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Catalysing Africa's Solar Markets

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ETHIOPIA - JOB CREATION THROUGH OFF-GRID ENERGY ACCESS

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ema ENERGY MARKET ACCELERATOR ETHIOPIA

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Abbreviations

AfDB	African Development Bank
DBE	Development Bank of Ethiopia
ESA	Ethiopian Standards Agency
ETB	Ethiopian Birr
GESI	Gender and Social Inclusion
GIZ	German Society for International Cooperation (Deutsche Gesellschaft für Internationale Zusammenarbeit)
GoE	Government of Ethiopia
LG	Lighting Global
MDCL	Market Development (for Renewable Energy and Energy Efficiency) Credit Line
MFI	Microfinance institution
MoFED	Ministry of Finance and Economic Development
MoWIE	Ministry of Water, Irrigation and Energy
MSMEs	Micro, Small, and Medium Enterprises
NBE	National Bank of Ethiopia
NEP	National Electrification Program
PAYG	Pay-as-you-go
PV	Photovoltaic
RBF	Results-based Financing
RTC	Rural Transformation Centres
SAS	Stand-Alone solar

Executive summary

Ethiopia has a fast-growing economy and a large workforce but is struggling to meet the demands of its labour market. Unemployment is reported to average 19.1% in some urban areas.[1] Additionally, over half of the youth in Ethiopia are unemployed or underemployed. Women see higher unemployment figures, with unemployment levels reaching double that of men in some urban areas. With 600,000 new workers entering the labour force every year, the economy needs to grow to provide opportunities for hundreds of thousands of people.[2]

The government, through the Jobs Creation Commission (JCC), aims to explore the untapped job creation potential of micro, small, and medium enterprises (MSMEs) through productive use of energy (PUE) technologies. MSMEs are the backbone of many economies and, in Ethiopia, these businesses created 880,000 new jobs between 2018 and 2019 alone.[3] Therefore, MSMEs present a viable avenue to close the employment gap, but they must first be positioned to scale their operations. MSMEs have the potential to grow by leveraging PUE technologies to enhance their business activities.

PUE technologies have been defined as solar powered systems that enable agricultural, commercial, or industrial activity [4]. PUE technologies are usually targeted towards populations that are off-grid or have unstable grid connections. PUE technologies can be powered via stand-alone solar panels attached to the appliance or through mini-grid connections. Once integrated into the business, PUE technologies can increase income levels and create jobs since they drive higher outputs, open up new income streams, and increase sales revenues.

Across three high-potential value chains, PUE technologies present opportunities to mechanize tasks and expand production capacity, creating on the order of 190,000 jobs.[5] Our analysis focused on three value chains that have the highest potential for impact and job growth – horticulture, wheat, and milk. We focused on key bottlenecks within those value chains and we estimated the job creation potential by applying a set of assumptions based on primary consultations on the ground and secondary research.[6]

- **Horticulture: Introducing solar water pumps in the horticulture value chain has the potential to meet a large irrigation need and would help create approximately 130,000 new jobs across the value chain.** Horticulture is a key farming activity in Ethiopia, but a lack of adequate water supply is a major constrain to production.[7,8] Uptake of solar water pumps can boost horticulture production several fold as farmers can extend growing into the dry season. As production levels increase, additional jobs are created across the horticulture value chain from sales to processing.[9]
- **Wheat: PUE solutions can address challenges of unreliable power and create approximately 50,000 jobs across the wheat value chain.** Grain milling and the processing of baked foods are prevalent activities in the food and processing industry in Ethiopia.[10] However, MSMEs are using

[1] Belay Felek (2020), Assessment of Unemployment in Dire Dawa Administration: Trends and Current conditions, [Link]
[2] USAID Feed the Future and CARE (2018), Labor Market Assessment Report, [Link]
[3] Precise Consult International (2020), Creating Jobs through Off-grid Energy Access
[4] IFC PULSE report, 2019
[5] Please not that job estimates are highly variable, and we focus on orders of magnitude
[6] Primary consultations conducted in the Amhara and Oromia regions
[7] Productive use of energy in Uganda, *Learnings from the Uganda Off-Grid Energy Market Accelerator*
[8] Precise Consult International (2020), Creating Jobs through off grid Energy Access
[9] Consultations with MSMEs that utilize PUE technologies
[10] Jobs Creation Commission (2019), Plan of Action for Job Creation 2020 - 2025

expensive technologies with unreliable power which reduces production levels.[11] Some estimates suggest that solar powered mills can boost average production levels by 25%.[12]

- **Milk: PUE in milk chilling from source to retail can address challenges of spoilage and wastage and can create an estimated 11,000 jobs.** Dairy farmers in Ethiopia produce about 4 billion litres of milk per year, however an 20 – 35% of all the milk produced is wasted primarily due to a lack of efficient cooling mechanisms.[13] In retail, MSMEs involved in food and beverage handling can use PUE technologies like solar-powered refrigerators, freezers, and cold rooms to reduce the risk of milk contamination and to preserve and extend the shelf life of milk.[14]

While select value chains demonstrate strong potential for job creation through the integration of PUE technologies, the market continues to see barriers limiting their uptake and therefore the potential scale of MSMEs. We evaluated these challenges from both the supply and demand side. Supply-side barriers affect PUE companies and slow down their ability to sell and distribute PUE technologies, while demand-side challenges hinder MSME access to PUE technologies. Supply and demand side challenges range from PUE companies not being able to access sufficient forex to import PUE technologies, to a lack of adequate information for MSMEs on PUE technology offerings, their functionalities, and where they can purchase these technologies from.[15]

Based on key market challenges, we make the following recommendations to help increase access to PUE technologies and hence create jobs.

- **Replicate previously successful foreign currency financing interventions and advocate for prescribed funding towards PUE technologies within existing initiatives.** Given forex restrictions in Ethiopia, PUE companies lack the much-needed hard currency to import new products. The forex challenge in Ethiopia has been partially addressed within the off-grid sector through initiatives such as the World Bank's Market Development Credit Line (MDCL), a USD 45 million facility administered by the Development Bank of Ethiopia (DBE), which extended guaranteed access to concessional forex loans for up to two years to eligible standalone solar (SAS) companies importing products.[16] The JCC can explore opportunities like this through targeted partnerships as well as advocating for prescribed funding allocations within these facilities towards PUE technologies.

- **Encourage additional blended finance facilities for PUE technologies.** An IFC study showed that PUE devices such as solar pumps, wheat milling, and dairy chilling are associated with relatively short pay-back periods of between 12-24 months and positive IRRs for MSMEs, which should translate into favourable lending economics for investors.[17] Blended finance, either through the use of concessional low interest capital or guarantees to financial institutions would encourage more lending for PUE technologies and can be used to demonstrate favourable lending economics. The JCC can enable more blended finance by encouraging international investors to explore these mechanisms within the context of Ethiopia. The JCC should shed more light on the local legal

[11] Ibid
[12] Consultations with MSMEs that utilize PUE technologies
[13] The Conversation (2018), Why Ethiopia's dairy industry can't meet growing demand for milk, [Link]
[14] F.A Chekol et at (2019), Food handling practice and associated factors among food handlers in public food establishments, Northwest Ethiopia, [Link]
[15] 67% of the MSMEs interviewed lack information on how to use PUE technologies and to integrate them into their production cycles
[16] MoWIE (2019), NEP 2.0
[17] Lighting Global, IFC, (2019), The market opportunity for productive use leveraging solar energy (PULSE) in Sub-Saharan Africa

mechanisms through which they can be created such as which government agencies to partner with and how to seek approval.[18]

- **Advocate for PUE companies to be put on the forex priority list.** The JCC can build awareness of the benefits of PUE technologies and advocate to include PUE companies in the forex priority list to increase the importation of these technologies which has been shown to create increased jobs. Moreover, the JCC can advocate to allow PUE distributors to access supplier credit, typically only reserved for manufacturing, to ease cash cycles and to allow foreign suppliers to provide goods on credit to PUE distributors while they wait for forex allocation to pay suppliers.
- **Continue to close information gaps for PUE companies.** Market consultations show that PUE companies have inadequate knowledge on end-user demand of PUE technologies[19]. The JCC can partner with PUE manufacturers, the Ethiopian Solar Energy Development Association (ESEDA), and other industry associations to develop training programs that train PUE companies on the functionality of specific technologies across different sectors. For example, in the case of solar pumps, suppliers can train PUE companies on understanding the type of agriculture and water infrastructure needed (e.g., availability and depth of water table) to ensure proper utilization of solar water pumps for irrigation. Trainings should be organized periodically to ensure new market entrants are included in the training. Partnerships between the JCC, technology suppliers, and associations can also serve to create market linkages and open new market sectors. The Energy Access Explorer – geospatial data maps, being developed by ACE TAF can be leveraged to identify market opportunities for PUE companies.
- **Create an enabling environment for demand-side subsidies (DSS) which can play a role in addressing the low affordability associated with PUE technologies.** DSS are subsidies that directly reduce the price of a product as opposed to supply side subsidies which are provided to companies in order to overcome market entrance risks and reach hard to reach populations.[20] Tackling the willingness to pay (WTP) issue is challenging for MSMEs that have low incomes. To address this affordability gap, the JCC can collaborate with government agencies such as the Ministry of Finance and Economic Development (MoFED) and development partners such as the World Bank, who are already exploring DSS in the context of electrification, to develop working groups to design DSS programs that target increased uptake of PUE technologies.

The recommendations highlighted in this report can play a key role in scaling the PUE sector and the generation of new employment opportunities in Ethiopia. The JCC may not be able to tackle all these issues alone but can form partnerships with a range of other strategic stakeholders. Therefore, strategic and coordinated efforts between the JCC and various stakeholders including government agencies, private sector players, development partners, investors, and other relevant groups are required to enable targeted interventions to support the growth of the sector.

[18] For example, the Rocky Mountain Institute and the IKEA Foundation explored a facility for PUE technologies in Ethiopia
[19] Consultations with MSMEs that use PUE technologies and off-grid energy experts
[20] For more information on the details of demand-side subsidies, please see the ACE report on Demand Side Subsidies from 2020 URL

Introduction

Ethiopia has a fast-growing economy and large workforce, but is struggling to meet the demands of its labor market. Ethiopia ranks 7th in gross domestic product (GDP) across Africa and 2nd in East Africa[21]. With a population of 112 million people in 2019, it is the second most populous country on the continent. The country's labor force stood at 53 million people in 2018, with 600,000 individuals entering the workforce every year.[22] However, the economy is not generating enough jobs for the size of the workforce. While different sources offer varying data on the unemployment rate, it is reported to average 19.1% in most urban areas.[23]

19.1%	2x	25.3%
Unemployment rate	**Men employed compared to women**	**Youth unemployment rate**

The private sector, specifically the Micro, Small, and Medium Enterprises (MSME) base, has the potential to absorb a large proportion of the workforce, but needs to be positioned for growth. Micro, small, and medium-sized enterprises are the second-largest employers in Ethiopia, creating 880,000 new jobs between 2018 and 2019 alone.[24] MSMEs help diversify the country's economic base, promote innovation, help deliver goods and services, and can be a powerful force for integrating youth and women into the workforce. However, the majority of MSMEs operate on the smaller end of the scale; in Addis Ababa alone, 75% of MSMEs are micro-enterprises and 21% are small enterprises.[25,26] Additionally, many MSMEs are set up informally and are engaged in low-productivity activities. To remain a primary driver of new employment opportunities, the MSME base needs resources to grow and expand its production capacity and generate new jobs.

Access to reliable energy, both grid and off-grid, remains a key constraint to increasing the production and business capacity of MSMEs. At the national level, access to energy in Ethiopia remains low. Only 33% of the population is connected to the grid, with coverage largely concentrated in urban areas.[27] Additionally, connection procedures to rural areas are costly, for example, the national utility takes 95 days to connect long-distance end-users at an average cost of USD 1,000 per connection.[28] For MSMEs, low energy access is coupled with frequent power outages which interrupt business operations. In light of this challenge, the Government of Ethiopia (GoE) has made off-grid energy a priority and seeks to achieve universal energy access through 35% of all connections being entirely off-grid by 2025. Currently, only 11% of the population is fully electrified by an off-grid source such as solar, leaving a current access gap of 24%.[29]

The uptake and application of off-grid solar solutions, specifically productive-use energy (PUE) technologies, can support a range of MSME economic activities and create jobs in Ethiopia. PUE technologies in this context are solar powered systems that enable agricultural, commercial, or industrial

[21] Statista (2020), African Countries with the highest Gross Domestic Product (GDP) in 2020
[22] USAID Feed the Future and CARE (2018), Labor Market Assessment Report, [Link]
[23] Belay Felek (2020), Assessment of Unemployment in Dire Dawa Administration: Trends and Current conditions, [Link]
[24] Precise Consult International (2020), Creating Jobs through Off-grid Energy Access. Note that moreover, the off-grid sector in East Africa has created over 350K jobs as per GOGLA
[25] Micro-enterprises in Ethiopia employ on average less than 5 employees while small enterprises employ 6 – 30 employees
[26] ADA (2017), Small and Growing Businesses in Ethiopia
[27] ESMAP (2018), Ethiopia: Beyond Connections
[28] SNV (2016), Off-grid Rural Electrification in Ethiopia Link
[29] MoWIE (2019), National Electrification Program 2.0

activity.[30] PUE technologies are usually targeted towards populations that are off-grid or connected to an unreliable grid. PUE technologies are powered via stand-alone solar panels attached to the appliance or through minigrids. PUE technologies can increase income levels since they drive higher outputs which increases sales revenues. This in turn generates labor demand to support resulting increases in operational scale. The potential for PUE exists across a range of sectors and value chains including: (a) agricultural applications such as irrigation; (b) industrial applications such as agro-processing, textile processing, and construction; and (c) services applications such as cold storage in retail services and the electrification of health centers.

There are a number of ongoing initiatives that seek to promote the uptake of PUE by MSMEs in Ethiopia and to enable job creation, but the market lacks coordinated intervention efforts[31]. On the public sector side, the GoE has conducted multiple assessments to inform value chain prioritization for job creation and has rolled out vocational training to address youth unemployment gaps. Additionally, the Ministries of Energy and Agriculture have undertaken mapping exercises of geographical clusters to inform the design of public PUE-focused programs. On the donor side, development organizations are extending financial and technical support to MSMEs to boost business growth and are working to accelerate the deployment of PUE. The United States African Development Foundation (USADF), for example, has funded three private minigrid developers to install minigrids that can support PUE technologies in rural parts of the country. However, efforts across the country remain fairly disconnected, leaving the need for a more targeted and coordinated approach to support local MSMEs to adopt the right PUE technologies and create employment.

This report focuses on the opportunity to drive job creation through the adoption of productive use technologies by MSMEs in Ethiopia, and targeted interventions that can support this objective. Specifically, it seeks to answer the following questions:

1. What is the current state of Ethiopia's workforce and MSME economic activity, and what does PUE uptake and use look like across major sectors?
2. Based on workforce trends, what key value chains present opportunity for MSME adoption of PUE technologies to drive job creation?
3. What barriers inhibit the scale of PUE technologies and constrain MSMEs in job creation?
4. What targeted interventions, including policy recommendations, can support MSME uptake of PUE and the creation of jobs?

The report was prepared for the Ethiopian Jobs Creation Commission (JCC) and aims to inform a broad audience composed of public, private, and donor stakeholders. The report follows an assessment conducted by the JCC that demonstrated the job creation potential of primary sectors in Ethiopia, including energy. Research for this report was carried out via desk research and direct consultations with MSMEs and PUE companies based in the Amhara and Oromia regions, and with key stakeholders from local Government agencies including the Ministry of Water, Irrigation and Energy (MoWIE), the Agricultural Transformation Agency (ATA), and the Ethiopian Energy Authority (EEA).

The report aims to inform the discussion for job creation in Ethiopia and to introduce PUE technologies to the conversation. This includes informing the JCC's Plan of Action for Job Creation (PAJC), which seeks to identify the set of policies and programs required to foster job creation and transform

[30] IFC PULSE report, 2019
[31] Various sources, as referenced on page 28

the business ecosystem to build vibrant and growth-oriented MSMEs. Other primary audience members include government agencies such as the Ministry of Water, Irrigation and Electricity (MoWIE) and a broader thematic community of public actors seeking to contribute to proposed interventions. The report is also useful for private sector companies, MSMEs, organizations looking to mechanize specific value chains, and financiers, seeking ways to invest, advocate for, and catalyze the growth of MSMEs and job opportunities in the country.

Jobs and the productive use of energy in Ethiopia

The state of the workforce and economic activity in Ethiopia

At the macroeconomic level, Ethiopia's workforce can be categorized into the agriculture, industry, and services sectors, with over two-thirds of the working population – 67% – engaged in agricultural activities in 2018. The remaining one-third of the workforce is split between services (23% of the total population) and industry (10% of the total population).[32] While industry has the lowest share of the workforce, investment in the sector generated the largest percentage of jobs in 2019, with 64% of new employment opportunities created in manufacturing and 16% in construction.[33, 34] Additionally, the distribution of the workforce has been slowly shifting away from agriculture over the past decade. In 2008, 75% of the working population was involved in agriculture which is higher than the percentage today.[35] The shift towards services and industry is a result of increased public and private investment into sub-sectors such as manufacturing, construction, and retail, with the spread of MSMEs reflecting this market trend.

Across the three macro sectors and within key value chains, MSMEs continue to struggle with low productivity and underutilization. In agriculture, for example, nearly 90% of the sector's workforce are smallholder farmers with an average farm size of 0.9 hectares.[36] However, smallholder farmers contribute only ~30% of Ethiopia's food production and most farmers sell less than a quarter of their produce. In agro-processing, only 6% of domestically consumed produce is processed.[37] In the services sector, despite most MSMEs having low energy needs (Tier 1 to 3 energy), many off-grid MSMEs are still relying on fossil fuels like kerosene lamps or costly diesel-powered products.[38]

[32] World Bank Data (2018), Employment in [sector] (% of total employment) (modeled ILO estimate) - Ethiopia
[33] The other 20% of jobs created were reported to be in Agriculture and Forestry (7.2%), less than 0.1% in Mining and Education, and the rest spread out across different sectors.
[34] Precise Consult International (2020), Creating Jobs through Off-grid Energy Access
[35] World Bank Data (2018), Employment in [sector] (% of total employment) (modeled ILO estimate) - Ethiopia
[36] Precise Consult International (2020), Creating Jobs through Off-grid Energy Access
[37] Jobs Creation Commission (2019), Plan of Action for Job Creation 2020 - 2025
[38] Tier is the amount of energy used by the end-user, measured from 0 to 5. Tier 0 entails no access while tier 5 entails maximum access and use. The MTF is a framework to measure energy access that was launched by the Energy Sector Management Assistance Program (ESMAP) in 2015. The MTF measures energy access based on seven attributes (namely capacity, availability, reliability, quality, affordability, formality, and health and safety) and determines energy access levels on a scale of 0 to 5. Globally, most governments use Tier 1 access as the minimum

Table 1 Overview of key macroeconomic sectors and related PUE opportunities

Key statistics	Sector-level challenges	PUE opportunity for MSMEs
Agriculture		
67% of the workforce employed in 2018. In rural areas the proportion is much larger, with 83% of the population engaged in agriculture.[39] **Key value chains include:** • Horticulture (fruits & vegetables) • Cereals (wheat, barley, maize, sesame) • Pulses (e.g. beans) and oilseeds • Poultry	**Lack of mechanization** as only 4% of smallholder farmers have access to agricultural machinery due to the costs of acquisition and maintenance.[40] **Lack of adequate storage facilities** and use of poor or manual post-harvest techniques e.g. sun drying of fruits leads to harvest losses averaged at 25 - 30% across different crops. **Low income levels** with farmers generating an average of $1,657 annually, with seasonal fluctuations.	The small scale of farming, low income levels, and **constrained cashflows limit the potential for new employment opportunities**, with farmers relying instead on unpaid family labor. **Agriculture presents high potential to leverage off-grid PUE solutions to mechanize tasks and increase outputs and incomes.**
Key statistics	**Sector-level challenges**	**PUE opportunity for MSMEs**
Services		
23% of the workforce employed in 2018. Jobs in the sector are projected to increase at a higher rate due to increased domestic investment. Key value chains / sub-sectors: • Commercial: retail, real estate, hospitality, transport, financial services • Public**:** Education, health services	**Lack of adequate storage facilities** mainly affecting retailers and health institutions – e.g., food retailers are exposed to a high risk of food contamination due to lack of equipment and health institutions lack cold chains to store blood, medicines, and vaccines. **Constant power outages** as majority of the education and health institutions require lighting to prolong working hours	The use of PUE in the sector presents **potential to prolong operational hours for MSMEs and public institutions, and to preserve the cold chain** in relevant storage and transportation activities.
Key statistics	**Sector-level challenges**	**PUE opportunity for MSMEs**
Industry		

[39] Precise Consult International (2020), Creating Jobs through Off-grid Energy Access
[40] Ibid

Employs 10% of the workforce. The sector relies heavily on electric-powered machinery; however, production output remains low due to challenges listed below. Key sub-sectors: • Manufacturing • Construction • Textile and apparel processing • Renewable energy • Mining	**High capital costs of machinery:** The sector is capital intensive, primarily manufacturing, mining, and construction. **Outdated technology:** Majority of MSMEs are using old and inefficient technology which limits the production capacities of the equipment **Large skills gap:** The industry sector is labor-intensive, relying on a range of low-, semi-, and high-skilled labor. However, access to skills training remains low, leading to labor shortage, particularly in the manufacturing sector	**The sector presents potential to expand the local manufacturing and export capacity of local MSMEs.** This can be done via access to reliable energy and technologies, as well as through upskilling the MSME workforce, particularly targeting youth and women

Case box 1: Showcasing the higher levels of unemployment in Ethiopia among women and the need for increase PUE adoption to tackle this

Women in Ethiopia have fewer employment opportunities and majority of them are underpaid

75%	61%	3x
of women participated in the labor force as of 2013	**of unpaid workers in Ethiopia are women**	**More men employed in urban areas than women**

Women face different socio-culture stereotypes that hinder them from starting and sustaining businesses. These primarily include:

- Low access to finance as some financial institutions are hesitant to offer loans to women because they perceive women to lack skills to adequately manage income generating activities
- Customers are biased toward purchasing products or paying for services from male-owned businesses

Learnings from studies in comparable markets demonstrate that uptake of PUE technologies is a potential avenue to create employment opportunities and increased income levels for women

India

Women have embraced various PUE technologies in poultry and horticulture to increase agricultural productivity levels. Women are running poultry farms and using solar panels for lighting. This allows chicks to grow faster due to long hours of light and for chickens to lay more eggs. Some women have also constructed vegetable chilling centers that are made of insulated containers and powered by solar panels.

Sudan

The Sudanese government has implemented PUE programs that target female livelihoods to increase agriculture productivity. The government has installed over 15 solar pumps to improve seasonal irrigation of Jubrakas, which are collective plots of land managed by groups of 10 to 12 women. This has helped to diversify household food crops particularly in the dry season, and supported women's increasing role as leaders of the community in managing and producing food.

Tanzania

PUE companies are using female sales agents to increase PUE sales. Women-owned companies such as Solar Sister uses female sales agents to distribute PUE technologies across the country, targeting mainly female entrepreneurs. These female sales agents also provide business development support to women using their equipment. This model has helped create jobs for women and studies show that women can sell to twice as many households as compared to men attributable to enhanced network effects.

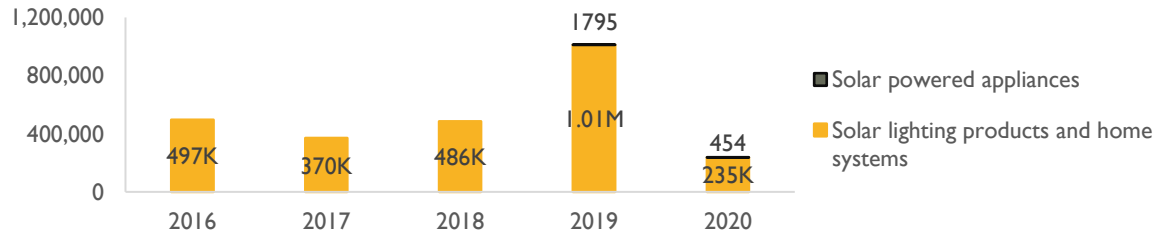
These examples highlight a few cases in which the increased uptake of PUE technologies can benefit women.

Source: Jobs Creation Commission, Plan of Action for Job Creation 2020 - 2025 UOMA (2020), Productive use of energy in Uganda; Precise Consult International (2020), Creating Jobs through Off-grid Energy Access, OCA research and analysis

The productive use landscape and the state of uptake among MSMEs

The level of sales of productive use technologies has been low in Ethiopia compared to household products; according to GOGLA only ~2,300 solar appliances were distributed between 2019 and 2021.[41] Close to 2 million standalone household products such as solar lanterns and solar home systems have been distributed since 2016.[42] In comparison, solar appliance uptake has seen a relatively slower ramp up.[43] A key driver of the solar appliance product uptake has been targeted financing interventions such as the World Bank Market Development Credit Line (MDCL), which prescribed funding allocations from the MoWIE for the distribution of solar technologies. Some of the larger systems distributed through MDCL had a peak power of 40Wp - 100Wp and are capable of powering solar appliances like fridges, freezers, and egg incubators.[44],[45]

Figure 1 Volumes of solar products sold from GOGLA affiliates in Ethiopia, 2016 – 2020[46]



[41] GOGLA sales summaries (2016 – 2020)
[42] Solar appliances are devices that require solar energy to function for example TVs, fans, and refrigerators
[43] OCA research and analysis
[44] Wp means Watt peak
[45] Signify (2019), Mapping the off-grid solar market in Ethiopia
[46] GOGLA sales summaries (2016 – 2020); Signify (2019), Mapping the off-grid solar market in Ethiopia, OCA analysis

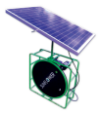
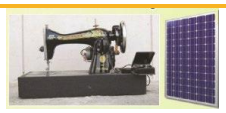
**Sales from 2020 are not exhaustive; the graphs represent solar powered appliance sales from January 2019 – June 2020. No adequate data from this source is available for solar power appliances (PUE technologies) sold before 2019.*

The current PUE landscape consists primarily of standalone solar (SAS) technologies and a few minigrid solutions that support household, community, and commercial applications. SAS systems are powered by solar panels that come with the productive use technology system. Primary standalone technologies in the Ethiopian market include televisions and refrigerators for household use, and business-specific technologies like solar-powered water pumps. High-capacity technologies like agro-processing machinery are yet to penetrate the market. Solar pumps are the most common standalone PUE technologies due to the GoE's efforts to increase water access for agriculture in rural areas (see the policy and recommendations section for more details on existing government interventions). MSMEs are also increasingly taking up PUE technologies for mobile charging and for powering low-energy appliances like hair clippers. On the minigrid side (elaborated more below), they are much more nascent. Known minigrids are approximately 15 in number and primarily driven by grant-funded efforts.

STANDALONE TECHNOLOGIES ELABORATION

Standalone PUE suppliers are primarily international companies who partner with local distributors and retailers due to retail trade restrictions on foreign-owned companies. Major players include d.light, Greenlight Planet, ENGIE Mobisol, among others. Due to Ethiopian trade regulations, foreign-owned companies are not permitted to engage in retail activities, therefore, they partner with local distributors such as Solar Development, Green Scene Energy, Lydetco, and Vera International to manage on-the-ground operations from marketing to after-sales support. SAS component manufacturing, that is production of individual PUE technology parts, is almost non-existent in Ethiopia; active manufacturers are primarily engaged in the assembly of imported components or assembly kits.

Table 2 Key examples of PUE technologies and active suppliers in Ethiopia

Category	PUE technology and examples of MSME activities supported			
Agricultural use	 Water pump **Food production:** Increases water access **Coffee:** Runs coffee-washing machines	 Egg incubator **Poultry:** Hatches eggs in bulk	 Oil press **Edible oils:** Presses and pulps seeds e.g., sunflowers into edible oils	 Hammer mill **Cereals:** Processes various grains into flour
Industrial use	 Grinder **Construction:** Cuts metal into different shapes and sizes	 Sawing machine **Carpentry**: Cuts metal and wood into different shapes and sizes	 Block-making machine **Masonry:** Makes concrete bricks and blocks, and pavers	 Sewing machine **Textile and clothing**: Supports tailoring activities like the production and repair of apparel

Services use	 Refrigerator **Retail – FMCG[47], Hospitality**: Preserves the shelf life of food, beverages **Institutional - Health facilities**: Stores medical products like blood, vaccines, drugs	 Hair clippers **Retail - Salons:** Cuts hair	 TVs and radios **Retail - Entertainment:** Powers screens in restaurants, salons, small movie theatres, and other commercial spaces	 Batteries / chargers **Retail – Multiple:** Charges electrical appliances such as mobile phone and car batteries
General	 Security lights **Institutions - Multiple:** Provides out-door lighting, primarily at night	 Fans **Institutions – Multiple:** Provides indoor cooling and circulation of fresh air	 Water heaters **Institutions - Multiple:** Supplies hot water	

Example manufacturers and distributors in Ethiopia across technologies		
International companies	**Local distributors**	**Manufacturers / Assembly houses**
DAVIS & SHIRTLIFF, d.light, mobisol, sunking (A company of ENGIE)	RENSYS, SOLAR DEVELOPMENT, Green Scene, LYDETCO, Vera International, Acme Engineering and Trading Plc	NIWA, fosera, SUNTRANSFER

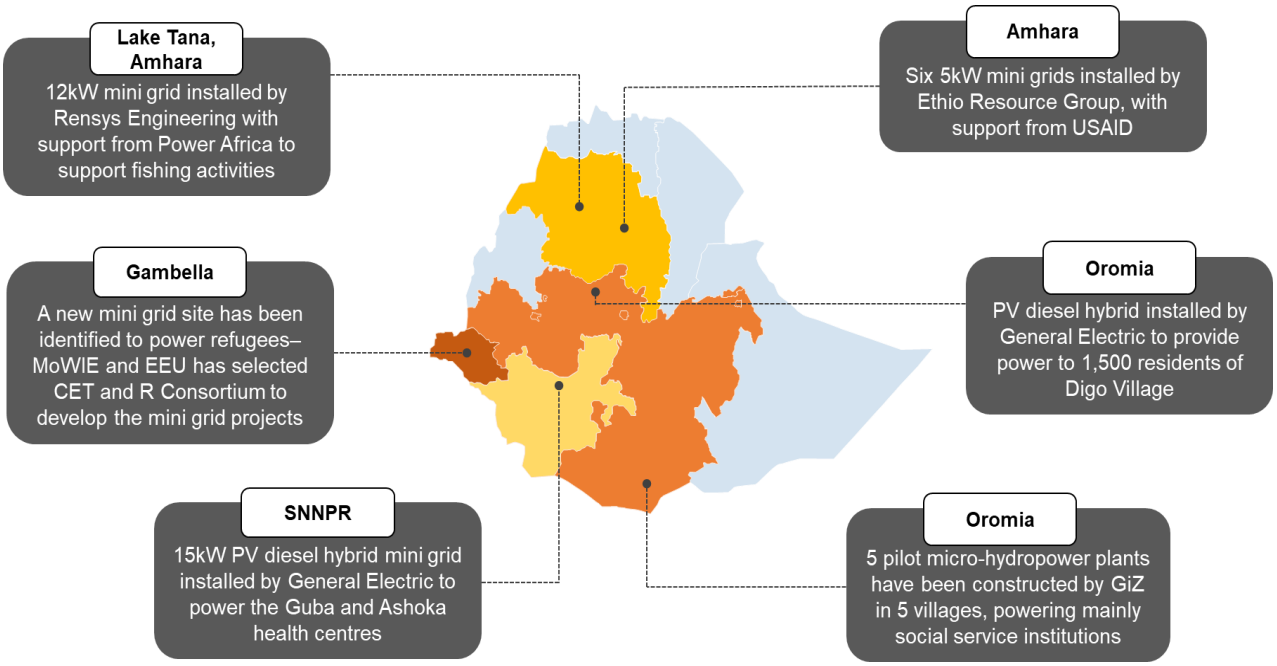
MINIGRID SECTOR

The minigrid landscape in Ethiopia is an even more nascent space than SAS; however, the new developed directive on licensing and tariffs is expected to increase minigrid development. Current studies show that only three minigrid developers have installed and operationalized solar-powered minigrids in Ethiopia, including: Ethio Resource Group (ERG), General Electric (GE), and Rensys Engineering.[48] Existing minigrids are primarily for institutional use such as powering health centers and commercial fishing activities around Lake Tana. Minigrids are severely underutilized; only ~10% of installed minigrid capacity is consumed and powers ~0.1% of Ethiopian households, who use the power for lighting and appliance charging.[49] Low minigrid uptake and development has been primarily due to underdeveloped licensing and tariff structures that did not offer clear guidance on how to charge customers and commercialize projects in the past. The first license was granted in June 2020 to the Ethio Resource Group and development partners such as Power Africa and the World Bank are actively engaging the government

[47] FMCG stands for Fast-moving Consumer Goods.
[48] OCA research and analysis
[49] Signify Foundation (2019), Mapping the off-grid solar market in Ethiopia

to explore optimal tariff rates that can ensure the commercial viability of productive uses of energy.[50,51] In light of the undeveloped licensing and tariff directives, the Ethiopian Energy Authority has recently drafted a new minigrid directive that clarifies minigrid licensing procedures, technical standards, quality of service and tariff regulations to encourage minigrid development, mainly from private developers.[52,53]

Figure 2 Landscape of operationalized minigrids across Ethiopia[54]



Opportunities for job creation through productive use technology

The nascency of the PUE sector in Ethiopia points towards the untapped potential of the market and the associated opportunities to create new jobs through MSMEs.

To demonstrate the potential for job creation through PUE, we conduct an analysis for three separate high-potential value chains to estimate the number of new jobs that can be created for a single MSME, which is then extrapolated to the national level. Across each value chain, we showcase the potential use of PUE technologies across its supply chain (which we define as (i) production; (ii) aggregation, transport, and storage; (iii) processing; and (iv) distribution and retail). Technologies profiled can be supported through either standalone solar or minigrid solutions; however, this report focuses primarily on the potential presented through standalone solar solutions given their relatively larger market traction in Ethiopia currently.

We define high-potential value chains as those that comprehensively meet a set of basic criteria, including:

[50] OCA consultations and analysis
[51] AfDB (2019), Market Assessment for the Off-grid Credit Facility
[52] Ethiopia Energy Authority (2020), Directive For minigrid – first draft [Link]
[53] Tigabu Atalo (2020), The Mini-Grid Law Progresses Slowly While Ethiopia Spends Millions for Diesel Power, [Link]
[54] Power Africa interview (2020); AfDB (2019), Market Assessment for the Off-grid Credit Facility; General Electric, Ethiopia – Developing Capacity, Consultations with an off-grid energy expert; GiZ, Energising Development Ethiopia, [Link]; GiZ (2018), Ethiopia boosts access to electricity and renewable energy, [Link]

- ***Relevance to productive-use technologies:*** Demonstrable presence of productive-use applications across the value chain, in Ethiopia or comparable markets.
- ***Ease of uptake by MSMEs:*** The productive-use applications do not present significant market, supply chain, or policy barriers to uptake for local businesses.
- ***Economic and earning potential:*** Employs or is projected to employ a sizeable proportion of the workforce across the value chain and presents opportunities to increase incomes earned.
- ***Gender and social impact:*** Presents opportunities for women, youth, and other vulnerable groups to be absorbed into new job roles.

Table 3 Value chain profiles and descriptions across key evaluation criteria

Criteria	Sectors and key value chains		
	Agriculture	**Industry**	**Services**
	Horticulture (focus on growing)	**Wheat (focus on processing)**	**Milk (focus on storage and retailing)**
Relevance to PUE technologies	• Majority of small holder farmers depend on rain for water supply; farmers can use solar water pumps to increase water supply • Pilots from Uganda show that solar water pumps for irrigation provide a strong business case for horticulture, allowing farmers to have more harvest cycles in a year[55]	• Small holder farmers are already using substitute technologies such as diesel-powered mills to mill wheat grains into flour[56]	• Milk retailors are already using substitute technologies like on-grid and diesel-powered cold chains and refrigerators
Ease of uptake by MSMEs	• Existing GoE initiatives such as Kobo integrated irrigation development project in Amhara and import tax waivers on solar pumps, and other efforts through the MoWIE and the ATA, are focusing on the mechanization of horticulture.[57,58]	• Auxiliary services such as packaging, storage, and cold chains that supplement and simplify agro-processing activities have been increasing in prevalence.	• Solar refrigerator prices are projected to fall as production costs drop due to improved technology that has a lower energy requirement, which can boost uptake among MSMEs.[59]

[55] UOMA (2020), Productive use of energy in Uganda, *Learnings from the Uganda Off-Grid Energy Market Accelerator*, [Link]
[56] Precise Consult International (2020), Creating Jobs through off grid Energy Access – A Desk Review
[57] GiZ (2020); Solar irrigation market analysis is Ethiopia, [Link]; The Kobo project is among the different solar water pump expansion projects implemented by the Agricultural Transformation Agency (ATA) across Ethiopia
[58] Signify (2019), Mapping the off-grid solar market in Ethiopia, [Link]
[59] GOGLA (2020), Off grid solar market trends report, [Link]

Economic and earning potential[60],[61]	• The value chain currently employs over 6.3M farmers. Jobs are projected to increase by 66% across all value chain activities by 2025 • Electrifying irrigation processes alone has the potential to unlock $1.2B in annual value by 2025	• The food & beverages processing industry currently employs 1.4M people. Jobs are projected to increase by 86% by 2025 with 400,000 new jobs generated through agro-processing alone • Replacing diesel mills, mitads (electric *injera* stoves), and bread baking ovens with solar powered substitutes can also unlock $1.05B in annual value by 2025	• Ethiopia currently has a milk shortage of 18 billion liters per year and the demand for dairy products is rising rapidly in Ethiopia which presents an opportunity for MSMEs in retail[62] • Milk cooling alone can unlock $1.3B in annual revenue by 2025 due to improved milk storage facilities leading to reduced milk spoilage and prolonged shelf life
Social impact	• Women predominantly engage in crop production as compared to men and they depend primarily on manual power [63] • Access to solar water pumps can help women increase their production levels	• Women predominantly engage in crop harvesting, storage, and processing, depending primarily on manual power • Access to PUE technologies such as millers, juicers and refrigerators can help women increase their productivity levels, manage their own businesses, and increase incomes. • Women can also free up time to engage in additional economic activities. Access to PUE gives them technological leverage	• Over 62% of street food vendors in Ethiopia are women; however, the majority of vendors lack storage equipment, putting their produce such as milk and its by-products at risk of contamination and spoilage.[64]

Analysis approach

Across these three value chains (horticulture, wheat, and milk), we analyzed the job potential across the supply chain.

[60] Jobs Creation Commission (2019), Plan of Action for Job Creation 2020 - 2025
[61] Rocky Mountain Institute (2020), Capturing the Productive Use Dividend, *Valuing the Synergies between Rural Electrification and Smallholder Agriculture in Ethiopia*
[62] The Conversation (2018), Why Ethiopia's dairy industry can't meet growing demand for milk, [Link]
[63] Nahausenay Abate (2017), The Roles Women on Agricultural Labor Conscriptions in Ethiopia, [Link]
[64] Temesgen Eliku (2016), Hygienic and Sanitary Practices of Street Food Vendors in the City of Addis Ababa, Ethiopia, [Link]

For each key activity along the supply chain, we assessed:

i. Key challenges that constrain efficiency and productivity of MSME activities
ii. Responsive PUE technologies that have been tested and validated in comparable markets, applying an average energy load (using the multi-tier framework (MTF) for measuring energy access[65]), and reported production capacity
iii. Projected increases in production at each stage of the supply chains, based on primary data from local MSMEs
iv. Projected number of new jobs created as a result of increased production, based on:
    a. Estimated numbers of MSMEs active in each value chain
    b. Projected numbers of new employees hired with increased production.
    c. An assumption that 2% of MSMEs at each stage of the value chain can or will adopt the technology[66]

$$\textbf{Number of jobs created} = \text{Number of MSMEs} \times \text{new jobs created via PUE technology} \times \text{\% of MSMEs that will adopt the technology}$$

We understand that this is a simplified calculation, but it aims to show order of magnitude impact that each of these technologies can have. Moreover, each job creates downstream jobs which are also highly variable which the calculations try to shed light on below. While there is some concern that PUE technologies might displace more manual jobs, on net they create more value and allow for higher quality jobs in the long-term.

To avoid repetition, we profile horticulture, wheat, and milk as case studies below but only focus on one high priority aspect of the value chain. Each of these three segments are highlighted in dark orange cells in each analysis table for easier reference.

Case study 1: PUE technologies creating jobs in horticulture; primarily through solar water pump uptake.

In this case study we focus on the horticulture value chain but place specific emphasis on "production" activities, which can be increased using solar water pumps. (See columns in orange in the table below)

Solar water pumps in particular have the potential to meet a large irrigation need and can help create approximately 130K new jobs in the horticulture value chain. A lack of an adequate water supply is a major constrain to horticulture production. Only 0.45% of the 4.9 million hectares of irrigable land is currently irrigated and only 2% is managed by smallholder farmers; the majority of the irrigated land is taken up by large-scale projects.[67] Additionally, only about 10% of off-grid agricultural households engage in irrigation activities, with approximately 13% of those households using motorized pumps.[68] Most small holder farmers depend on rainwater and are therefore vulnerable to droughts and the effects of climate change. Others depend on traditional water pumping systems powered by diesel or gasoline engines but the fuel cost and access constraints make the systems unreliable and expensive for rural communities.[69] Therefore, uptake of good irrigation practices has the potential to boost horticulture production, and with the adoption of solar

[65] The multi-tier framework (MTF) measures energy access in a tiered spectrum, from Tier 0 (no access) to Tier 5 (highest level of access)
[66] While 2% seems low, in horticulture it implies over 114,000 solar pumps (against less than 2,000 solar appliances sold in Ethiopia as recorded by GOGLA in 2019 and 2020)
[67] Precise Consult International (2020), Creating Jobs through off grid Energy Access
[68] Power Africa (2019), Ethiopia Off-grid Market Assessment
[69] Misrak Girma et al (2015), Feasibility study of a solar photovoltaic water pumping system for rural Ethiopia, [Link]

water pumps farmers can extend growing seasons into the dry season. Furthermore, as production levels increase, the number of employees at each supply-chain stage is estimated to double as MSMEs employ more workers to support larger farming operations, as shown in the analysis below.

Additionally, electric water pumps (including solar powered pumps) can unlock over USD 1.3B annual value in the next five years.[70] Based on an analysis by the Rocky Mountain Institute, the Growth and Transformation Plan II (GTP II) proposed to irrigate 4.1 million hectares of land by 2020 but the target has not been met.[71] However, if 13% of this land is irrigated by 2025, targeting mainly small holder farmers, total capital expenditure on electric water pumps is estimated to cost USD 99M. These capital costs are expected to generate USD 1.2B from value of production and USD 0.27M from utility revenue.[72]

Outside of production, poor post-harvesting and aggregation techniques such as sun drying, and a lack of adequate storage facilities are also leading to high post-harvest losses estimated at 25-30%. [73] Traders can reduce spoilage rates in the horticulture value chain through solar powered refrigeration, and MSMEs can substitute inefficient processing equipment with solar powered technologies such as solar dryers for drying fruits, and solar juicers for making fruit juice.

Horticulture value chain				
Supply chain for horticulture	**Production**	**Aggregation, Transport & Storage**	**Processing**	**Distribution & Retail**
Activities	Farming	Storage	Juicing and drying fruits	Vegetable and fruit selling
Challenges	Limited water supply as farmers rely on seasonal rainfall	Insufficient storage facilities as farmers transport produce to trade areas	Shortage of modern processing plants and insufficient and long manual processes	Spoilage leading to low product shelf life
Potential PUE technologies	Solar water pumps for irrigation	Solar freezers to prolong the shelf life of fresh product	Solar dryers to dry produce as a preservation technique; solar juicers to process fruits	Solar refrigerators for retailers
Estimated energy requirement / Tier[74]	Tier 3	Tier 3	Tier 3	Tier 3

[70] Rocky Mountain Institute (2020), Capturing the Productive Use Dividend, Valuing the Synergies between Rural Electrification and Smallholder Agriculture in Ethiopia
[71] Rocky Mountain Institute, Capturing Productive Demand, 2020
[72] Ibid
[73] Jobs Creation Commission (2019), Plan of Action for Job Creation 2020 - 2025
[74] Tier 3 technologies use between 1000 and 4000 watts per hour on a daily basis; watts per hour are units of energy used to measure the amount of energy generated

Average unit cost price (USD)		USD 750[75]	USD 800[76]	USD 32[77]	USD 800[78]
Estimated production capacity of technology		2 Ha[79]	50 – 100 liters[80]	20 – 120 kg of fresh produce[81]	50 – 100 liters[82]
Projected increase in production (%)[83]		300%[84]	300%[85]	300%[86]	300%[87]
Estimated number of MSMEs involved in activity		~5,700,000 farmers[88]	~5,700,000 farmers and cooperate unions[89]	~5 fruit processing companies[90,91]	~1,200,000 vendors[92,93]
Assumptions applied *per* MSME	**Average no. of employees**	5 farm workers[94]	7 farm and union workers[95]	20 fruit processing workers[96]	7 retail staff[97]
	Estimated no. of new employees	0.5 farm workers	0.5 farm and union workers	5 fruit processing workers	0.5 retail staff
Estimated number of jobs from increased production		60,000 farm workers	60,000 farm and union workers	>5 fruit processing workers (assumes one MSME adopts the technology)	12,000 retail staff

[75] OCA research and analysis
[76] CLASP (2019), The state of the off-grid appliance market, [Link]
[77] Abu Tefera et al (2013), Evaluation and demonstration of direct solar potato dryer, [Link]
[78] CLASP (2019), The state of the off-grid appliance market, [Link]
[79] OCA research and analysis
[80] CLASP (2019), The state of the off-grid appliance market, [Link]
[81] Mulatu Wakjira (2010), Solar drying of fruits and windows of opportunities in Ethiopia, [Link]
[82] CLASP (2019), The state of the off-grid appliance market.
[83] The projected increase in production (%) is estimated from the number of times the production increases as the MSMEs utilize the PUE technologies. These numbers are primarily obtained from consultations with MSMEs and secondary research
[84] Precise Consult International (2020), Creating Jobs through off grid Energy Access; Drip irrigation powered by technologies such as solar water pumps can increase farmer yields by 1x to 5x depending on crop and soil conditions. The 300% is an average of the increased farmer yields
[85] Consultations with MSMEs that utilize PUE technologies
[86] Mulatu Wakjira (2010), Solar drying of fruits and windows of opportunities in Ethiopia
[87] Consultations with MSMEs that utilize PUE technologies
[88] Julia Brethenoux et al (2012), Agribusiness Innovation in Ethiopia, [Link]
[89] Food and Agriculture Organization of the United Nations (2019), Postharvest extension bulletin, [Link]
[90] Ethiopian Investment Agency (2012), Investment opportunity profile for the production of fruits and vegetables in Ethiopia, [Link] Number is likely significantly higher
[91] This is an estimate number of MSMEs as the number of MSMEs involved in processing is very low as these activities barely exist at small scale
[92] Brenna Kirk et al (2019), Variety, Price, and Consumer Desirability of fruits and vegetables in 7 cities around the world, [Link]
[93] OCA research and analysis
[94] George Rapsomaniks (2015), The economic lives of smallholder farmers, [Link]
[95] Consultations with MSMEs that utilize PUE technologies
[96] Ibid
[97] Thomas Woldu et al (2013), Urban Food Retail in Africa: The Case of Addis Ababa, Ethiopia, [Link]

Case box 2: Insights on uptake of solar water pumps from interviews with horticulture farmers.

Farmers highly depend on water pumps for horticulture production. All the horticulture farmers consulted use water pumps for water supply, however the sources of energy differed among the farmers. The various energy sources included on-grid electricity, diesel, and solar.

However, production levels are constantly slowed by unreliable and expensive energy sources. Majority of the farmers that primarily use on-grid electricity and diesel complained of high energy costs attributed to high fuel costs or frequent power-cuts

These farmers have expressed the need to replace existing technologies with solar pumps to increase production levels. To address the unreliable and expensive energy sources, all the farmers provided solar water pumps as the best option as they are considered reliable and cheaper to maintain. These farmers estimate the solar water pumps to increase production levels by 3 times (300%). The same approach was used across the value chain to determine the projected increase in production, supported with secondary research, where applicable.

Case study 2: PUE creating jobs through processing of wheat, and related cereals

In this case study we focus on the wheat value chain but place specific emphasis on wheat processing which can be increased through the use of solar powered mills. (See columns in orange in the table below)

PUE in wheat processing can address challenges of unreliable power and high capital costs of machinery and has the potential to create approximately 50k jobs across the supply chain. The food and beverages (FBPI) processing industry is Ethiopia's largest contributor to the industry sector, accounting for 12% of the total industry uptake, with grain milling and processing of baked goods being the most prevalent activities in FBPI. [98],[99]

Food processing relies heavily on electric power to run machinery, yet MSMEs are using expensive and outdated technologies that limit production capacities, which also compromises quality of outputs.[100] Uptake of PUE technologies can substitute the existing technologies boosting production levels by an average of 176% across all activities and creating high quality jobs in the processing sector.

Increased uptake of electric mills (including solar water mills) has the potential to double MSME profits, generating USD 1.05B in annual value by 2025.[101] Mechanized milling using fossil fuels has already demonstrated profitability but the uptake of electrified mills has the potential to double realized margins and also halve energy costs for wheat farmers.[102] Furthermore, if 90% of farmers and processors in rural areas take on electric grain millers by 2025, the total capital expenditure is estimated to cost USD 51M.[103,104]

Wheat processing value chain

[98] Jobs Creation Commission (2019), Plan of Action for Job Creation 2020 - 2025
[99] Ibid.
[100] Ibid.
[101] Rocky Mountain Institute (2020), Capturing the Productive Use Dividend, *Valuing the Synergies between Rural Electrification and Smallholder Agriculture in Ethiopia*
[102] Scarlett Santana et al (2021), Productive Uses of Energy in Ethiopia, [Link]
[103] Rocky Mountain Institute, Capturing Productive Demand, 2020
[104] Value of production entails the market value of the food and agricultural products at the time they are produced.

Supply chain for wheat processing		Production	Aggregation, Transport & Storage (ATS)	Processing	Distribution & Retail
Activities		Wheat growing, Irrigation	Storage	Milling	Selling of flour, baked goods, animal feeds
Challenges		Limited supply of water	Inadequate storage equipment leading leads to spoilage of seeds	Old millers and slow manual power leading to low quality flour and small volumes	Spoilage leading to low shelf life and high costs to power baking stoves
Potential PUE technologies		Solar water pumps	Solar freezers and cold storage rooms	Solar powered millers	Solar baking ovens and solar refrigerators
Estimated energy requirement / Tier		Tier 3	Tier 3	Tier 3	Tier 3
Average unit cost price (USD)		USD 750[105,106]	USD 800[107]	USD 2,875[108]	USD 626[109]
Estimated production capacity of technology		2 Ha[110]	50 – 100 litres[111]	1,000kg/ day [112]	50 – 100 litres[113]
Projected increase in production (%)		300%[114]	300%[115]	25%[116]	80%[117]
Estimated number of MSMEs involved in activity		~4,700,000 farmers[118]	~6400 farmers[119,120]	~500 small scale millers [121]	~74,400 bakeries[122]
	Average no. of employees	5 farm workers	7 farm workers[123]	5 miller workers[124]	3 bakery workers[125]

[105] OCA research and analysis
[106] Prices could be higher if pumps are accessorized with other components e.g., irrigation systems, controllers, inverters etc.
[107] CLASP (2019), The state of the off-grid appliance market, [Link]
[108] Scarlett Santana et al (2021), Productive Uses of Energy in Ethiopia,[Link]
[109] Rocky Mountain Institute, Capturing Productive Demand, 2020; CLASP (2019), The state of the off-grid appliance market, [Link]
[110] OCA research and analysis
[111] UOMA (2020), Productive use of energy in Uganda, *Learnings from the Uganda Off-Grid Energy Market Accelerator*, [Link]
[112] OCA research and analysis
[113] UOMA (2020), Productive use of energy in Uganda, *Learnings from the Uganda Off-Grid Energy Market Accelerator*, [Link]
[114] Precise Consult International (2020), Creating Jobs through off grid Energy Access
[115] Consultations with MSMEs that utilize PUE technologies
[116] Ibid.
[117] Ibid.
[118] Adugnaw Anteneh (2020), Wheat production and marketing in Ethiopia: Review study
[119] Ibid
[120] Nicholas William et all (2015), The Wheat Supply Chain in Ethiopia: Patterns, Trends, and Policy Options, [Link]
[121] The World Bank Group (2018), Cereal Market Performance in Ethiopia: Policy Implications for Improving Investments in Maize and Wheat Value Chains, [Link]
[122] OCA research and analysis; the number is not comprehensive as this includes only those registered in the Addis Biz Business directory
[123] Bezabih Emana (2009), Cooperatives: a path to economic and social empowerment in Ethiopia, [Link]
[124] Yared Sertse et al (2011), Small scale edible oil milling operations, [Link]
[125] Consultations with MSMEs that utilize PUE technologies

Assumption applied per MSME	**Estimated no. of new employees**	0.5 farm workers	1 farm workers	1 miller worker	1 bakery worker
Estimated number of jobs from increased production		48,000 farm workers	120 farm workers	90 miller workers (assumes 20% uptake)	744 bakery workers

Case study 3: PUE creating jobs in the transportation, storage, and retail of milk and related by-products

In this case study we focus on the milk value chain but place specific emphasis on milk storage which can be increased through the use of refrigeration PUE technologies. (See columns in orange in the table below)

PUE in milk storage and retail can address challenges of spoilage and wastage, support the preservation of the cold chain, and can create approximately 11K jobs across the supply chain. The majority of MSMEs involved in food and beverages handling are exposed to a high risk of food contamination due to lack of proper storage equipment, exposing foodstuffs to pests that cause food spoilage and food borne diseases.[126]

Solar refrigerators, freezers, and cold rooms can be leveraged to bridge the gaps in the cold chain and can create approximately 10K jobs. Dairy farmers in Ethiopia produce about 4 billion litres of milk per year but 20 – 35% of all the milk production is wasted primarily due to lack of efficient cooling facilities and equipment.[127,128] In addition, only 7% of the milk produced by rural farmers is sold in the market as the majority is also lost due to lack of cooling systems either in transportation or in initial phases.[129] PUE technologies like solar-powered refrigerators, freezers, and cold rooms reduce the risk of milk contamination and can preserve it and its by-products such as cheese. Increased PUE uptake is estimated to increase storage amounts by ~ 30% as milk is stored for longer periods.

Finally, the Rocky Mountain Institute estimates that PUE milk cooling in Ethiopia can unlock $1.3B in potential economic value.[130] They estimate that electric milk cooling (including solar powered cooling) can increase milk production and storage by 75% by 2025, through the establishment of milk cooling centres.[131] Set up costs per milk cooling centre are estimated at USD 26,400 while the total capital expenditure for all cooling centres to meet production and storage levels could cost ~ USD 196M.[132]

Milk retailing value chain				
Supply chain for milk retailing	Production	Aggregation, Transport & Storage (ATS)	Processing	Distribution & Retail

[126] F.A Chekol et at (2019), Food handling practice and associated factors among food handlers in public food establishments, Northwest Ethiopia, [Link]
[127] Betela Beyene (2015), Review on Value Chain Analysis of Dairy Products in Ethiopia College of Agriculture and Veterinary Medicine, [Link]
[128] The Conversation (2018), Why Ethiopia's dairy industry can't meet growing demand for milk, [Link]
[129] Precise Consult International (2020), Creating Jobs through off grid Energy Access – A Desk Review
[130] Rocky Mountain Institute, Capturing Productive Demand, 2020
[131] Ibid
[132] Rocky Mountain Institute, Capturing Productive Demand, 2020

Activities		Feeding, breeding, and milking	Storage	Pasteurization	Selling of milk
Challenges		Low milk production	Inadequate storage equipment leading leads to milk spoilage and spillage	Adulteration of milk	Inadequate storage equipment leads to milk and cheese spoilage and spillage
Potential PUE technologies		Solar powered milking machines	Solar powered refrigerators and cold rooms	Solar powered pasteurizers	Solar powered refrigerators and cold rooms
Estimated energy requirement / Tier		Tier 3	Tier 3	Tier 4 - 5	Tier 3
Estimated production capacity of technology		5 – 10 liters	35 – 1,000 liters	2,000 – 10,000 liters	35 – 1,000 liters
Projected increase in production (%)		20%[133]	30%[134]	30%[135]	30%[136]
Average unit cost price (USD)		USD 800[137]	USD 800[138]	USD 62,500[139]	USD 800[140]
Estimated number of MSMEs involved in activity		~500,000 dairy farms[141]	~500,000 dairy farms	None available; majority of companies are large-scale. However, if the technology is available, it may attract MSMEs to join the market	~21,000 food retailers[142,*]
Assumptions applied per MSME	**Average no. of employees**	10 dairy farm workers	10 dairy farm workers	None	10 retail staff[143]
	Estimated no. of new employees	1 dairy farm worker	1 dairy farm worker	None	20 retail staff

[133] Chipula Grivin et al (2020), Solar powered technologies for the smallholder dairy industry in Malawi, [Link]
[134] UOMA (2019), Productive use of off-grid energy: The business case in Uganda's dairy value chain, [Link]
[135] Ibid.
[136] Ibid.
[137] CLASP (2019), The state of the off-grid appliance market, [Link]
[138] Ibid
[139] UOMA (2019), Productive use of off-grid energy: The business case in Uganda's dairy value chain, [Link]
[140] Ibid
[141] Betela Beyene (2015), Review on Value Chain Analysis of Dairy Products in Ethiopia College of Agriculture and Veterinary Medicine, [Link]
[142] Thomas Woldu et al (2013), Urban Food Retail in Africa: The Case of Addis Ababa, Ethiopia, [Link]
[143] Ibid.

Estimated number of jobs from increased production	5,000 dairy farm workers	5,000 dairy farm workers	None	200 retail staff

Overview of supply and demand side constraints that affect PUE uptake

While select value chains demonstrate strong potential for job creation through PUE, the market continues to see barriers that limit both the uptake and scale of technologies, and MSME capacity to generate jobs. We categorize these challenges into two groups:

- **Supply-side:** Barriers that affect PUE suppliers, slowing down their distribution of PUE technologies
- **Demand-side:** Barriers that hinder MSME access to PUE technologies

This section does not aim to list all MSME challenges but focuses on key challenges that inhibit the PUE technology sector. Likewise, these challenges are not in a particular order. Many of the insights below were pulled from primary consultations.

Supply-side challenges

Barriers that affect PUE suppliers, slowing down their distribution of PUE technologies

Limited access to information

Inadequate knowledge of end-user demand of PUE technologies is discouraging PUE companies from importing and distributing products. While PUE manufacturers may have a strong understanding of end-user needs, local PUE distributors and retailers, who make up virtually the entire market, have a knowledge gap that limits their marketing and sales success, and therefore their reach and impact. Distributors and retailers have little information on key demographic MSME data such as revenue turnover, business activities, and geographical locations, and a superficial understanding of the nature of end-user demand e.g., product preferences.[144,145] For example, players active in the agricultural and horticulture value chain have expressed concerns on lack of adequate information on the soil and crop type that can be supported through solar powered irrigation.[146] An inability to identify the specifications of water pumps required by farmers can lead to product mismatches.

Limited access to finance and Forex for PUE distributors

Limited access to and use of foreign currencies, has slowed down importation and PUE operator scale. All the PUE operators interviewed expressed lack of access to foreign currency as a key barrier.[147] Operators require hard foreign currency to purchase and import PUE technologies from international manufacturers and suppliers. However, the National Bank of Ethiopia (NBE) manages the approval and disbursement of forex based on a priority list for which PUE technology importers are not highly favoured.[148,149]

[144] Primary consultations with PUE companies and MSMEs utilizing PUE technologies
[145] Consultations with an off-grid energy sector expert
[146] Ibid
[147] Primary research
[148] Primary consultations with PUE operators and an expert from the Agricultural Transformation Agency
[149] Consultations with an off-grid energy expert

Restrictions on foreign investment into retailers limits financing that PUE companies can receive. Only fully locally owned companies, without any form of foreign investment are permitted to obtain a license to import or retail solar products, including PUE technologies in the country.[150] A company that receives any form of foreign investment is classified as an international company and is prohibited from importing and distributing solar products in the country. PUE distributors in this position would therefore be ineligible to operate as retailers and directly serve customers.[151] This leaves PUE suppliers to rely on the local commercial sector for financing, an unideal option as they are exposed to high interest rates between 12 - 15% and high collateral requirements valued between 165% - 178% of the loan amounts.[152]

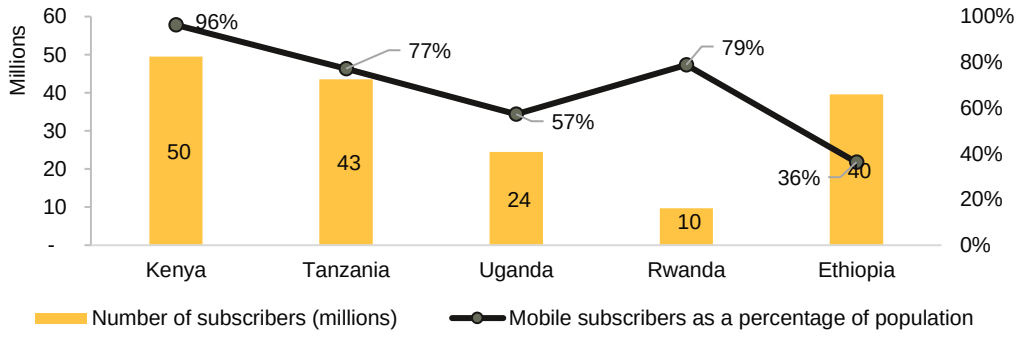
Low skills development within PUE distribution companies

Our interviews suggest that PUE companies lack adequate knowledge and technical expertise to maintain new products which hinders distributor ability to grow. Given the nascency of the sector, skills training programs that target this sector are very limited. Likewise, some companies lack the technical capacity to install and or maintain various PUE technologies. Government strategies exist to integrate solar maintenance trainings in TVET schools and universities across the country which creates jobs; however, these programs are still in their infancy.[153]

Limited digital infrastructure

Despite these developments, a low rate of mobile phone penetration has also contributed to a slow adoption of PAYG for PUE technologies.[154] The penetration of mobile phones in Ethiopia is below its regional counterparts, with just over one-third (~33%) of the population owning a mobile device. Lack of mobile phones, mainly in rural areas, reduces the use of mobile money services and mobile banking that can facilitate payment plans for PUE technologies through PAYG.

Figure 3 Absolute and relative mobile phone subscriptions, regional comparison[155]



Inconsistent tax requirements and tax restrictions

Tax exemption policies on solar products are inconsistently applied. The Ministry of Finance and Economic Development lifted import duties on Lighting Africa certified products in 2010 and is exploring a reduction of PUE tariffs as it relates to agriculture.[156] However, majority of the PUE companies interviewed expressed that this policy is not uniformly implemented as tax officials lack adequate knowledge to assess

[150] GOGLA (2020), 2020 Off Grid Solar Market Trends Report, [Link]
[151] OCA research and analysis
[152] USAID (2016), Opening Doors: A Performance Evaluation of the Development Credit Authority (DCA) in Ethiopia
[153] Consultations with an off-grid energy sector expert
[154] Consultations with an off grid energy expert
[155] World Bank, Mobile cellular subscriptions - Ethiopia
[156] USAID (2019), Off-grid Solar Market Assessment, [Link]

and determine tax exempt products, which further increases end-user prices.[157, 158] To address tax inconsistencies, different government agencies such as Ethiopian Energy Authority, MoFED, Ministry of Trade and Industry and the Ethiopian Investment Commission are developing a handbook to provide guidelines on the customs clearing process and tax and duty types (customs duty, sur tax, excise, VAT, and withholding tax).[159]

Furthermore, existing regulations do not favor domestic manufacturing or assembly of solar products. Despite duty waivers on certain solar PV product imports, a company that seeks to assemble PUE devices in Ethiopia is expected to pay taxes for semi-finished components that are used to make the finished product.[160] While no PUE distributors interviewed were exploring this option it may enable jobs in assembly.

Tax restrictions on PAYG models limit PUE companies from designing scalable consumer financing models that address end-user affordability. PUE companies adopting PAYG models are required to pay all tax related charges for credit sales at the time the sale is made irrespective of successful future payment collections from customers.[161,162] This has discouraged PUE companies from extending PAYG services to end-users given the uncertainty around consumer repayments or has encouraged PAYG companies to adopt high gross margins to account for this tax loss.[163]

Restrictions on international vertical integration

Regulations inhibit international manufacturers from engaging in the retail of solar products which limits their ability to vertically integrate the PUE supply chain, thus increasing business costs and constraining market reach. Foreign-owned manufacturers are prohibited from engaging in distribution and retail activities as per Ministry of Trade and Industry regulations.[164,165] This creates a fragmented supply chain in which foreign companies enter into distribution partnerships with local companies, adding a layer of activity and cost to the product, and making it less affordable for MSMEs. PUE technologies can have markups of 50% - 200% on the import cost of the system.[166] The low level of integration also means that PUE companies have less flexibility in reaching remote areas, putting rural MSMEs at a disadvantage.

Moreover, distribution of PUE technologies is complex and local companies may not always have the latest know-how on how to optimize it. Local companies may struggle to pull best practices from foreign countries associated with which products to sell and how to best reach off-grid populations.

The lack of vertical integration also stifles the adoption of pay-as-you-go (PAYG) models, limiting MSME payment options and discouraging uptake of PUE technologies. Even if PUE companies could easily reach rural MSMEs, majority of the MSMEs interviewed in this PUE study expressed the need for increased financing options that can finance PAYG business models.[167] PAYG models in adjacent and comparable East African markets, such as Kenya, have been most successful where companies are able to control the end-to-end supply chain. This includes collecting user data of the use of specific technologies,

[157] Consultations with PUE companies
[158] Precise Consult International (2020), Creating Jobs through off grid Energy Access - A Desk Review
[159] OCA research and analysis
[160] Ibid.
[161] Africa Clean Energy Technical Assistance Facility and Open Capital Advisors (2021), Ethiopia stand-alone solar investment map
[162] Consultations with an off-grid energy sector expert
[163] Ibid.
[164] Precise Consult International (2020), Creating Jobs through off grid Energy Access - A Desk Review
[165] Consultations with an off-grid energy sector expert
[166] GOGLA (2020), Off grid solar market trends report, [Link]
[167] Primary consultations with MSMEs utilizing PUE technologies

monitoring repayment behavior, and analyzing after-sales support to re-inform product design.[168] Without this option in Ethiopia, PUE companies are building comparatively minimal business experience across the value chain and may have a more difficult time gaining sufficient momentum to scale.

Demand-side challenges that hinder MSME uptake of PUE technologies

Barriers that hinder MSME access to PUE technologies

Low affordability and limited access to finance for MSMEs

PUE technologies such as solar refrigerators and solar water pumps have upfront costs ranging from 21,000 ETB to 41,500 ETB (USD 500 to USD 1000), primarily due to import taxes and foreign exchange restrictions.[169] Over 70% of the MSMEs interviewed mentioned that PUE technologies are expensive to purchase.[170] The high prices have led to low affordability and willingness to pay as some MSMEs cannot afford these technologies.[171]

A majority of the local financial lending institutions in Ethiopia lack dedicated and specialized loan products for solar PUE technologies.[172,173] Generally, majority of the MSMEs interviewed lack adequate financing to purchase PUE technologies primarily due to high interest rates and collateral requirements imposed by financial institutions that discourage MSMEs from borrowing.[174] Collateral rates can reach over 234%.[175] Collateral is not always distributed in a gender-equal way which can discriminate women. Simultaneously some MSME owners that have Islamic faith-based religious beliefs, are not able to benefit from access to loans that charge interest rates.[176]

Limited access to information for MSMEs

MSMEs lack adequate information on the PUE technology offerings, their functionalities, and where they can purchase these technologies from. 67% of the MSMEs interviewed lack information on how to use PUE technologies and to integrate them into their production cycles. Moreover, they also lacked information on where to purchase them.[177] This problem is further heightened by the lack of extension services such as technical institutions or business training programs that provide targeted training on the use and maintenance of various PUE technologies.[178,179]

Some MSMEs are aware of the available technologies, but they lack trust in their functionalities and durability given the high circulation of sub-standard technologies on the market.[180] Uncertainty on the effectiveness of the PUE technologies further reduces MSME willingness to purchase them.

Low skills development for MSMEs

MSMEs sometimes lack adequate knowledge and skills to operate PUE technologies and / or manage business operations, limiting business growth. Over 65% of MSMEs interviewed mentioned

[168] OCA research and analysis
[169] Africa Clean Energy Technical Assistance Facility and Open Capital Advisors (2021), Ethiopia stand-alone solar investment map; Lighting Global, IFC, (2019), The market opportunity for productive use leveraging solar energy (PULSE) in Sub-Saharan Africa
[170] Primary consultations with MSMEs that utilize PUE technologies
[171] Small holder farmers in Ethiopia earn on average, USD 1657, per year which means there is limited spending that is possible on PUE technologies.
[172] Lending institutions such as commercial banks and microfinance institutions
[173] Primary consultations with MSMEs using PUE technologies and microfinance institutions
[174] Ibid
[175] The World Bank Group, SME Finance in Ethiopia: Addressing the missing middle challenge, [Link]
[176] Primary consultations with MSMEs using PUE technologies
[177] Ibid
[178] Ibid.
[179] Consultations with an off-grid energy sector expert
[180] Precise Consult International (2020), Creating Jobs through off grid Energy Access - A Desk Review

that they lack the technical capacity and expertise to make use of available PUE technologies.[181] The low skills levels are partially due to a lack of extension services such as technical institutions or business training programs that offer targeted training on the use and maintenance of various PUE technologies.[182,183] Rural-based MSMEs in particular also lack effective business management skills such as financial management, which limits the capacity to effectively manage and control cash flows.[184]

Shortage of spare parts

Given the shortage of foreign currency, most importers face delays in importing spare parts. Thus, if companies are unable to import spare parts to meet the demand, end-users will also be unable to maintain their technologies leading to low production levels.[185]

Policy and stakeholder recommendations

Given the challenges highlighted in the section above, this section outlines existing and future interventions that can be adopted by government and other stakeholders in a coordinated intervention effort. Increased access to PUE technologies cannot happen in a vacuum; a concerted effort across public, private, donor, and other ecosystem support actors is needed to catalyze the creation of jobs through PUE.

Recommendations were broken into two groups:

- **Supply-side interventions:** Interventions that address challenges that PUE companies face or that slow down the distribution of PUE technologies.
- **Demand-side interventions:** Interventions that address challenges that hinder MSME access to PUE technologies or constrain MSME job creation potential.

Supply-side interventions

Interventions that address challenges that PUE companies face or that slow down the distribution of PUE technologies.

Financing interventions

Enable access to concessional forex loans for PUE companies to support their importation costs by replicating previous foreign currency financing interventions or advocating for prescribed funding towards PUE technology within existing initiatives. The forex challenge in Ethiopia has been partially addressed within the off-grid sector through initiatives like the World Bank's Market Development Credit Line (MDCL), a USD 45 million facility administered by the Development Bank of Ethiopia (DBE), which extended guaranteed access to concessional forex loans for up to two years to eligible standalone solar (SAS) companies to support SAS imports.[186] Over an 8-year implementation lifetime from 2012 – 2019, approx. 1.2 million solar lanterns and home systems were distributed, and 31 SAS retailers participated and benefited.[187] At least two new facilities are already in the pipeline that are inspired by the MDCL: (i) the ADELE program - Accelerating Distributed Electricity and Lighting in Ethiopia - a USD 450

[181] Precise Consult International (2020), Creating Jobs through off grid Energy Access - A Desk Review
[182] Consultations with PUE companies and MSMEs using PUE technologies
[183] Precise Consult International (2020), Creating Jobs through off grid Energy Access - A Desk Review
[184] Financial Management Practices of Micro and Small Enterprises in Addis Ababa, Ethiopia
[185] Consultations with an off-grid energy expert
[186] MoWIE (2019), NEP 2.0
[187] MoWIE (2019), NEP 2.0; Consultation with Development Bank of Ethiopia (DBE)

million facility by the World Bank, and (ii) an African Development Bank (AfDB) line of credit to the Commercial Bank of Ethiopia, a USD 100 million facility. The JCC can explore opportunities to incentivize stakeholders involved in management of these facilities to prescribe funding towards PUE technology, or seek to catalyze the formation of new, targeted partnerships solely focused on PUE. Furthermore, the JCC can advocate for the government to include PUE technologies in the forex priority list to increase the sales of these technologies and through it, create increased jobs. Additionally, the JCC can also advocate for PUE companies to access supplier credit, typically only reserved for manufacturers on the priority list, to ease cash cycles and to allow foreign suppliers to supply goods on credit to PUE distributors while they wait for forex to pay suppliers.

In addition, encourage blended finance facilities for PUE technologies. An IFC study showed that PUE devices such as solar pumps, wheat milling, and dairy chilling are associated with relatively short pay-back periods of between 12-24 months and positive IRRs for MSMEs which should translate into favourable lending economics for investors.[188] Moreover, the life-cycle costs of PUE devices are often lower than the life-cycle costs of diesel-powered equivalents. Blended finance, either through the use of cheap capital or guarantees to financial institutions would encourage more lending for PUE technologies. The MDCL facility remains a good example of a blended finance intervention where the DBE beared the full risk of loans in the facility. The JCC can enable more blended finance by encouraging international investors to explore these mechanisms within the context of Ethiopia. The JCC should shed more light on the local legal mechanisms through which they can be created such as which government agencies to partner with and how to seek approval.[189] Other considerations, such as gender-sensitive lending, can also be factored into allocation to support women-led MSMEs.

Information access interventions

Market-building training delivered in a scalable manner is required to address the lack of information on PUE devices. This can take the form of trainings to distributors as well as credible studies by verified partners to close information gaps. In addition, the JCC can partner with PUE suppliers, the Ethiopian Solar Energy Development Association (ESEDA), and other industry associations to conduct market studies and to disseminate findings through sector reports to showcase PUE business potential and thus convincing local companies to take on distributor risk for PUE technologies.[190] Below is a summary of existing access to information interventions. The next step includes distilling the main principles from these studies for distributors to ensure they have the information they need to provide PUE technologies at scale.

[188] Lighting Global, IFC, (2019), The market opportunity for productive use leveraging solar energy (PULSE) in Sub-Saharan Africa
[189] For example, the Rocky Mountain Institute and the IKEA Foundation explored a facility for PUE technologies in Ethiopia
[190] The JCC can partner with PUE suppliers, the Ethiopian Solar Energy Development Association (ESEDA), and other industry associations to conduct market studies

Case box 3: Overview of ongoing interventions to support PUE uptake in Ethiopia

Organization/ Entity	Intervention
Ethiopian ATA Agricultural Transformation Agency የኢትዮጵያ ግብርና ትራንስፎርሜሽን ኤጀንሲ	**The Agricultural Transformation Agency (ATA) is mapping high potential areas for small-scale irrigation to inform the design and implementation of PUE programs in these areas.** ATA, with support from Radar Technologies International and Addis Ababa University, is conducting shallow water mapping exercises across the country to identify water resources and terrains that can handle small scale irrigation. So far, ATA has mapped ~234K sq. kilometers of land in 6 regions of Oromia and SNNP coupled with publishing water atlases as an information resource of their work. The atlases have been distributed to over 162 woredas and uptake of small-scale irrigation in these regions is estimated to economically strengthen over 6.4M households. ATA has also trained water well-draining enterprises to operate and drill shallow wells that are suitable for solar water pumps.
Ministry of Water, Irrigation & Electricity VERITAS SOUTH SOUTH NORTH	**MOWIE is collaborating with SouthSouthNorth (SSN) and Veritas Consulting to explore the economic viability of 285 potential minigrid sites, with a focus on the Agricultural Commercialization Clusters (ACCs)**. So far, SSN has built the case for horticulture commodities (tomato, onion, banana, mango, avocado) as the focus of the study primarily due to their income potential (earning up to 10x higher for farmers than cereals) and the high energy demands at the pre-harvest and post-harvest stages. The project also aims to validate a total of 20 viable sites to conduct pre-feasibility studies or pilots that demonstrate the commercial viability of minigrids for private investors.
	MoWIE is also collaborating with SNN to develop financial models to test the viability of capex subsidies for private developers interested in minigrid development. Capex costs for minigrids are relatively high on a per user basis. This translates to relatively higher tariffs. MoWIE and SSN are developing a model that calculates the level of subsidy that will require private developers to provide cheaper tariffs despite the high capex costs. MoWIE plans to use this model to increase transparency between the government and minigrid developers in providing reasonable subsidy amounts and setting cost reflective tariffs.
SOLAR VILLAGE ETHIOPIA	**On the private sector side, the company Solar Village Ethiopia has engaged farmers in the SNNP and Amhara regions to understand the specification requirements and willingness to pay for solar water pumps**. Results show that there is a high demand from farmers for pumps with capacity to extract ground water from up to 25 meters and be able to irrigate a land of up to 0.2 Ha. Farmers also demonstrate a high demand for pumps priced at an average price of USD 750. This need encouraged Solar Village Ethiopia to import solar water pumps with a power output of 300 and 600 kWh at a cost of USD 500 and 1,000 approximately.

Low skills development interventions

PUE device training to distributors should be provided by the suppliers of PUE devices[191]. JCC can partner with PUE suppliers and the Ethiopian Solar Energy Development Association to develop training programs that train PUE distributors on the functionality of specific technologies. For example, in the case of solar pumps, suppliers can train PUE distributors on understanding the type of agriculture and water infrastructure needed (e.g., availability and depth of water table) to ensure proper utilization of solar water pumps for irrigation. Trainings should be organized periodically to ensure new distributors are included in the training. Where possible, suppliers can also train existing technicians on how to operate and manage PUE technologies, for example training existing electricians or companies working with diesel powered products. A study in Tanzania and Kenya on technician training showed that a majority on technicians were eager to learn how to service off-grid technologies and wanted to attend trainings on them.[192]

Digital infrastructure interventions

Despite the relatively low mobile phone penetration rate, Ethiopia still presents an attractive market for PAYG due to its large size and a demonstrated willingness to adopt PAYG from end users. Ethiopia's population is almost 2x that of Tanzania, the next largest East African market, and in comparing regional data on mobile money accounts, its absolute number of mobile phone subscribers exceeds those of Uganda and Rwanda combined.[193] Moreover, households that are not connected to the grid have demonstrated a willingness to pay for electricity services over time for a Tier 2 solar product (50 – 200Wp capacity to power >2 lightbulbs and low load appliances e.g., a fan) at a price point of $583.[194] 35% of unconnected households are willing to pay over 6, 12, and 24-month periods (13%, 12%, and 10% of unconnected households, respectively).[195] Some public services like water and electricity are piloting mobile money payments, but they can only be used to make a specific utility payment. Moreover, the country has slowly begun to liberalize the digital payments industry, for example, the NBE permitting non-bank institutions to apply to issue payments instruments and the NBE licensing Ethio telecom, the country's sole telecom operator, to launch a mobile money platform that will enable customers to receive and make payments through their mobile phones. All in all, there is development on the digital infrastructure side that private companies should be made aware of.

Tax policy interventions

The Ministry of Finance and Economic Development (MOFED) needs to streamline the application of taxes and customs duties on imported PUE technologies. This can be done through greater training to customs officials on PUE technologies. Moreover, as PUE devices allow for increased mechanization and industrial activity, the JCC can consider advocating for the removal or a reduction of tariffs on importation to reduce the cost of the product and increase productivity within Ethiopia. Some estimates suggest that a removal of tariffs could lead to savings as high as 40% on the FOB price of PUE devices.[196] Currently, only solar water pumps are exempt from duty tax, excise tax, and surtax but MOFED is exploring tax exemption for agriculture PUE appliances. The JCC can support MOFED to consider extending these

[191] While we suggest suppliers of PUE devices provide trainings to ensure they remain practical, there is a case for helping TVET centers in Ethiopia to augment training and in those cases private sector players can help TVET centers to develop relevant curriculum.
[192] Include lighting Global source
[193] Financial Inclusion Insights, FII, Countries; World Bank Blogs (2018), Financial Inclusion in Ethiopia: 10 takeaways from the latest Findex

[195] ESMAP, Ethiopia: Beyond Connections, World Bank et al. 2018
[196] Precise report - Ethiopia - Job creation through Off-grid Energy Access

tax exemptions for other PUE technologies such as solar millers and refrigerators to increase their affordability and to enable job creation across different value chains.[197]

Review PAYG taxes so that taxes are not paid on the full sale amount but rather the income stream that companies receive. PAYG implies that income is only generated when customers repay for products. Thus, tax treatment should be revised so that only the income generated is taxed and the upfront transfer of assets is not. The JCC can work with Ethiopia Revenues and Customs Authority (ERCA) to create an exception for solar companies specifically involved in PAYG. [198]

Quality standards interventions

Enforce standards consistently to control market quality. JCC can collaborate with the government to develop and enforce importations standards to reduce the circulation of poor-quality technologies. Where possible the government should use globally accepted standards as opposed to country-specific ones to ensure that a wider variety of PUE technologies can be imported. The Ethiopian Standards Agency (ESA) has succeeded in giving quality-verified products preferential treatment to acquire financing through government programs.[199] However, the standard is having minimal effect in limiting the importation of below-par quality products. Better collaboration is needed between the ESA, Ministry of Trade, and customs authorities such as rural authorities which are also involved in monitoring standards at a local level to ensure consistency.

Other supply-side interventions

In the long-term, the government, with support from development partners and the private sector, may consider expanding the local PUE manufacturing sector as the market matures and demand increases. Setting up domestic manufacturing facilities has potential to streamline the distribution of PUE technologies throughout the country as it reduces the sector's dependence on imports and forex. An increase in the number of local manufacturers would also generate new jobs for the sector, including both skilled workers such as design specialists, engineers, technicians, software and hardware developers, and management personnel, as well as semi-skilled and unskilled workers involved in operations and on the factory floor.[200] However, such an effort would be considerably capital intensive and technologically advanced, a financially viable option only once the market demonstrates a sufficient level of demand for PUE products.

Demand-side interventions:

Interventions that address challenges that hinder MSME access to PUE technologies or constrain MSME job creation potential.

Affordability and finance interventions for MSMEs

[197] Miriam Otoo et al (2018), Business Model Scenarios and Suitability: Smallholder Solar Pump-based Irrigation in Ethiopia, [Link]

[198] While this poses a potential risk PUE companies being categorised as financial institutions, which could require them to fulfil various policies such as having a minimum paid up capital of Birr 200,000 (USD 4,700) and a minimum of five co-founders for MFIs, thus discouraging companies from venturing into the model, the JCC can collaborate with the ERCA and NBE to develop policies that solely govern the PAYG model. Moreover, as Ethio Telecom rolls out a mobile money platform that facilitates digital payments, policies could evolve that require end-uses to pay a digital service tax for payment transactions. Countries like Uganda imposed similar taxes in 2018 and consequently saw a significant drop in the number of new mobile money activations associated with PAYG as end-users could not afford the taxes.[198] The government later repealed the taxes however, allowing the PAYG market to recover

[199] MoWIE (2020), NEP 2.0

[200] Jobs Creation Commission (2019), Plan of Action for Job Creation 2020 - 2025

Demand side subsidies (DSS) can play a role in addressing the low affordability associated with PUE technologies. Demand side subsidies are subsidies that directly reduce the price of a product as opposed to supply side subsidies which are provided to companies in order to reach hard to access populations.[201] Tackling the willingness to pay (WTP) issue is challenging for MSMEs that have low incomes. To address this affordability gap, JCC can collaborate with development partners and government agencies such as the Ministry of Finance and Economic Development (MoFED) to develop DSS programs. DSS are already playing a key role in helping to achieve SGD 7 as over 112M people are projected to lack the required affordability by 2030 to pay for access to lighting.[202] Different development partners such as GIZ and the World Bank are exploring DSS and their potential across emerging economies. DSS for solar pumps, wheat millers, or refrigeration, in particular could enable increased incomes for users. DSS can also be used to target specific groups such as youth or women as well.

Increases in the supply of financing or grants are needed to decrease the cost of financing to enable MSMEs to borrow. MSMEs that face high costs of lending will continue to face these challenges so long as the supply of financing is limited for lenders. Address this issue from the supply-end of financing to enable increased lending. JCC can conduct dialogues with development partners and government agencies such as NBE to set up credit guarantees from development entities or government funding to help speed up the adoption of PUE technologies.[203] Another option is a cost-sharing model where a group of farmers pool their funds to invest in a PUE technology. Pooling investments would reduce individual risk and could allow farmers to negotiate lower interest rate loans from MFIs or banks.[204] JCC can collaborate with farmers' unions, SACCOs, and cooperatives to relay the benefits of cost-sharing to farmer groups in different communities. Moreover, the JCC may be able to work with SACCOs to create loan products for MSMEs.

Other demand-side interventions

Training on how to operate PUE technologies should be provided by PUE companies to MSMEs. JCC can partner with PUE companies to introduce training programs or to publish an information pack to teach MSMEs on how to use PUE technologies to maximize their efficiencies and output.[205] For example, Mobisol, has trained end-users to use solar powered hair clippers and SunCulture has trained farmers to use their solar water pumps. This training can also include business management training to support MSME development, although it should be made extremely relevant for MSMEs in Ethiopia.

Distributors can also use the existing Rural Transformation Centers (RTCs) as skills training hubs to reach a wide range of farmers as these end-users are already using the RTCs to collect, sort and store their agricultural produce.[206,207] These trainings can target and train both horticulture and wheat farmers on how to operate PUE technologies. Furthermore, these programs should consider a gender nuanced approach to promoting productive uses – JCC and companies can identify, farmer cooperatives, and women or youth groups that drive various activities in the high potential value chains and empower them with knowledge on how to use PUE technologies. Moreover, the JCC can work with the solar

[201] For more information on the details of demand-side subsidies, please see the ACE report on that from 2020 URL
[202] GOGLA (2020), Off grid solar market trends report, [Link]
[203] International Water Management Institute (2018), Business models for solar-powered irrigation in Ethiopia, [Link]
[204] Ibid
[205] An information pack could include relevant information such as the shallow ground water map developed by ATA, the river basin map developed by MoWIE Basin Authority, banks that provide credit lines for PUE products, and the crop production map developed by ATA,
[206] RTCs are geographic clusters of infrastructure that provide integrated services to rural communities
[207] Programme for Country Partnership (PCP) Ethiopia (2018), Integrated Agro-Industrial Parks in Ethiopia, [Link]

association and relevant counterparts to promote PUE technologies in MSME exhibitions, SACCO exhibitions, and market days in rural areas to ensure people understand the products.

Maintenance needs to be baked into existing contracts or sales with end-users. The government currently requires distributors to offer 1- or 2-year warranties. Distributor needs to make clear how much spare parts cost and where possible should offer warranties for at least the expected pay-back period of a PUE devices. MSMEs will not take up new and expensive technologies if they do not know what will occur in the case of malfunction or breakdowns. This is particularly the case with PUE devices which are subject to requiring more maintenance due to excessive through-put.

Case box 4: Learnings from the Uganda Off-Grid Energy Market Accelerator (UOMA) on PUE

UOMA supported pilots in Uganda to help better understand the uptake of high impact PUE technologies. UOMA is a dedicated and neutral intermediary focused on scaling off-grid energy access in Uganda. In the PUE space, UOMA has provided targeted pilot support to PUE companies to identify scalable business models and technologies, and also conducted research to better understand high impact value chain opportunities.

Learnings from the pilots show that PUE technologies have strong potential to impact millions and drive economic growth.

- Solar irrigation is the most developed use case, with a strong economic case for farmers cultivating high value crops and with access to quality water sources.
- Agro-processing units such as solar mills are still in the pilot stage.
- Refrigeration solutions are still relatively expensive, though companies are selling products commercially, albeit at low volumes.

Various interventions are being implemented in Uganda to encourage PUE uptake, which can be leveraged by Ethiopian stakeholders within the relevant context. Among them:

- **Improved affordability through PAYG models:** Some companies are utilizing PAYG to increase affordability, experimenting with flexible payment plans that spread clients' payments over a year or two years, and into seasonal or monthly payments that better match farmers' income and expenditure patterns. Other companies that were initially targeting smallholder farmers have shifted their focus to businesses since these customers make repayments more consistently, and, in a few instances, have opted to fully purchase systems upfront. PUE companies in Ethiopia can adopt similar PAYG mechanisms, although current tax limitations on PAYG models need to be accounted for.

- **Increased access to consumer finance through grassroot structures:** PUE companies are partnering with grassroot structures such as cooperatives and SACCOs to distribute technologies coupled with financing to farmers. Farmers prefer borrowing from them due to the less strict collateral requirements. Likewise, SACCOs in Ethiopia are considered to have immense potential in financing short term loans for agricultural production technologies and for lending in rural areas where both the state and the private sector have struggled. SACCOs can also be used to distribute products as they already act as a point of sale for fertilizers and common FMCG products such as soap.

- **Increased consumer awareness through setup of demo sites:** PUE companies have set up demo sites in various areas to showcase the benefits of PUE technologies as end-users with limited capital are more willing to invest in solar pumps once they see the returns of the technologies. In Ethiopia, demo sites can be done in conjunction with the Ministry of Agriculture.

- **Increased modification of PUE technologies to meet customer needs:** PUE manufacturers, particularly solar water pump manufacturers like SunCulture, are customizing pumps to meet farmers' needs. However, customization of technologies is still low generally due to the high investments required. PUE companies in Ethiopia can also conduct research to better understand end-user needs so as to import and distribute technologies that meet end-user needs.

Source: **UOMA (2020), Productive use of energy in Uganda, *Learnings from the Uganda Off-Grid Energy Market Accelerator***

Conclusion

The adoption of PUE technologies by MSMEs will play an important role in driving new employment opportunities and bridging the employment gap in Ethiopia. National unemployment rates, specifically, of the youth population, indicate the urgent need for public and private intervention. Given the demonstrated viability of MSMEs as a viable avenue to generate new jobs, creating over 800,000 in 2018, it is critical to consider solutions and technologies that can support increased MSME capacity. Productive use energy technologies present such opportunity.

Currently, the distribution of both standalone and minigrid PUE solutions remains low. With just over 2,000 solar PUE appliances distributed between 2019 and 2020, compared to millions of solar household products. The minigrid landscape is even more nascent, as minigrid developers wait on approved licensing and tariff directives.

Opportunities for job creation are present across key macroeconomic sectors and value chains, with high potential in horticulture, processing of cereals, and milk cooling. At the macroeconomic level, the workforce is heavily skewed towards agriculture, with relatively small numbers in industry and services. However, workforce trends have been shifting in favor of the latter sectors over the past decade. For this report, we profiled three high-potential value chains, based on their potential to drive new employment opportunities across all major activities of a value chain.

To position the market for growth, targeted interventions that address constraints for both PUE companies and MSMEs are needed. Financing interventions that mobilize the right kind of financing such as forex to support PUE imports and end-user subsidies or grants to enable MSME uptake are critical. There are also sensitization and training efforts needed to close the information and skills gaps for both PUE companies and MSMEs. On the policy side the PUE industry needs to see consistent enforcement of tax waivers and quality standards to set the precedent for technologies coming into the country and ensure a fair marketplace.

The policy and stakeholder recommendations detailed in this report can inform and enable job creation through MSME adoption of PUE technologies. The JCC intends to use this report to inform an initial set of policy measures to catalyze jobs. Continuous dialogue and co-development of solutions is important to achieving coordinated interventions.