectations around women participation is especially harmful.*"

Moreover, one expected consequence of increased spending on fuel is that farmers are less likely and, in most cases unable, to hire workers. One micro agricultural enterprise participant claimed that increased input costs have reduced their farming operation by half. Where they previously would farm 10 acres, now that they attend to the field on their own, they are more likely to farm less than 5 acres. Owners and operators of micro agriculture enterprises who had workers said they were forced to lay them off because they couldn't afford the wages. This contrasts with some of the experiences of small and medium enterprises. In Gedarif, for example, two views were prevalent among owners of small and medium-sized enterprises. One view was that stable electricity ensures that workers can be more efficient and reduces idleness. Another view centred around the need to maintain consistent levels of output: to produce the same volumes when electricity is unstable, farmers must hire more workers. The broader implications of the continuous downsizing of workers hired on farms include impacts on rising unemployment levels and poverty levels. In cases when farmers consistently produce less may also have impacts on total amounts they are able to sell in the market and disposable income. More so, the high prices of diesel are likely to only be afforded by large scale producers leading to a widening gap between small holder farmers and

Energy access challenges extend beyond the field. Participants in Blue Nile state highlight the importance of electricity for running local shops, clinics and public utilities. One female participant in Blue Nile state emphasised the limitations introduced by fuel price fluctuations at the household level, claiming that, "*You try to save money to buy a gas cylinder, you find that the price of gas has risen, and there is not enough money for a person to engage in agriculture.*" In this case, a choice must be made between meeting personal energy needs and the financial needs of the enterprise. On post-production operations, a female participant who runs a small agricultural enterprise in Kassala mentioned that fuel scarcity also affects transport. She mentioned that, "*[It's two issues together]: we cultivate using diesel and we transport using diesel*." In this case, however, solar energy only addresses one of the issues. A more diverse set of renewable sources (electricity) or fuels (biodiesel, biofuels), requiring a more complex infrastructure of production, distribution and storage, must be considered to address the fuel scarcity issue in transport.

The high reliance on diesel generators and other forms of off-grid generation is because the grid does not extend to agricultural areas. Farmers must bear the cost of an electricity connection in order to take advantage of the subsidised electricity tariffs for the agricultural sector.

The impact of the conflict on energy access is not consistent across states. Some participants thought the conflict had almost no impact on energy access in areas where there is no grid electricity. In Gedarif state, a female participant who operates a micro-enterprise in agriculture said that, "*Areas that don't have electricity [will] not be affected by this problem*," and that, "*... since these areas are from the grid, there is already renewable energy [in operation]*." The increased uptake of off-grid technologies (renewable and fossil fuel-based) among farmers and micro agricultural enterprises has had a discernable effect on employment. One participant in Gedarif pointed out that:

> "*Alternative energy also increased employment opportunities, because the generators need maintenance, so this is an additional work so it will need another worker; [it] needs cleaning, oil changing, and so on. The turning on and operation added to an increase in employment for us.*"

The indirect effects of the war - and other economic and political shocks - through increased prices vary depending on firm size.

3.2. Shift towards renewable energy

A growing recognition of renewable energy benefits was evident, although concerns about the initial investment costs persisted. Participants expressed interest in solutions like instalment plans, price reductions, or financial assistance for solar energy installations. Users who transitioned to solar energy reported high levels of satisfaction, noting marked improvements in business efficiency and a reduction in material waste.

Participants expressed that having access to solar energy tools provided them with a sense of control and security. One participant from Sennar stated: "*We support it because its tools are available, and I can do my project without fear of power outages.*"

This sense of security contributes to their ability to engage in projects without concerns about energy availability. The transition to solar energy was seen as a means to increase security and control over energy resources. Adopting renewable energy, particularly solar energy, was viewed as a pathway to economic opportunities and empowerment for women and youth. Women participants emphasized that solar energy enabled them to engage in various projects at home, such as making cakes and ice cream, leading to income generation and personal benefits. Participants highlighted the benefits of renewable energy, such as cost-effectiveness (once the capital cost of instalment is guaranteed), reduced reliance on fuel, and the potential for year-round farming. The shift to renewable energy is perceived as a way to enhance agricultural productivity and sustainability, presenting a financially viable option with significant demand and market acceptance.

In non-agricultural sectors, renewable energy solutions address immediate needs. In Northern State, a participant who runs a pharmacy has highlighted that power outages, increased electricity tariffs and cooling needs have forced the business to shift to solar energy: "*The constant power outage, we have medications and insulin that need to be stored in specific cooling conditions and temperatures, so the power outage and its fluctuations cause us problems, that's why we use solar energy as an alternative source of energy*." Similarly, food businesses and catering firms have struggled with power outages. For one firm, a new solar system partially solved food preparation problems. However, in some cases, solar systems do not provide sufficient power. A clothing store owner mentioned that "*... solar energy partially solved the problem for me. I have surveillance cameras and air conditioners which are excluded… and [demand is] limited to fans and lighting systems*," and, practically, to install a system that meets the firm's power needs, the participant claimed that, "... *[the cost of] a comprehensive solar energy system will be high, and probably, I will not find enough space for*

it." The capacity constraints and spatial requirements of solar systems are most prevalent in power-intensive sectors.

The feasibility of the transition to renewables is not consistent across sectors. For example, the shift to renewables has not been straightforward in the mining sector despite the various potential applications. The national grid does not reach most mining areas in the North. In these areas, companies and artisanal miners initially used diesel generators. The advent of solar PV as an alternative was welcomed and solved some of the fuel scarcity issues for the sector. However, the scale of the systems was not enough to satisfy the energy demands of the production processes. One participant who runs a small firm operating in the mining sector explained that, as an alternative to grid electricity, "*... workers [and firms] used substitutes such as diesel and later appeared the solar system, but it was not enough to [operate] the mills and washers.*" The solar systems were sufficient for certain applications, but, in general, their usefulness is limited in the sector: "*... solar systems were used for simple uses, but the machines and mills [used in the production processes] rely on [diesel] generators*."

Other issues include ease of technology adoption. Some farmers who were able to acquire renewable energy systems - for example, solar pumps for irrigation - found them difficult to operate. In Kassala, a male participant operating a micro enterprise highlighted that renewable energy requires some knowledge of operation and maintenance, and that, "*there are specific instructions that the farmer is supposed to know so that he does not lose the entire system.*"

Female participants were particularly supportive of a switch to solar energy, highlighting its user-friendly nature in comparison to diesel generators. Female participants in the focus group discussions highlighted the challenges they face in accessing energy in terms of affordability and reliability. For instance, financial constraints were identified as a significant barrier, leading to difficulties in purchasing electricity and fuel. The impact of electricity instability on their work was also emphasized, with disruptions affecting activities like baking and online work. Female participants showed a willingness to pay for alternative or renewable energy solutions, citing benefits such as mental comfort, stability, and reduced costs compared to traditional electricity. In certain states, participants highlighted the challenges they face in accessing a stable supply of electricity for their agricultural operations. The instability of the electricity supply leads to financial losses and affects their ability to retain workers and sustain their businesses effectively.

The resistance to transitioning to renewable energy was primarily due to a lack of awareness and exposure to renewable technologies. However, as some experienced the advantages firsthand, the resistance diminished, and those who were initially sceptical became advocates for adopting renewable technologies. Challenges in transitioning to clean energy included initial investment costs, concerns about compatibility with existing infrastructure, and differences in devices used for solar energy compared to traditional electricity. One other source of resistance to transitioning to renewable energy was a lack of awareness and exposure to renewable technologies. Participants expressed the need for financial support to facilitate the transition, indicating a barrier to adopting clean energy.

In the rainfed agricultural sector, several participants reported no expenditure on energy, attributing this to a lack of necessity for energy use in their operations. The adoption of

renewable energy presents numerous benefits and opportunities, particularly in fostering economic development and innovation. As highlighted in the discussion from White Nile, transitioning water pumps from fuel to renewable energy can spark creativity among youth, who are often the sons of farmers. This shift not only enhances energy efficiency but also encourages the younger generation to engage in sustainable practices, leading to overall economic growth.

The effect of conflict has led to a heightened pressure on electricity availability, and it made the transition to decentralized , reneweables more neccesariy however it has also increased the cost of solar. Some participants who were using it in their households and were considering it fro their businesses noted a significant increase from pre-conflict prices. In the expert interviews, the benefits and suitability of decentralized systems were consistently highlighted. Numerous experts indicated that weaknesses and losses in infrastructure may have created an opportunity for such systems. However, challenges related to cost, storage, and know-how reveal that MSMEs require substantial support from the state or INGOs to transition effectively. Cost-sharing, training, and the setup of solar systems (or other forms of clean energy) cannot be left solely to individual firms. This approach risks only larger or wealthier businesses adopting these technologies, potentially leading to an incomplete transition in the long run.

Participants highlighted the significant capital costs associated with adopting clean energy solutions, particularly solar power. The need for multiple panels, batteries, and related equipment required a substantial initial investment that many MSMEs claimed they could not afford. The lack of financial resources was identified as a significant obstacle preventing businesses from adopting renewable energy technologies despite recognizing their potential benefits in the long run.

Challenges related to finances and the availability of funding were acknowledged in the context of renewable projects. Although funding exists for such initiatives, the main hurdle lies in effectively showcasing viable projects to potential donors. Experts underscored the importance of improving project presentation and execution in order to access the existing pool of funds, one way of mitigating this could be through regional collaboration, and the importance of keeping up with neighboring countries to accelerate technology deployment. One expert claimed that *“[Sudan] must keep up, particularly with neighboring countries because that will foster our ability to roll out our technology faster as well*”. There was a lot of emphasis on the agricultural sector and the role of financial institutions and development organizations in financing energy transition initiatives.

Due to the conflict, leading to the loss of assets and stocks. This has resulted in some SMEs leaving the market, which also makes them less likely that they will be able to invest into clean energy in whatever sector they end up in.

Experts highlighted that MSMEs are not considered a specific category with distinct needs, there is a general absence of recognition of the unique struggles faced by MSMEs with regards to electricity access and usage and access to renewable energy technologies for back-up or This isn't necessarily only limited to the experts opinion of the situation of MSMEs but it is also related to the experts opinions themselves of the role that MSMEs can play in the energy sector. During the interviews, MSMEs were seen mostly as utilizers of clean energy when/if it is

provided or as providers, especially with a focus on selling solar systems to other companies or end users. In this regard, the energy transition and the role of MSMEs in it is a matter of opportunity as opposed to deliberate policy.

3.3. Regulatory Framework and Energy Policy

Participants acknowledged the importance of government support in promoting renewable energy initiatives and facilitating the transition to clean energy. They emphasized the need for policy advocacy to address barriers to the widespread adoption of clean energy and ensure a supportive regulatory environment. Participants also highlighted the role of government incentives and subsidies in making renewable energy technologies more accessible and affordable for small-scale farmers. financial support and awareness, emphasized the crucial need for government and institutional support in facilitating the transition to sustainable energy solutions. Participants highlighted the importance of payment facilities and funding for renewable energy technologies to overcome financial constraints. emphasized the importance of government support in terms of policy decisions, financial incentives, and awareness campaigns to facilitate the adoption of renewable energy technologies. Suggestions included logistical support, incentives for renewable energy users, and agreements for energy sharing between users and the national grid. This theme underscores the role of external support mechanisms in overcoming barriers to clean energy adoption and promoting sustainable economic growth in the region.

There was generally a positive view of decentralized solutions. This view stems from the understanding of limitations in state capacity to provide access to electricity, especially in the context of the current and previous conflicts. For example, the five Darfur states are not connected to the national grid and are serviced by a decentralized system (this inequitable distribution of electricity is arguably a cause of conflict). The impact of decentralized energy systems was discussed as a strategic approach to enhance energy access and improve state-citizen relations, particularly in conflict-prone regions. By empowering local communities with reliable energy sources, decentralized energy systems can contribute to stability and resilience. This theme underscores the social and political implications of decentralized energy solutions beyond their economic benefits.

The current conflict may have a positive effect on the clean energy transition due to reduced state capacity and continued demand for electricity across the country. A private sector expert and former government advisor maintained that "*We need a decentralized economy and therefore energy structure and village level. It's more resilient and definitely more relevant to the current conflict*". By empowering local communities with decentralized energy solutions, the energy transition can could contribute to regional sustainable development. One expert mentioned that decentralization can begin at the state level, and that there are ample opportunities for expanding electricity access, benefiting the private sector through enhanced access to energy. This view was echoed by owners of MSMEs. A participant from the focus groups in Sennar stated "*Instead of paying [a large sum of money] to the electricity company,*

pay it for solar energy. You won't need to bring a pole; you'll pay half the cost and bring a few panels, and your mind will be at ease. No power cuts or wires".

Several companies in Sudan already offer solar energy solutions, making solar the preferred option for clean energy investment in the country. Other reasons for the popularity of solar are its physical characteristics, modular nature (which allows for easy upgrading) and relatively low investment and maintenance costs. Most experts highlighted the importance of decentralized solutions, particularly using solar PV, in addressing the energy access gap in Sudan. They pointed out the cost-effective nature of solar PV systems, making them suitable for rapid deployment. For example, they discussed how solar energy can be harnessed to provide electricity to remote areas where grid connectivity is limited, thereby improving access to reliable energy sources for communities. This comes in contrast to what participants in MSMEs mentioned about high costs associated with solar energy.

Despite the increased appetite for solar and decentralized solutions due to the war and destruction of centralized state capacity. The conflict has exacerbated the financial constraints, "*Forex is now a major issue, banks will not give dollars for anything unless its basic goods and services,*" stated an energy expert in an international organization. The financing gap was identified as a constraint and as an opportunity.

The adoption of renewable energy technologies was underscored as essential for enhancing energy security in Sudan, where a considerable portion of the population lacks access to reliable energy sources. Moreover, the implementation of decentralized renewable energy solutions is expected to stimulate economic growth, particularly in the agricultural sector. By reducing energy costs and creating job opportunities, renewable energy can contribute to economic development and poverty alleviation in the country. Given the current hardships imposed by the conflict it is essential to support access to energy in the agricultural sector especially, this may relieve the major threat of food insecurity across the country.

"Energy policy in Sudan has actually regressed," a climate expert stated in an interview, the discovery of oil has led all policy makers to focus all policies on oil and entirely neglect renewable resources. Hydro-power also featured heavily in energy plans. The building of massive, expensive, dams such as Marawi dam which has led to displacements of millions, and hasn't necessarily expanded the grid. The environmental impacts of dams is also disastrous, including methane emissions and risk of landfills. After the revolution, the transitional government showed more enthusiasm for renewable energy however, the process was still slow and protracted, for example the announcement for the new legislation was supposed to be announced in November 2021, however it only officially took place January of 2023. This delay signals a main impediment, which is weak institutional capacity and a lack of political will.

Currently, the energy policy is still scattered and doesn't cut across all sectors of the economy. For example, there have been tax exemptions given to imports of electric cars and solar equipment. However, an understated challenge for adopting a comprehensive energy policy is corruption. Despite its weakness and inability to expand the grid the Sudan Electricity Company is still invested in obstruction, because it stands to incur a huge loss if solar energy was officially adopted and subsidized by the government. Companies and even households in both urban and rural areas will likely turn to solar especially if they are helped with the initial cost (which is

the highest). The negative role played by the electricity sector institutions in Sudan was mentioned by a government official working in the xx he stated that

Challenges and legislative framework and the need for stable policies. Despite the potential benefits, Sudan faces challenges in quality standards, engineering practices, and financing capacity related to decentralized renewable energy technologies. Additionally, the absence of clear regulations and policies hinders the transition towards renewable energy. The existing legislation in Sudan is still in its early stages, with proposed laws awaiting finalization to support the energy transition and progress made under the civilian government was revered by the current conflict. Yet, of the key opportunities arising from the energy transition is the potential for job creation and economic empowerment, particularly for MSMEs. On the positive impact on job creation, one expert explained that "*Good job creation – on the MSME side – in delivering the service and increased ability to trade lowers their costs and reconstruction*".

By investing in renewable energy projects and decentralized systems, there is a dual benefit of creating employment opportunities and reducing operational costs for businesses, thereby stimulating economic growth. The past few years have seen an increase in the adoption of solar. One industry expert mentioned that "*[If] you were to drive through an agricultural area you'd notice a significant change in the landscape. Around two out of every five farms now have solar systems installed—a sight that was practically unheard of just four years ago when only a few systems dotted the area*". This shift has been instrumental in boosting the profitability of these farms, surpassing what they previously achieved with subsidized fuel. Consequently, farmers have been able to expand their operations, with some even venturing into second or third farms. Solar energy has proven to be a transformative factor, offering a winning formula for agricultural enterprises. Yet this shift was primarily an indirect consequence of the removal of fossil fuel subsidies, which made solar PV much more competitive. One owner of a private sector energy company claimed that, "*The most important policy change for the sector in the last five years was the [fossil fuel] subsidy removal. Now solar is more competitive because diesel is being sold at market prices*". However, the subsidy reform did not have an immediate positive impact for all sectors of the economy.

One of the challenges identified in the interviews is the realization that renewables alone are not sufficient for providing energy access. This was the general sentiment from experts. One entrepreneur working in clean energy maintained that "*Renewables on their own do not work and we all know that batteries are not an energy source, they're just a form of energy storage*". This underscores the need for complementary energy sources in off-grid communities, additionally the need for mega centrally planned projects for energy generation. Moreover, broad stakeholder engagement is crucial for a successful integration of renewables in Sudan's energy infrastructure. One expert highlighted that people are generally enthusiastic about adopting new technology and are open to change, primarily due to the ongoing electricity issues which have created significant fatigue and a greater willingness to adapt.

One of the challenges to green energy transition lies in the lack of prioritization of the private sector. Despite the private sector being factored into the transition plans, there were limitations and anti-private sector sentiments that hindered their prioritization. This lack of emphasis on private sector involvement can impede the progress of green energy initiatives, as

their expertise and resources are crucial for successful implementation. Closely associated with this is the issue of grid utilization and regulatory barriers: Another significant challenge is the requirement to utilize the grid effectively for wheeling and distribution of green energy. This necessitates the establishment of laws and regulations that allow for captive power generation and distribution. However, existing regulatory barriers and the need for specific legal frameworks can pose obstacles to the seamless integration of green energy sources into the grid infrastructure, hindering the transition process.

4. Appendix

Focus group discussions – interview guide

Introductory script

As part of a research project on the adoption of clean energy among Small and Medium Enterprises in the Arab world (Morocco, Tunisia, Egypt, Lebanon, Sudan, Jordan) carried out by the Economic Research Forum, We are conducting these focus groups to understand better the situation of energy transition for SMEs/MSMEs and the obstacles facing all of you, as well as your motivations for adopting clean energy.

Script on energy transition:

Energy transition refers to the global energy sector's shift from fossil-based systems of energy production and consumption — including oil, natural gas and coal — to renewable energy sources like wind and solar. Concerns about the impact of fossil fuel use on climate change are a fundamental motivation for the energy transition.

1. Introduce yourself and your business/sector.
2. What challenges do you face in accessing energy? (fuel, electricity, etc.)
1. How has the conflict affected your access to energy
2. How has the conflict affected your ability to produce/operate?
3. How has electricity instability in the past few years affected your company's growth? Did it affect your decisions to hire more people? Or lay off people?
4. For those who use renewable technologies - have you found any advantages in using renewable energy technologies? (this is for those who have already transitioned)
5. For those who don't use renewable technologies - Why do you not use renewable energy technologies?
1. Did/do you face resistance within (or outside) your company when wanting to transition to clean energy?
2. Would you support a transition from fossil fuels to renewable energy? Why? Why not?
3. What kind of support would you require to transition to renewable energy?
4. What potential benefits and opportunities do you foresee from adopting renewable energy?
5. How do you envision the transition to renewable energy impacting your business, specifically in terms of creating employment opportunities for women and youth?

6. Could you share the specific plans, programs, or intentions your organization has in place to expand employment opportunities during the transition to renewable energy schemes, with a particular focus on increasing the participation of females and youth in the workforce?
7. How much more than your current expenditure on electricity/energy would you be willing to pay for a renewable energy technology?
    . Why are you willing to pay more?
    . Why are you not willing to pay more?
2. In the context of the current conflict, do you think renewable energy would increase your energy security?
3. Have you noticed variations in the climate cycle in the region/state where you operate?
    . What changed exactly? (Rainfall patterns, flooding, etc.)
    . Have these variations affected your operations?
    . What do you think is the reason behind these changes?
2. Have you noticed any form of environmental degradation in the region/state where you operate?
    . Does this affect your operations?
    . What do you think is the reason behind the environmental degradation?
2. Do you think transitioning to clean energy will give women and youth more opportunities for employment?

If the participants answer “I don’t know” or appear confused by questions 9 and 10, then explain what climate change is using the scripts below:

Script on climate change:

Climate change refers to long-term shifts in temperatures and weather patterns. Such shifts can be natural, due to changes in the sun’s activity or large volcanic eruptions. But since the 1800s, human activities have been the main driver of climate change. Primarily due to the burning of fossil fuels like coal, oil and gas. Burning fossil fuels generates greenhouse gas emissions that act like a blanket wrapped around the Earth, trapping the sun’s heat and raising temperatures.

Focus group discussions – participant sampling

Gedarif State

Participants	Firm size	Gender	Sector	RE use	RE main
Group 1					
1	Micro	Female	Agriculture	Yes	Yes
2	Micro	Female	Agriculture	Yes	Yes
3	Micro	Female	Agriculture	Yes	No
4	Micro	Female	Agriculture	No	No
5	Micro	Female	Agriculture	No	No
6	Micro	Male	Agriculture	Yes	Yes
7	Micro	Male	Agriculture	Yes	Yes
8	Micro	Male	Agriculture	Yes	No
9	Micro	Male	Agriculture	No	No
10	Micro	Male	Agriculture	No	No
Group 2					
1	Small	Female	Agriculture	Yes	Yes
2	Small	Female	Agriculture	Yes	No
3	Small	Female	Agriculture	No	No
4	Medium	Female	Agriculture	Yes	No
5	Medium	Female	Agriculture	No	No
6	Small	Male	Agriculture	Yes	Yes
7	Small	Male	Agriculture	Yes	No
8	Small	Male	Agriculture	No	No
9	Medium	Male	Agriculture	Yes	No
10	Medium	Male	Agriculture	No	No

Kassala State

Group 1					
1	Micro	Female	Agriculture	Yes	Yes
2	Micro	Female	Agriculture	Yes	Yes
3	Micro	Female	Agriculture	Yes	No
4	Micro	Female	Agriculture	No	No
5	Micro	Female	Agriculture	No	No
6	Micro	Male	Agriculture	Yes	Yes
7	Micro	Male	Agriculture	Yes	Yes
8	Micro	Male	Agriculture	Yes	No
9	Micro	Male	Agriculture	No	No
10	Micro	Male	Agriculture	No	No
Group 2					
1	Small	Female	Agriculture	Yes	Yes
2	Small	Female	Agriculture	Yes	No
3	Small	Female	Agriculture	No	No
4	Medium	Female	Agriculture	Yes	No
5	Medium	Female	Agriculture	No	No
6	Small	Male	Agriculture	Yes	Yes
7	Small	Male	Agriculture	Yes	No
8	Small	Male	Agriculture	No	No
9	Medium	Male	Agriculture	Yes	No
10	Medium	Male	Agriculture	No	No

Gezira State

Group 1					
1	Micro	Female	Agriculture	Yes	Yes
2	Micro	Female	Agriculture	Yes	Yes
3	Micro	Female	Agriculture	Yes	No
4	Micro	Female	Agriculture	No	No
5	Micro	Female	Agriculture	No	No
6	Micro	Male	Agriculture	Yes	Yes
7	Micro	Male	Agriculture	Yes	Yes
8	Micro	Male	Agriculture	Yes	No
9	Micro	Male	Agriculture	No	No
10	Micro	Male	Agriculture	No	No
Group 2					
1	Small	Female	Agriculture	Yes	Yes
2	Small	Female	Agriculture	Yes	No
3	Small	Female	Agriculture	No	No
4	Medium	Female	Agriculture	Yes	No
5	Medium	Female	Agriculture	No	No
6	Small	Male	Agriculture	Yes	Yes
7	Small	Male	Agriculture	Yes	No
8	Small	Male	Agriculture	No	No
9	Medium	Male	Agriculture	Yes	No
10	Medium	Male	Agriculture	No	No

Sennar State

Group 1					
1	Micro	Female	Agriculture	Yes	Yes
2	Micro	Female	Agriculture	Yes	Yes
3	Micro	Female	Agriculture	Yes	No
4	Micro	Female	Agriculture	No	No
5	Micro	Female	Agriculture	No	No
6	Micro	Male	Agriculture	Yes	Yes
7	Micro	Male	Agriculture	Yes	Yes
8	Micro	Male	Agriculture	Yes	No
9	Micro	Male	Agriculture	No	No
10	Micro	Male	Agriculture	No	No
Group 2					
1	Small	Female	Agriculture	Yes	Yes
2	Small	Female	Agriculture	Yes	No
3	Small	Female	Agriculture	No	No
4	Medium	Female	Agriculture	Yes	No
5	Medium	Female	Agriculture	No	No
6	Small	Male	Agriculture	Yes	Yes
7	Small	Male	Agriculture	Yes	No
8	Small	Male	Agriculture	No	No
9	Medium	Male	Agriculture	Yes	No
10	Medium	Male	Agriculture	No	No

While Nile State

Group 1					
1	Micro	Female	Agriculture	Yes	Yes
2	Micro	Female	Agriculture	Yes	Yes
3	Micro	Female	Agriculture	Yes	No
4	Micro	Female	Agriculture	No	No
5	Micro	Female	Agriculture	No	No
6	Micro	Male	Agriculture	Yes	Yes
7	Micro	Male	Agriculture	Yes	Yes
8	Micro	Male	Agriculture	Yes	No
9	Micro	Male	Agriculture	No	No
10	Micro	Male	Agriculture	No	No
Group 2					
1	Small	Female	Agriculture	Yes	Yes
2	Small	Female	Agriculture	Yes	No
3	Small	Female	Agriculture	No	No
4	Medium	Female	Agriculture	Yes	No
5	Medium	Female	Agriculture	No	No
6	Small	Male	Agriculture	Yes	Yes
7	Small	Male	Agriculture	Yes	No
8	Small	Male	Agriculture	No	No
9	Medium	Male	Agriculture	Yes	No
10	Medium	Male	Agriculture	No	No

Red Sea State

Group 1					
1	Micro	Female	Non-Agriculture	Yes	Yes
2	Micro	Female	Non-Agriculture	Yes	Yes
3	Micro	Female	Non-Agriculture	Yes	No
4	Micro	Female	Non-Agriculture	No	No
5	Micro	Female	Non-Agriculture	No	No
6	Micro	Male	Non-Agriculture	Yes	Yes
7	Micro	Male	Non-Agriculture	Yes	Yes
8	Micro	Male	Non-Agriculture	Yes	No
9	Micro	Male	Non-Agriculture	No	No
10	Micro	Male	Non-Agriculture	No	No
Group 2					
1	Small	Female	Non-Agriculture	Yes	Yes
2	Small	Female	Non-Agriculture	Yes	No
3	Small	Female	Non-Agriculture	No	No
4	Medium	Female	Non-Agriculture	Yes	No
5	Medium	Female	Non-Agriculture	No	No
6	Small	Male	Non-Agriculture	Yes	Yes
7	Small	Male	Non-Agriculture	Yes	No
8	Small	Male	Non-Agriculture	No	No
9	Medium	Male	Non-Agriculture	Yes	No
10	Medium	Male	Non-Agriculture	No	No

River Nile State

Group 1					
1	Micro	Female	Non-Agriculture	Yes	Yes
2	Micro	Female	Non-Agriculture	Yes	Yes
3	Micro	Female	Non-Agriculture	Yes	No
4	Micro	Female	Non-Agriculture	No	No
5	Micro	Female	Non-Agriculture	No	No
6	Micro	Male	Non-Agriculture	Yes	Yes
7	Micro	Male	Non-Agriculture	Yes	Yes
8	Micro	Male	Non-Agriculture	Yes	No
9	Micro	Male	Non-Agriculture	No	No
10	Micro	Male	Non-Agriculture	No	No
Group 2					
1	Small	Female	Non-Agriculture	Yes	Yes
2	Small	Female	Non-Agriculture	Yes	No
3	Small	Female	Non-Agriculture	No	No
4	Medium	Female	Non-Agriculture	Yes	No
5	Medium	Female	Non-Agriculture	No	No
6	Small	Male	Non-Agriculture	Yes	Yes
7	Small	Male	Non-Agriculture	Yes	No
8	Small	Male	Non-Agriculture	No	No
9	Medium	Male	Non-Agriculture	Yes	No
10	Medium	Male	Non-Agriculture	No	No

Northern State

Group 1					
1	Micro	Female	Non-Agriculture	Yes	Yes
2	Micro	Female	Non-Agriculture	Yes	Yes
3	Micro	Female	Non-Agriculture	Yes	No
4	Micro	Female	Non-Agriculture	No	No
5	Micro	Female	Non-Agriculture	No	No
6	Micro	Male	Non-Agriculture	Yes	Yes
7	Micro	Male	Non-Agriculture	Yes	Yes
8	Micro	Male	Non-Agriculture	Yes	No
9	Micro	Male	Non-Agriculture	No	No
10	Micro	Male	Non-Agriculture	No	No
Group 2					
1	Small	Female	Non-Agriculture	Yes	Yes
2	Small	Female	Non-Agriculture	Yes	No
3	Small	Female	Non-Agriculture	No	No
4	Medium	Female	Non-Agriculture	Yes	No
5	Medium	Female	Non-Agriculture	No	No
6	Small	Male	Non-Agriculture	Yes	Yes
7	Small	Male	Non-Agriculture	Yes	No
8	Small	Male	Non-Agriculture	No	No
9	Medium	Male	Non-Agriculture	Yes	No
10	Medium	Male	Non-Agriculture	No	No

Key informant interviews – interview guide

THANK YOU FOR AGREEING TO THIS INTERVIEW.

As part of a research project on the adoption of clean energy among Small and Medium Enterprises in the Arab world (Morocco, Tunisia, Egypt, Lebanon, Sudan, Jordan) carried out by the Economic Research Forum, We are conducting these interviews to better understand the barriers and opportunities of an energy transition and the role for SMEs/MSMEs. We also hope to understand the opportunities an energy transition presents for female and youth employment.

WE HAVE A SERIES OF QUESTIONS REGARDING THE ENERGY TRANSITION IN SUDAN. THE ENERGY TRANSITION REFERS TO THE SHIFT FROM FOSSIL FUEL-BASED SYSTEMS OF ENERGY PRODUCTION AND CONSUMPTION TO RENEWABLE ENERGY SOURCES.

Interviewer to ask the following:

DO YOU AGREE TO BE INTERVIEWED?

If "Yes":

DO I HAVE YOUR CONSENT TO RECORD?

1. Highlight/outline your involvement in the energy sector in Sudan?
2. Which energy technologies do you think would be most suitable in increasing access to electricity (energy) in Sudan?
    - Prompt 1: Do you think this technology(ies) will increase or decrease Sudan's energy security?
    - Prompt 2: Do you think, by adopting this technology(ies), Sudan will be able to achieve significant economic growth?
2. Are there existing laws or legislations that are conducive to the energy transition? If so, what are they?
3. Which laws or legislative amendments would be required to support or encourage an energy transition in Sudan?
    - What are the legal or institutional barriers to instituting these changes/amendments?
    - What are the political barriers?
    - What are the economic barriers?
2. Following up on your answer to Question 2, are there any laws or legislations designed to increase renewable energy adoption among MSMEs? If so, what are they?
    - If not, why is that?
        - Prompt: Do existing legislations treat MSMEs and large enterprises the same?

2. What are your thoughts on the potential impacts of broader adoption of decentralized renewable energy technologies?
    . On MSMEs?
    . What would be the impacts on local communities?
    . Are there any potential implications of decentralized systems on state-citizen relationships?
2. Considering the current conflict, are there advantages to adopting decentralized renewable energy systems over conventional infrastructure energy systems?
    . Are there specific sectors that would benefit more than others
    . How can it be adopted? and/or financed?
2. What are the main opportunities and barriers for Sudan companies in the energy transition?
3. What are the expected impacts of energy transition on the labor market (skills needed, jobs loss and creation, wages, etc…) specifically for women and youth