

LOCALLY HARNESS POWER OF THE SUN

Making the Case for SHS
Manufacturing and
Assembly in Ethiopia



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JUNE
2023

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Acronyms

ADELE	Access to Distributed Energy and Lighting in Ethiopia	MDCL	Market Development Credit Line
CBU	Completely Built Up	MFIs	Micro Finance Institutes
CKD	Complete Knock Down	MoF	Ministry of Finance
DBE	Development Bank of Ethiopia	MoTRI	Ministry of Trade and Regional Integration
DP	Development Partners	MoWE	Ministry of Water and Energy
ECAE	Ethiopian Conformity Assessment Enterprise	MTF	Multi-Tier Framework
ECC	Ethiopian Customs Commission	LC	Letter of Credit
EEU	Ethiopian Electric Utility	LED	Light Emitting Diode
EMA	Energy Market Accelerator	NBE	National Bank of Ethiopia
ENREP	Electricity Network Reinforcement and Expansion Project	NEP	National Electrification Plan
EPEI	Ethiopian Power Engineering Industry	OFS	Operations Feedback System
ESEDA	Ethiopian Solar Energy Development Association	OG	Off Grid
ETB	Ethiopian birr	OGS	Off Grid Solar
FOREX	Foreign Exchange	PFI	Private financial institutions
FDI	Foreign Direct Investment	PCB	Printed Circuit Board
FIs	Finance Institutions	PUE	Productive Use Energy
FXD	Forex directive	PV	Photo Voltaic
FY	Fiscal Year	PVoC	Pre-Verification of Conformity
GoE	Government of Ethiopia	QTM	Quality Test Method
GDP	Gross Domestic Product	R&D	Research and development
HH	Households	SAS	Stand Alone Systems
IDA	International Development Association	SHS	Solar Home Systems
IFC	International Finance Corporation	SME	Small and Medium Enterprises
ISM	Initial Screening Method	SKD	Semi Knock Down
MCM	Market Check Method	TAM	Total Accessible Market
		USB	Universal serial bus
		USD	United States Dollar
		WB	World Bank
		WEF	World Economic Forum



Executive Summary

For Ethiopia to achieve national electrification through its integrated on and off grid electrification plan by 2030, roughly 9 million households must have access to stand-alone solar home systems (SHS). Yet, the current dependency on imports, and the policy and financing ecosystems are leading to a high deviation in the supply of products in the SHS market from the projected demand. Finding practical solutions to these challenges is vital to fully electrifying the Ethiopian population as planned in the NEP 2.0.

As of the publishing of this research, there are four SHS assemblers on the ground and a manufacturing company that is expected to start production by the end of the year. Despite these efforts, there is still much work to be done to meet the increasing demand for SHS products in the country. This study aims to assess the SHS market of Ethiopia and identify the potential of local manufacturing and assembly on a national scale.

Key Insights

A market analysis conducted on the current off-grid SHS market shows that except for 2019, none of the yearly off-grid electrification targets set by NEP 2.0 were met through both import and local SHS supply.¹

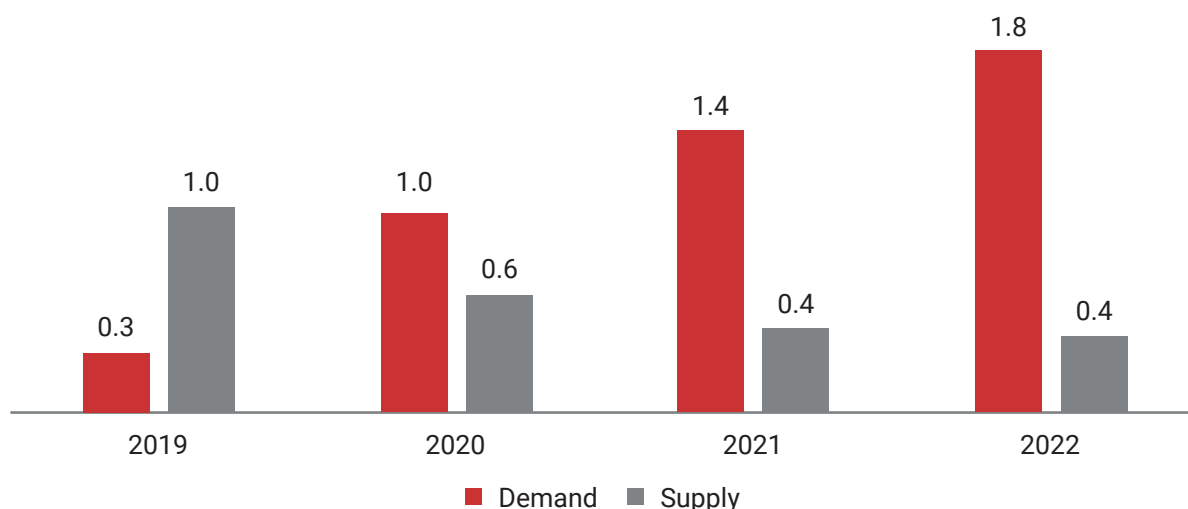


Figure 1 OGS systems demand Vs supply (million units)

Source: NEP 2.0, GOGLA (2022) Sales and Impact Report

The supply of SHS to the off-grid market has been highly import-dependent. Of the 2.5 million SHS sold since 2019, less than 2 percent were locally assembled while there was no SHS product in the market that was locally manufactured.

The study found that start-to-end manufacturing can lead to a 49 percent per unit decrease in FOREX when compared to importing a fully built-up equivalent product. The increased FOREX reduction in local manufacturing results from localization of engineering and design costs, manufacturing of main components, and other costs such as labor and utility.

Local assembly of SHS sub-systems (CKD of SKD modal) reduces the FOREX needed per unit by up to 24 percent (compared to import of CBU) through locally sourcing available components of an SHS such as cables, LED bulbs, plastic casings, and packaging materials. In addition, it has been shown that local manufacturers or assemblers of sub-systems can supply SHS assemblers' products at competitive prices when compared with similar imports, which can result in reducing the overall cost of locally assembling CKD SHS.

The research indicates that by encouraging the scaling up of local assembly and indigenous manufacturing of SHS, 47 percent of the clean/efficient energy demand in Ethiopia can be met and USD 98 million can be saved in net FOREX needs. Similarly, up to FOREX USD150 million in total costs can be saved in the coming four years. This means local assemblers and manufacturers can supply more products to the market using less FOREX and, equally importantly, provide substantially increased socio-economic benefits such as speed up rural electrification rates, high-wage technical and managerial job creation, and technology transfer that can help the country to be more competitive and represented in global technology manufacturing.

Local job creation with SHS assembly and manufacturing is a value addition in expanding the skilled workforce. Promoting local production and assembly of SHS products can lead to the development of a well-trained workforce equipped with the necessary knowledge and technical expertise to design, assemble, install, and maintain solar systems. Localizing SHS production can also foster research and development (R&D) initiatives in clean energy technologies. This can create job opportunities for scientists, engineers, and researchers.

¹ Global Off-Grid Solar Market Report (2021-2022), NEP 2.0



Key Challenges

Access to FOREX is the biggest of the challenges that limits the supply of SHS products in Ethiopia.

The supply of SHS products and off-grid products as a whole is highly import dependent, thus the lack of access to FOREX directly contributes towards the slow growth of the entire economy in general and the off-grid sector in particular.

Past and recent FOREX regulations enacted in response to FOREX supply scarcity are reducing the supply of SHS. Policies that regulate available FOREX do not prioritize the SHS sector resulting in the depletion of available FOREX prior to SHS suppliers are provided the opportunity to use this resource. As a result, the supply of SHS that could enter the market will not be made available.

The implementation of tax incentives to the sector as a whole or specifically local assemblers/manufacturers is not consistent. Due to frequent policy amendments, exclusion of proper HS codes for components in the tariff book, and customs officers not accurately understanding and/or applying the correct categorization of solar home system parts and components the taxation and customs clearing of SHS components is very difficult and heavily cumbersome for assemblers/manufacturers.

Stringent collateral demands of FOREX credit facilities are not attainable for emerging local assemblers/manufacturers. Emerging local enterprises start with few immovable assets that can be used as collateral to access both bank loans

and credit facilities. As financial institutions require high collateral this results in the inability for emerging local assemblers/manufacturers to use this critical financial resource.

Lack of after-sales maintenance and technical support (training) service. As the SHS sector is primarily import and distribution focused, there is minimal care given to providing solar users after-sales maintenance and training services. The proper provision of after-sales services can resolve problems such as early burnout of bulbs, failure of controllers, and fast draining of batteries, as they are common issues. Inadequate after-sales service and maintenance of products also undermines consumer protection.

Local manufacturers are unable to acquire international quality certification locally. Ethiopia Conformity Assessment Enterprise (ECAE) has a solar laboratory which performs Initial Screening Method (ISM) and Market Check Method (MCM) testing and certification of SHS products. MCM testing is performed on certified products at VeraSol's discretion and ensures that the quality of products sold in the market is preserved as the initially certified quality. ISM method provides important comments to manufacturers and product designers on an indication of whether the product will fulfill the quality standards. While these certifications enable local manufacturers to sell product locally, the ECAE does not perform tests which grant accreditation in the selling of products to the international market.



Recommendations

Value-creation based FOREX allocation: Allocating the FOREX from credit facilities of DBE such as ADELE for applicant companies based on the value, they create could help in improving the FOREX scarcity local assemblers/manufacturers are facing; it could also lead to efficiently utilizing the scarcely available resource.

Employing consistent tax regulations and providing capacity building training to implementers such as customs agents. Tax policies and their frequent amendments and implementation inconsistencies lengthen the importation process of SHS components. Fair tax regulations and proper categorization of components that assemblers and manufacturers import will help incentivize the sector. Timely communications among Ministries and government agencies regarding policy changes and quick update to customs officers will also be very beneficial in implementing up-to-date policies, which will help assemblers and manufacturers in reducing their cost of production.

Collateral support: Smaller companies have previously struggled to take advantage of available FOREX resources and loan programs such as ADELE because of their inability to provide the collateral requirements and working capital loans from commercial banks. Thus, the inclusion of collateral support in such facilities would increase their chances of securing the necessary FOREX.

Increasing the capacity and scope of locally available quality certification programs and testing labs: ECAE has come a long way in increasing the capacity to perform necessary tests and conducting certification programs of SHS. In growing its scope, ECAE should get accreditation by Vera sol to perform Quality Test Method (QTM). This is a method which is designed to confirm the overall performance and quality of the product. It is the necessary accreditation to grant selling of new product of local manufacturers in the international market. This will further increase the local capacity building and improve the technology manufacturing sector.

1. Introduction

1.1. Country Overview

Ethiopia has shown a rapid economic growth rate ranking 3rd in gross domestic product (GDP) across Africa, after Nigeria and South Africa as of 2021. The service and agriculture sectors are the main contributors to the GDP growth rate of the country with the industry sector contributing 28.9% of the total GDP.² The industry sector (combining both manufacturing and construction sub-sector) has shown a steady increase in its contribution to the GDP from 2012 to 2021³. Although the recent developments in the country such as foreign exchange shortages and the internal conflict in the country has slowed down manufacturing and construction activities, economic growth is expected to remain strong in the FY 2023⁴.

Ethiopia is the second most populous country in Africa, with a population of 120 million in 2021⁵. However, as of 2023 the country is still striving to provide electricity for the majority of its population. With only 44 percent of its population electrified in 2019⁶ the Government of Ethiopia set out a National Electrification Plan to provide electricity access through targeting 65 percent of electricity access with grid and 35 percent with off-grid technologies. Solar products, specifically Solar Home Systems (SHS) have the potential to drive an increase in the electrification rate of households in Ethiopia, especially in rural areas where only 27 percent of households have access to electricity⁷. Solar Home System is a small-scale individual energy generation system that uses photovoltaic solar panels to generate electricity and store it using batteries for household use. SHS systems can provide Tier 1, Tier 2, and Tier 3 electricity access as specified by NEP 2.0.

Solar Home Systems have the potential to reach rural and deep rural areas of Ethiopia to provide light and electricity access to the most disadvantaged groups of the population. However, the majority of SHS suppliers are small and medium-scale enterprises and depend on the importation of fully assembled products. This dependence on imports leads the environment to be highly susceptible to macro-economic events, such as the depletion of the foreign currency reserves, and the effects of inflation.

In its Ten-Year Development plan the GOE has emphasized its reallocation of the factors of production from low productivity to high productivity sectors resulting in a manufacturing-led economy⁸. This sector has the particular attention of the GoE with plans to attract investment in large numbers in the industry, satisfy domestic demand, and expand job creation, which is one of the main challenges plaguing the Ethiopian Government. This favorable environment for the expansion of manufacturing creates a large opportunity for the manufacturing and assembly of SHS products in Ethiopia.

The neighboring countries of Ethiopia also have a high demand for solar products. According to a 2022 SDG7 Access to Electricity report, 568 million⁹ people in Sub-Saharan Africa do not have access to electricity. This goes to show that there is a large market for solar home systems in the region. With growing potential in the sector and the support of the government in the manufacturing sector, there is a capability of producing solar home systems at a competitive price.

² 2021-22 Annual report.pdf (nbebank.com)

³ 2021-22 Annual report.pdf (nbebank.com)

⁴ World Bank Document

⁵ Population, total - Africa | Data (worldbank.org)

⁶ NEP_2.0_Ethiopia.pdf

⁷ NEP_2.0_Ethiopia.pdf

⁸ Ten Years Development Plan PDF.pdf

⁹ SDG7 report (2022) Access to Electricity

1.2. Ethiopian Manufacturing Policy

Ethiopia is implementing a national manufacturing initiative, 'Ethiopia Tamrit', that aims to increase export revenues as well as help manufacturers to meet the increasing local demand by substituting imports and reducing production costs. The manufacturing and industry sector is projected to grow from 6.8% in 2020 to 17.2% by 2030, increase its production capacity to 85% from the 50% target, and foreign trade revenue to 9 billion US dollars from the current 400 million US dollars from the sector.¹⁰

The plan incorporates absorbing more human resources, even taking a share of employment from agriculture and other subsectors, to bring about urbanization across regions. Currently, manufacturing share to employment is 5% and by 2030 the plan is to reach 15% by creating 5 million new job opportunities.¹¹ To realize these goals, the GoE offers several manufacturing supportive incentives for both domestic and foreign investors who wish to invest on manufacturing in Ethiopia.

Some of these incentives are:

1. Income tax incentives.

- Business income tax exemption is applied to the manufacturing sector for up to 6 years based on sub-sector and location of investment. Electrical systems manufacturing is exempted 2-4 years of income tax based on the investment location.¹²
- Export-oriented business is exempted by an additional two years of income tax with 60% or more export or supply to an exporter.

2. Customs incentives.

- Capital goods, machinery, and other accessories needed to produce goods or render services, are exempted from customs duty and other taxes for different periods based on their invested capital and number of employees.¹³
- Customs duty reduction on imported raw materials by import substituting local manufacturers.
- Customs duty and other taxes exemption on imported raw materials for export manufacturers.¹⁴
- Customs duty and other taxes exemption on construction materials needed to establish a new manufacturing facility.¹⁵

3. Financial incentives.

- DBE Soft loan for strategic investment projects in priority sectors which includes manufacturing. The repayment term goes up to 20 years; and interest rate ranges between 9%-9.5% depending on export capability. Also, longer grace period (up to five years) is provided, and the project itself is taken as a collateral.¹⁶
- Reduced charge for opening Letter of Credit (LoC) by manufacturers (reduced from the regular rate of 3.5% to 0.5%).¹⁷

¹⁰ Ethiopian news agency, May 2022.

¹¹ Ministry of industry, March 2023

¹² Investment proclamation 270/2012

¹³ Investment proclamation 270/2012

¹⁴ Customs duty second schedule directive no 45/2016

¹⁵ Investment proclamation 270/2012

¹⁶ Development bank of Ethiopia credit policy.

¹⁷ Ethiopian investment commission(link)

1.3. Overview of SHS Manufacturing and Assembly in Ethiopia

Ethiopia has the 2nd largest market potential in Sub-Saharan Africa and the largest in the world after India and Nigeria, this market is primarily supplied with SHS products that are imported from different parts of the world¹⁸. The OGS market is still in its emerging stage, as 82% of Households (HHs) using Off Grid Solar (OGS) products as a primary source acquired them in the three years from 2016 – 2019. The supply side of the SHS market is dominated by importation and distribution companies, with minimal involvement of manufacturers and assemblers. From 2019 – 2022, 2.45 million units of SHS has been sold from China, India, and Europe while local assemblers contributed nearly 45,000 SHS units^{19,20}. **Thus, calling for a need to strategize ways to convey the viability and potential of SHS manufacturing and assembly in Ethiopia.**

Local manufacturing/assembly of SHS products has been active for about a decade, there are currently 4 SHS assemblers and one manufacturing company that has yet to start its operations. These assembly companies contribute below 2 percent of the total supply to the OGS market and are producing SHS 80 percent below their total capacity. **The current annual production of all local assemblers altogether, which is on average 11,500 units, is below the annual production capacity of just one of them.** This underperformance is primarily attributed to the lack of sufficient access to FOREX needed to import components. In addition, financing and regulatory hurdles such as the inconsistency in tax regulations, quality assurance issues, and national macro-economic factors are hindering the sector from its growth and expansion. SHS importers that have years of experience in the sector have a promising capacity to produce up to 350,000 SHS units annually.²¹

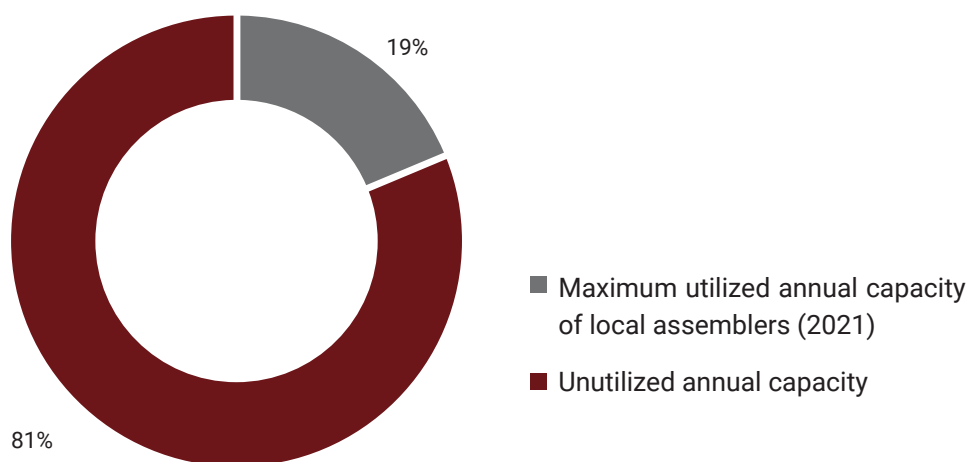


Figure 2 Local assemblers capacity utilization

Source: Interview with assemblers, Precise analytics

¹⁸ Market Map_ Intellectap_Ethiopia_2019.pdf

¹⁹ Interview data (GOGLA sales data)

²⁰ Precise analytics

²¹ Interview with importers.



1.4. Study Objective and Methodology

This research aims to assess the current SHS ecosystem of Ethiopia and evaluate the potential of local SHS manufacturing and assembly to supply the country's electricity needs. Specifically, it seeks to:

- Assess the current state and challenges of local SHS manufacturing and assembly in Ethiopia;
- Conduct an in-depth analysis of the supply and demand side of the SHS market;
- Identify the potential benefits of local SHS manufacturing and assembly, including its potential for FOREX savings, job creation, etc.;
- Provide recommendations to scale up and catalyze the local manufacturing and assembly of SHS products.

The study was conducted to inform key sector stakeholders and the broader audience to catalyze action towards the manufacturing and assembly of solar products in Ethiopia. By exploring the national benefits that can be unleashed through local manufactory and assembly and comparing it with SHS import and distribution, the study aims to notify government agencies and the broader thematic community of public actors seeking to contribute towards the acceleration of electricity access in Ethiopia.

Research for this study was conducted via desk-review and primary research through consultation with key stakeholders in the sector such as SHS manufacturers, assemblers, importers, and assemblers. By selecting participants with years of experience in the energy sector, this study represents diverse perspectives on the study subject. Both quantitative and qualitative data collection and analysis methods were used to allow for a comprehensive understanding of the viability of local assembly and manufacturing of SHS. The quantitative data collected through the structured questionnaire was analyzed by developing a socio economic and financial model. The model assesses the impact of renewable energy industry policies on drivers of solar adoption such as tariffs. The model includes detailed cost breakdown of assemblers, manufacturers and imports to assess the cost of localization. Additionally, it analyses the foreign exchange saving and job creation of locally assembling and manufacturing.

The study adheres to ethical guidelines for research, including informed consent of participants, confidentiality, and privacy protection.

2. Demand Assessment

2.1. Demand Analysis

2.1.1. Addressable Market

According to the NEP 2.0, 35 percent of the Ethiopian population is expected to have access to electricity through 9 million off-grid connections, providing electricity to 45 million people. This means that, on average, approximately 840,000²² new households will be connected through Off-grid (OG) solutions annually between 2019 - 2025. This is a large market for solar home systems.

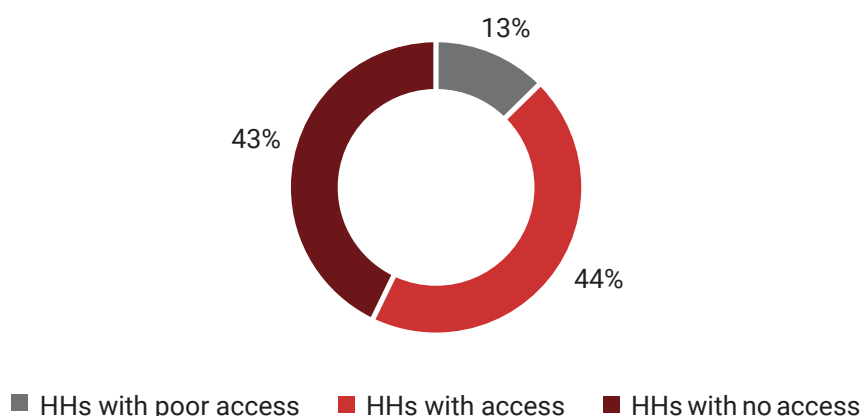


Figure 3 Access to electricity in Ethiopia

Source: Ethiopia: Beyond Connections - Energy Access Diagnostic Report Based on the Multi-Tier Framework, World Bank

The figure above shows the potential market size of off-grid solutions as 56 percent of Ethiopian households have poor or no access to electricity. This weakly served rural community provides much of the opportunity for the growth of the OGS sector as 95% of SHS sales are to rural households located at least 2.5 km away from the national grid²³.

According to a 2022 SDG7 Access to Electricity report, 568 million people in Sub-Saharan Africa do not have access to electricity²⁴. The electrification

rate in some of the countries, like South Sudan accounts for only 7 percent electrification²⁵. This vast market offers future export opportunities for solar technology manufacturers and assemblers in Ethiopia allowing the solar sector to not only save FOREX but earn additional foreign currency as well. Local manufacturers can also take advantage of the preferential treatment due to the African Continental Free Trade Area, an agreement that will reduce tariffs among member countries and cover policy areas such as trade facilitation.

²² NEP_2.0 Ethiopia

²³ Ethiopia's Off Grid Energy Access Financing

²⁴ SDG7 report (2022) Access to Electricity

²⁵ SDG7 report (2022) Access to Electricity

2.1.2. Willingness and Ability to Pay

As suggested by the NEP 2.0 there is a high willingness to pay for solar products with 80% of households willing to pay for a Tier 2 solar lighting systems. Of these HHs 45.1 percent would be willing to purchase the SHS products up front, while 34.8 percent would buy the products within a 6-to-24-month repayment plan. Tier 2 SHS provides at least 4 hours of electricity per day and is able to power low-load appliances—such as multiple lights, a television, or a fan. Most rural households who were unwilling to pay, however, cite the affordability of the product as the main constraint.

Additionally, the willingness to pay of customers is shaped by their local perceptions of the sector and

confidence in SHS products. An increase in quality product sales will only be realized when products align with the customer's willingness and ability to pay.

The primary driver of purchasing decisions is not increased power output, but rather how suitable the products are for their daily needs. The added feature of a mobile charger and a radio kit increases willingness to pay of customers. Market research indicates that consumers are paying higher prices for lower-capacity products compared to those that offer higher capacity ²⁶.

2.2. Drivers of Demand

Demand for SHS products is affected by a variety of macro and micro economic factors. The microeconomic factors affecting adoption of SHS technologies are affordability, availability, and the accessibility of SHS products in the market. While factors such as the country's surging inflation and its low FOREX reserves affect the uptake and expansion of the SHS market.

2.3. Barriers to Demand

I. Limited consumer financing options

The majority of the financing activity of MFIs in the off-grid sector is through government-run credit facilities such as the DBE managed projects. Beyond the vetting process, DBE exercises no oversight on the interest rates set by MFIs when lending to households.

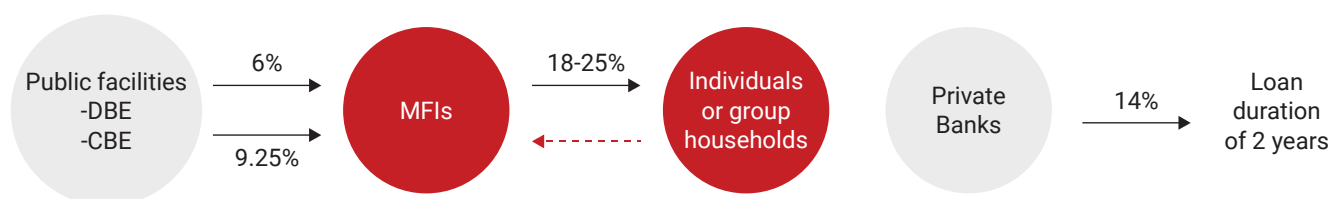


Figure 4: Lending Rates Across Financing Channels

Source: Stand Alone Solar SAS Market Update Ethiopia (2021)

²⁶AFDB_Off-grid Market Assessment

The figure above illustrates MFIs can lend to the end consumer at up to 2x the interest rate compared to the interest provided by government facilities. MFIs borrow from government facilities like DBE at relatively low-interest rates below 10%, where DBE bears the full risk of the loans²⁷ and from private banks at 14%, eventually lending to households at rates up to 25%. When set against the average monthly income of a rural household (approx. \$21), such rates can act as a deterrent for consumers. Rural consumers are still receiving credit from microfinance organizations (MFIs), but the interest rates they pay are too high for poor households to afford.²⁸

Additionally, large-scale agricultural activity means that many households have seasonal incomes that depend on harvests, which can be incompatible with the repayment periods or frequencies.

The adoption and scale of PAY Go has been slowed by the policy and social environment surrounding financial transactions. The bank-led model of digital mobile services, as a result of the NBE's restrictions of payment instruments issuances to finance. These restrictions hinder the end customers' opportunity of paying for SHS.

II. Quality and Services Related Challenges Prevalent

The market share of quality non-certified products is on the rise, and quality assurance procedures are not in favor of quality products.

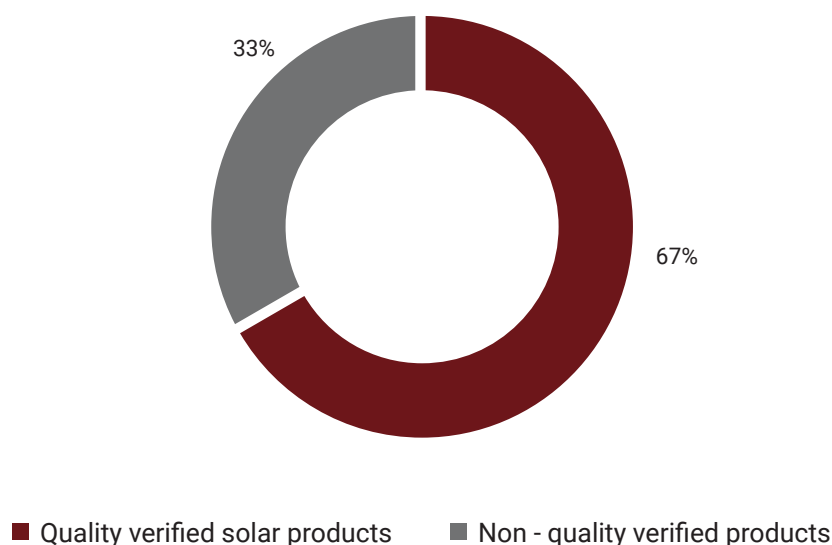


Figure 5: Quality verified Vs unverified solar products.

Source: GoGLA Market Report, 2021

The non-quality verified products, which in most cases, are poor in quality, and cheap in the upfront price, are damaging consumers' trust as well as creating market spoilage.

²⁷ Development Bank of Ethiopia, *The Role of DBE in Financing Inclusive Investment in Climate Resilient Green Economy*, 2015

²⁸ Stand-Alone-Solar-SAS-Market-Update-Ethiopia



3. Supply Assessment

There is a wide gap in the demand and supply market of solar lighting products in Ethiopia, the primary contributing factor to this gap is the off-grid sector's dependence on imports. The supply composition of SHS products shows the share of locally assembled/manufactured products is quite minimal when compared to the imported volume. As of 2022 the number of local assemblers and manufacturers shows a steady increase to 6 companies when compared to just one from 2014.

Although SHS suppliers have been growing in number, the yearly supply volume of importers has not shown steady growth. This is primarily due to the inaccessibility of the FOREX needed for imports. Due to the same reason local assemblers/manufacturers production growth has remained inhibited.

3.1. Supply Growth Trend and Market Presence

The solar lighting and home system supply to Ethiopian market has seen growth in the past 6 years with a total of 2.45 million SAS products supplied to consumers between 2019 and 2022.²⁹ When this supply volume is compared to the total addressable market (TAM), or 9 million OGS connections targeted by the NEP 2.0, only 27.2 percent is addressed in the first four of the entire seven years.

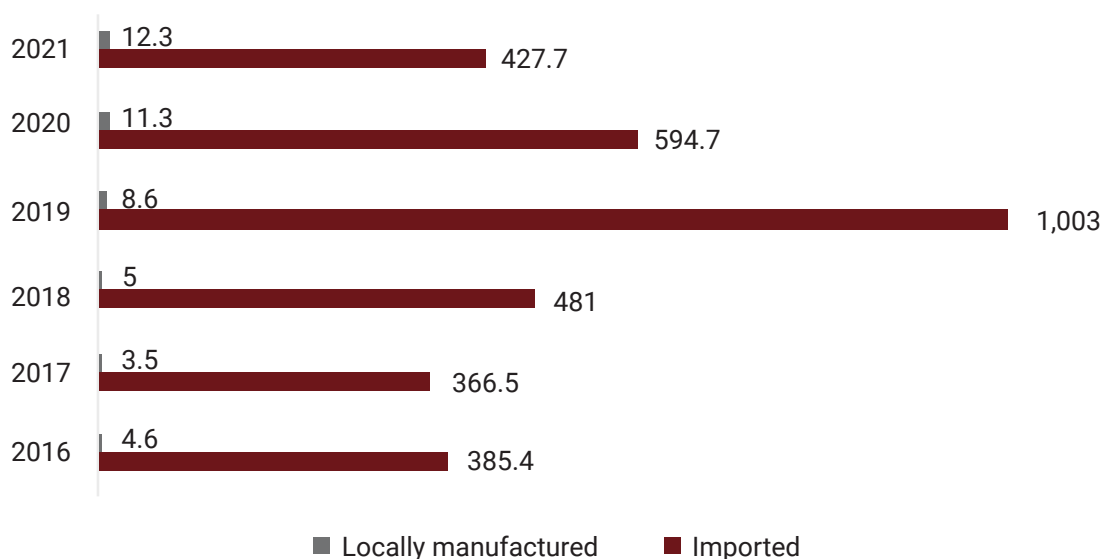


Figure 6: Volume of locally assembled/manufactured SHS Vs Imported (thousand units)

Source: Global off-grid market report H2 2021, Local assemblers/manufacturers' data

²⁹ GoGLA SAS market report, 2022.

The highest supply growth happened between 2018 and the end of 2019 due to the credit facility that provided finance to solar companies (through both access to FOREX and working capital). Additionally, imported CBU systems were exempted from duty tax, these fiscal supports attributed to the growth in supply of solar products in the market. In the following 2 years, there has been a decrease in supply of solar products attributed to several factors such as COVID 19, devaluation of Ethiopian birr, depletion of credit facilities for solar sector and the political instability of Ethiopia, that disturbed the global economy and the OG sector specifically.

3.2. Supply Chain Analysis/Mapping

SHS companies in Ethiopia source their products in one of three forms: Completely Built Up (CBU) system, Semi Knocked Down (SKD), or Completely Knocked Down (CKD). Depending on which forms they purchase and sell, they are identified as importers, SKD assemblers, or CKD assemblers respectively. Local SHS manufacturers design product components and import these products in CKD form. This process starts with the design of the system and involves components' fabrication and assembly. Major components in the production include photovoltaic panels, batteries, cables, inverter, control board and appliances such as bulbs, radio, and phone chargers. The delivery process of a functional Solar Home System (SHS) to end-consumers involves multiple steps such as manufacturing of components, assembling, packaging, wholesale, and distribution. This process comprises a chain that interconnects several stakeholders.

SKD assembly is a production assembly method whereby kits of partially assembled components (i.e., modules), are assembled to finished products. The systems are imported in a limited number of modules and the final touch in production will be localized. Another form of knocked down systems' assembly is the Completely Knocked Down (CKD) system assembly, whereby SHS components are imported from the manufacturing country in a completely unassembled form. To complete CKD assembly, local assemblers import components unassembled, and can replace some of the imported components with locally manufactured ones.³⁰

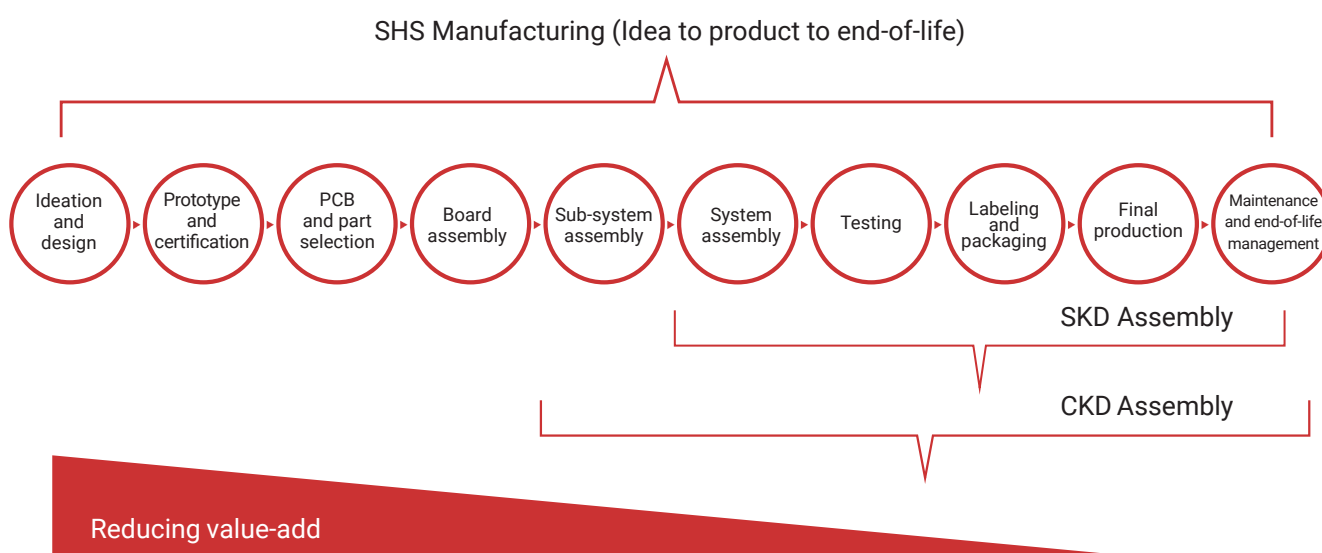


Figure 7: SHS product life cycle

The products available in Completely Built Up (CBU) form are fully assembled and ready-to-use systems that are directly imported and distributed to end-users. In Ethiopia, a significant portion of the solar home systems currently in use are obtained as CBU products manufactured by industry leaders such as China and India.

³⁰ Solar Manufacturing, Department of Energy

3.2.1. Import Supply Chain

The import of completely built-up SHS holds the lion's share of the supply market in Ethiopia. As of 2023 there are about 33 SHS companies, registered under ESEDA, engaged in the importation and distribution of solar products. Despite the lengthy importation process, which is further exacerbated by frequent solar regulation updates, and the challenges related to FOREX acquisition, these companies provide more than 90 percent of the total sales volume shown in Fig 5.³¹

Moreover, the inconsistent implementation of tax regulations adds another layer of complexity to the import process.

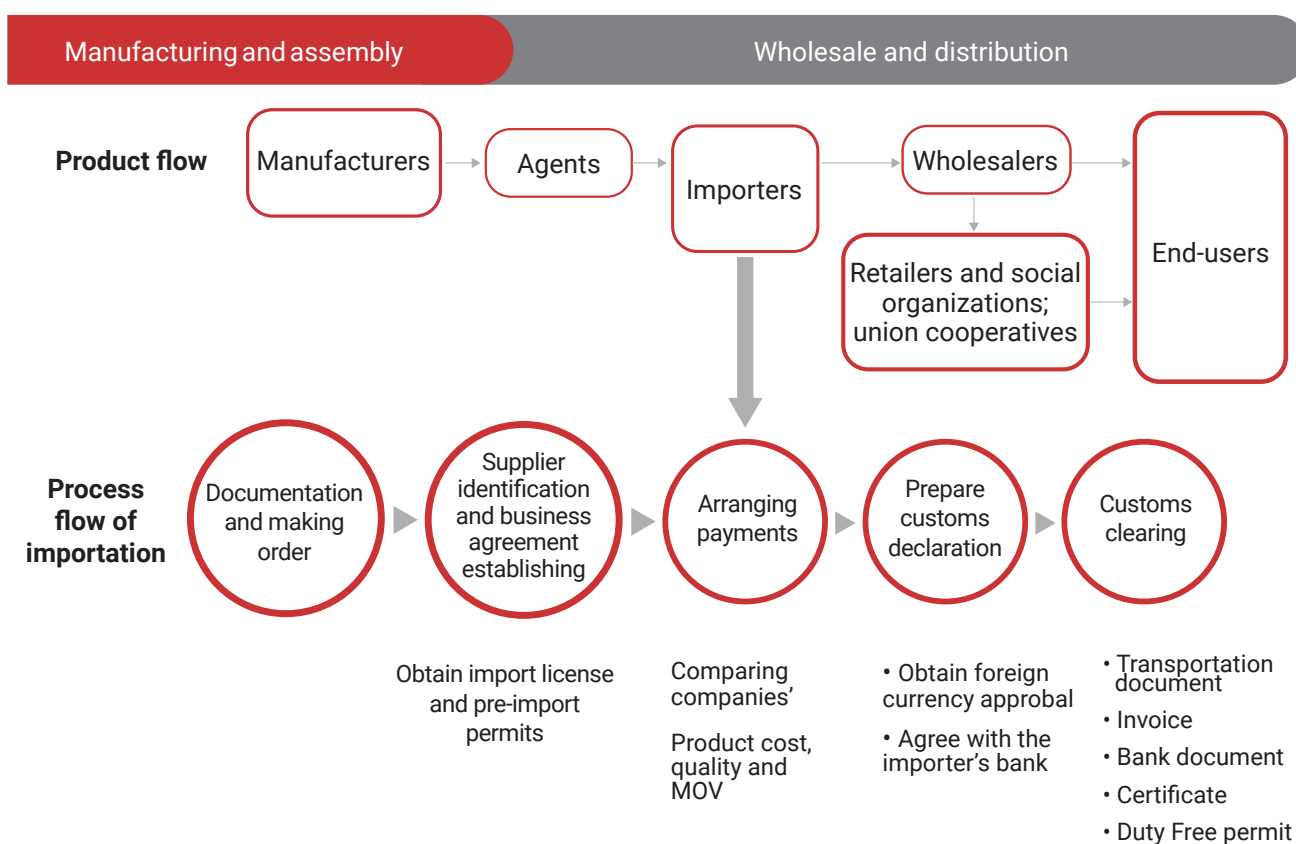


Figure 8: Supply Chain of Imported SHS Products

Source: ESEDA, interview with importers

³¹ The sales volume referred to as 'total' in this section is not inclusive of sub-standard and counterfeit products in the market.



Photo by Abramba Technologies Plc

3.2.2. SKD Assembly Supply Chain

The assembly of Semi-Knocked Down systems is the final stage in an SHS production system. It involves locally assembling SKD components into a single SHS package. These SKD products are imported directly through special supplier linkages with foreign manufacturers.

Even though all the needed components are imported in a single package, when compared to the import of Completely Built-Up products SKD assembly provides room for local value addition like labor for assembling the units. SKD assembly can also act as a steppingstone to get in to CKD assembly and manufacturing, as companies who transition from CBU import get to learn about assembly and build their technical capacity.

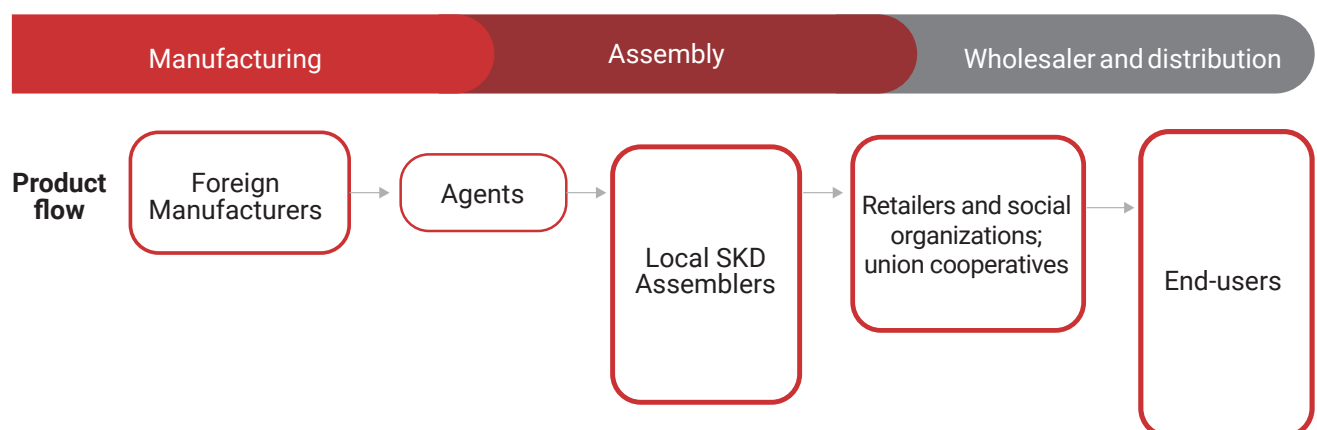


Figure 9: Supply Chain of SKD Assembled SHS Products

Source: Interview with SKD assemblers



Photo by Abramba Technologies Plc

3.2.3. CKD Assembly Supply Chain

A step ahead of SKD assembly in value-addition to SHS units is the assembly of Completely Knocked Down parts. CKD components are not imported in a single package, this provides assemblers the option to locally source available components such as bulbs, cables, PV panels, packaging, and housing materials. Existing and emerging local manufacturers have the potential to supply some of their products to SHS CKD assemblers. This local sourcing reduces the FOREX needs of assemblers and promotes local manufacturing.

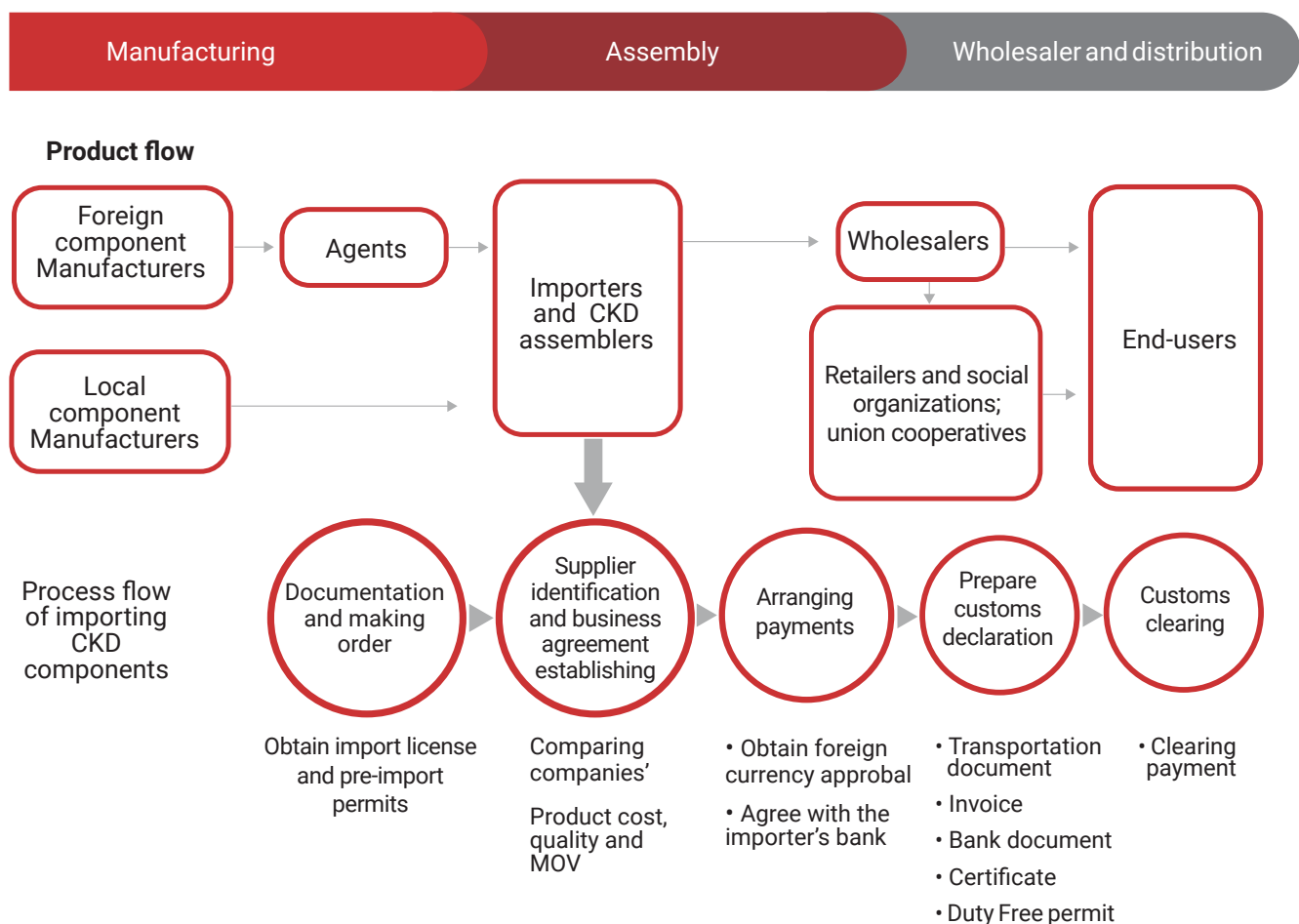


Figure 10: Supply Chain of CKD Assembled SHS Products

Source: Interview with SKD assemblers and manufacturers

Company	Product	Status
Ethiopian Power Engineering Industry (EPEI)	Solar panels	EPEI had started solar panel manufacturing 12 years back with an annual production capacity of 20MW but ceased operation after 6 years due to various internal reasons. Currently the factory is on its way to restart manufacturing of monocrystalline PV panels in a joint-venture with a foreign manufacturing firm to scale up its production to 500-850MW. It targets to avail its products to local and international market. In the long run, EPEI also plans to manufacture solar batteries and invertors for solar systems.
Euro-cable	Electric Cables	Euro cables produces installation wires and power cables for voltages up to 1 kiloVolt.
Kaledawit Electronics	System controller	Kale electronics is an electronic controller designing and manufacturing firm that aspires to supply system control of SHS units to assemblers. Kale has also prototyped and tested a thousand units of its solar lighting products so far.
Winsol green power	Plastic molds	Winsol Green Power Engineering is one of the major energies (especially off-grid energy) equipment and solution provider. In addition to these, the company currently owns a plastic injection molding facility that can potentially produce solar home system components using the molding equipment.

Table 1: Examples of Potential local sourcing partners³²

³² Additional potential local sourcing partners can be found in the Annex.

³³ EPEI, an industry in of Ethio-engineering group, has been manufacturing solar panels.

3.2.4. Manufacturing Supply Chain

Local manufacturing of SHS products provides the most value-add in the supply of solar products in Ethiopia. Due to the nascent nature of the manufacturing sector, after the SHS component is designed locally the design is sent abroad to be manufactured into component parts. Local manufacturers thus have to both design and import the system components and proceed to assemble the component parts locally before providing the SHS products to the market.

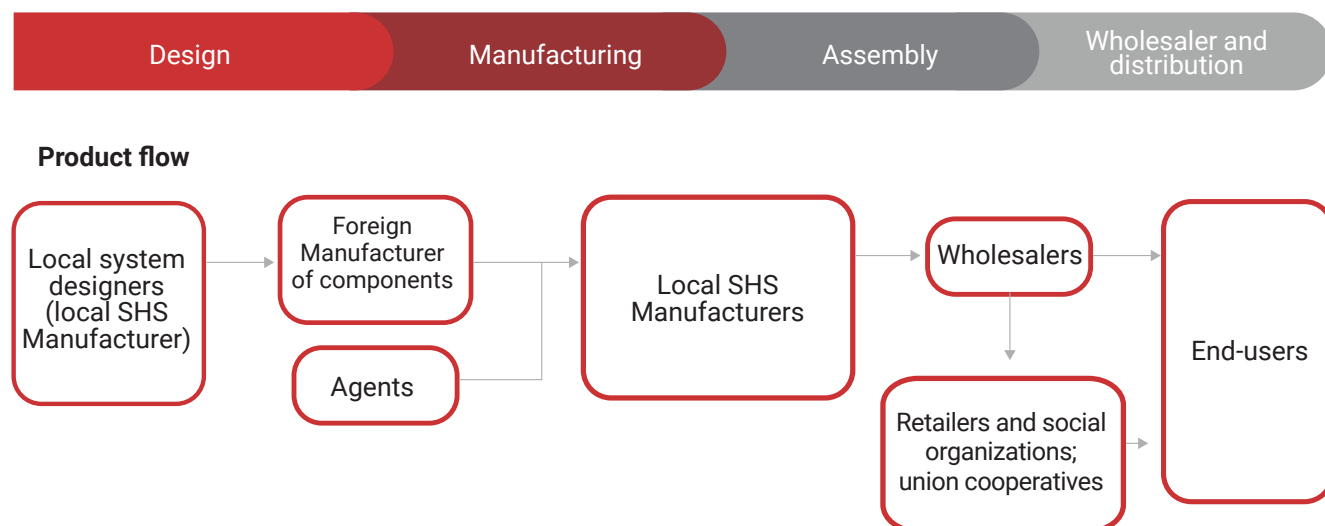


Figure 11: Supply chain of local SHS manufacturing

Source: Interview with manufacturers

3.3. Challenges in Supply

Access and availability of FOREX is the key bottleneck for all SHS suppliers. Due to the country's current FOREX scarcity the NBE has removed solar import as a priority sector. Additionally, regulations for surrendering FOREX now demands private enterprises to surrender up to 70 percent of their total FOREX earning to NBE and 10 percent of their total earnings to their banks. A remarkable source for FOREX in SHS supply was ADELE, a USD 40 million FOREX credit facility provided through the development bank of Ethiopia (DBE). Since the end of the previous round of this program, access to FOREX has become the key challenge limiting the supply of SHS products.

Lack of infrastructure in rural areas is also a universal challenge among SHS suppliers, with high demand for their products present in rural areas facilities such as banking, roads, and telecom services are underdeveloped. Reaching and delivering SHS products to these areas requires additional costs for SHS suppliers.

Importation and distribution company challenges

Inconsistencies with customs regulations is also a challenge for SHS importers as tax incentives are applied differently for similar products. This has led to uncertainty in customs clearing procedures.

SKD assembly company' challenges

For assemblers of SKD systems, accessing FOREX is more difficult as FOREX granting facilities such as ADELE are proposal based and do not prioritize local value-addition.

The operational cost of SKD assemblers when compared to importers is very high as they are only getting less than one shipment of goods to assemble annually due to lack of access to FOREX. This in turn makes them idle for most of the year. Since they employ staff to do the assembly and manufacturing, compared to CBU importers, they have additional



investments and cost in the production facility. Thus, when compared to CBU importers it is challenging for SKD assemblers to operate.

Manufacturing company challenges

The unavailability of international quality assurance and certification in Ethiopia challenges local manufacturers by exposing them to high expenses to assure their products quality by foreign companies. This is unique to the manufacturing of SHS products as CBU and SKD SHS complete quality assurance and conformity test in their source country.

The approval of all components that manufacturers need by the Ministry of Industry to receive duty-free benefits are repetitive leading to the incessant preparation of lists containing hundreds of components along with specifications (For every modification in design) and providing explanation for it creating delays and becoming a tedious bureaucratic task.

4. Current Policy and Regulation Affecting the SHS Manufacturing & Assembly Industry

As the Ethiopian government focuses more on enabling the manufacturing environment in the country, below are programs/policies designed to empower the off grid and/or manufacturing sectors.

Ethiopian National Energy Policy: Policy stipulates increasing access to electricity through on-grid and off-grid technologies, providing incentives for private investment in off-grid electrification, and facilitating financing for renewable technologies. The national energy policy promotes small scale solar technologies like Solar Home Systems and Solar Lanterns.

National Electrification Program (NEP 2.0, 2019): The document plans out universal electrification in 2025 through grid and off-grid connections (65% on-grid, 35% off-grid) and universal access to the grid in 2030. Currently, NEP 3.0 is under development and soon to be released.

Energy Standards and Regulations: Ethiopia has linked fiscal incentives with quality standards. Ethiopia Conformity Assessment Enterprise (ECAE) has a solar laboratory testing a range of solar products. The enterprise tests the quality standards for pre-import verification products. Ministry of Trade and Regional Integration (MoTRI) is mandated to control the compliance of goods with the Ethiopian standards and take measures against those found to be below the standards. Oversees the coordinated enforcement of standards by other enforcement bodies. MoTRI has temporarily delegated its responsibility to Ethiopian Conformity Assessment Enterprise (ECAE) to control the services of PVoC agencies.

Custom Duties (2010 – 2022): This policy has several significant advantages, including the potential improvement in after-sales services, foreign exchange savings from importing Semi Knocked Down (SKD) components instead of fully finished SHS products, and the creation of knowledge-based, high-tech, and clean energy jobs. This paper will discuss the importance of these three pillars in Ethiopia's pursuit of a sustainable and thriving solar industry, and their potential impact on the country's economy and rural electrification efforts. Ethiopia's policy to impose a 15% tariff on imported solar panels and associated Solar Home System (SHS) products, while offering reduced tax rates for locally assembled and manufactured SHS products, serves to promote the growth of the domestic solar and overall electronic manufacturing industry.

4.1. Challenges in Policy

Manufacturing contributes a very small share of the GDP of Ethiopia. According to the NBE annual report 2021/2022, manufacturing contributes to a 6.76% share of the total GDP growth. The country currently does not have specific fiscal incentives in place targeting local manufacturing³⁴. SHS manufacturing, in particular, is thus under-incentivized regarding policy and regulations. There are improvable policies and regulations that create an enabling environment.

³⁴ Assessment-of-Local-Manufacturing-of-Off-Grid-Solar-in-Sub-Saharan-Africa-Policy



Photo by Abramba Technologies Plc

• Taxation of raw materials

Spare parts and raw materials are to be taxed, wherever the raw material itself is not set as duty free. SKD and CKD kits are duty free considering them as finished goods. But to go further into assembling and manufacturing, raw materials are taxed, putting them even at a disadvantage from importers. Another barrier for manufacturing and assembly is the fact that no certification can be provided for components. This could be a barrier for local products to obtain certification and export their goods to other countries.

There is a problem on the side of quality assurance for manufacturers as components, CKD, and SKD can't be tested before assembly. This limits the possibility to source from different places and go deeper into assembly or manufacturing which resulted in tax exemptions of quality solar products.

• Capital goods

In Ethiopia, the only incentive practically available for smaller local assemblers are duty exemptions for capital goods (machinery required for assembly). The investment incentives seem to be directed towards larger businesses. The smaller companies also do not have access to infrastructure that enables large scale manufacturing. Free Trade Zones and industrial parks are meant to attract larger companies. The local assemblers who are small are left to rent office and factory space often in areas that do not have adequate infrastructure such as assured three phase industrial power.³⁵

³⁵ Assessment-of-Local-Manufacturing-of-Off-Grid-Solar-in-Sub-Saharan-Africa-Policy

5. Financial Landscape

The role of financing institutions in the energy sector is one of the primary enabling factors in the SHS supply chain, it directly determines the growth and expansion of SHS companies as solar products are FOREX dependent.

Commercial banks, the Development Bank of Ethiopia, and microfinance institutions (MFIs) are approached by importers, local assemblers, and manufacturers seeking loans, grants, or equity financing to meet their initial investment and working capital needs. Although there are over 30 banks and 40 MFIs in Ethiopia³⁶, only a few of these institutions are willing to finance solar companies. The OG sector is relatively new in Ethiopia and capital intensive with long-term returns, this reduces its attractiveness for FIs. As a result, private firms struggle to secure their assistance.

5.1. Access to FOREX

Credits and grants provided by commercial banks, DBE facility, and development partners are the popular sources of FOREX for off grid companies. A recent survey conducted by ESEDA and its partners revealed that most solar companies access FOREX through letters of credit provided by commercial banks.

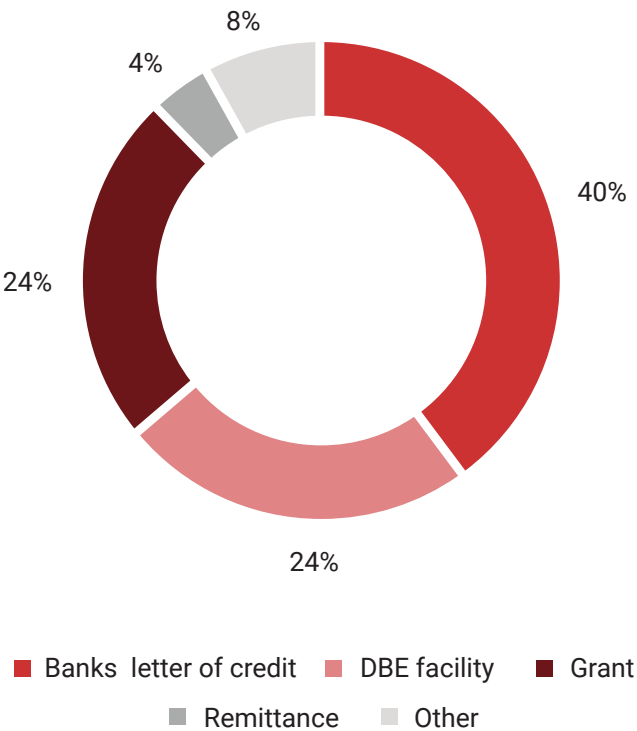


Figure 12: Sources of FOREX for SHS companies

Source: Access to FOREX and its impact on the renewable energy sector (2023)

³⁶ National bank of Ethiopia, August 2022

I. Banks letter of credit

As mentioned, accessing FOREX has been the biggest constraint for SHS importers, assemblers and manufacturers for a long time. This FOREX shortage has been exacerbated in the past two years due to several factors including COVID 19 pandemic, internal conflicts, and the depreciation of the local currency.

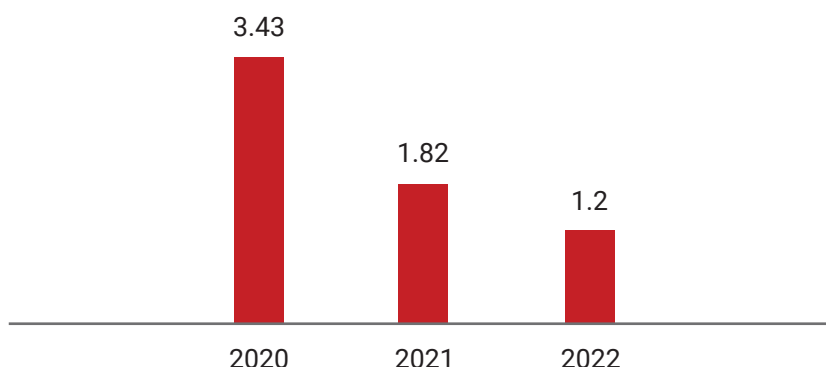


Figure 13: NBE FOREX reserves in the fourth quarters of 2020/21/22 (USD Billion)³⁷

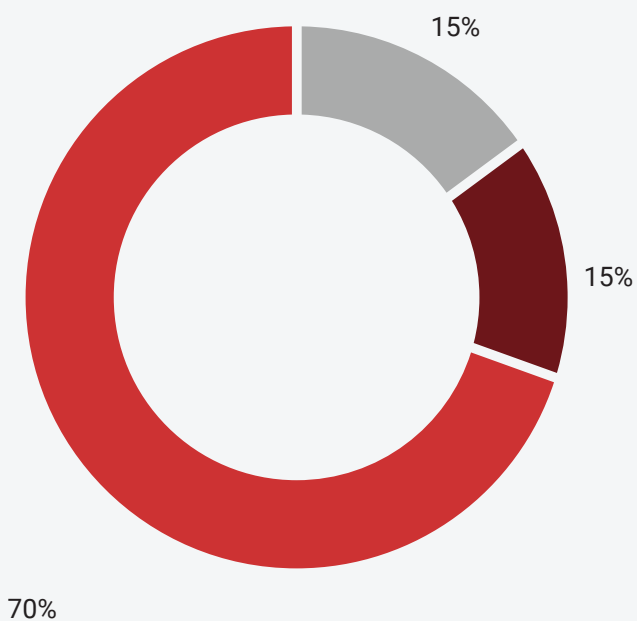
To give context, the nation's FOREX reserve in the fourth quarter of 2022 has reduced by 60 percent compared to previous years. In response to this, the National Bank of Ethiopia (NBE) has been amending FOREX allocation, utilization, and retention regulations based on the country's FOREX position. Some of the measures that highly influenced the solar sector are:

- **Priority listing:** The National Bank of Ethiopia (NBE) requires commercial banks to allocate 50% of their total FOREX to commodities listed in primary, secondary, and tertiary priorities. Unfortunately, solar items do not belong to any of these categories and are therefore not given any priority.³⁸
- **The FOREX retention and utilization directive:** The FOREX retention directive that has been frequently updated does not allow FOREX retention accounts to be created for companies that are not engaged in export businesses.³⁹
- **Companies' FOREX surrendering:** Individuals or companies are only allowed to reserve 20 percent of their total FOREX earning, surrendering 70 percent to the NBE and 10 percent to their respective commercial bank.
- **Commercial banks surrender:** Commercial banks are subject to surrendering 70 percent of their total earnings to the NBE. And at least half of the remaining must be allocated for high priority commodities' importers.

³⁷ Cepheus Macroeconomic outlook, 2023, The global economy

³⁸ FOREX Allocation Directive No. 77/2021

³⁹ FOREX Retention and Utilization Directive No. 79/2022



1. Allocated for registration exempted forex requests including:

2. Forex retention accounts
3. Ivisible payments
4. Payments authorized by NBE and
5. Salary transfer of foreign employees

6. To be sold on a first come first serves basis to importers. SHS importers are can access from this portion.

Figure 14: Commercial banks' FOREX allocation

Source: FOREX retention and utilization directive FXD/79/2022

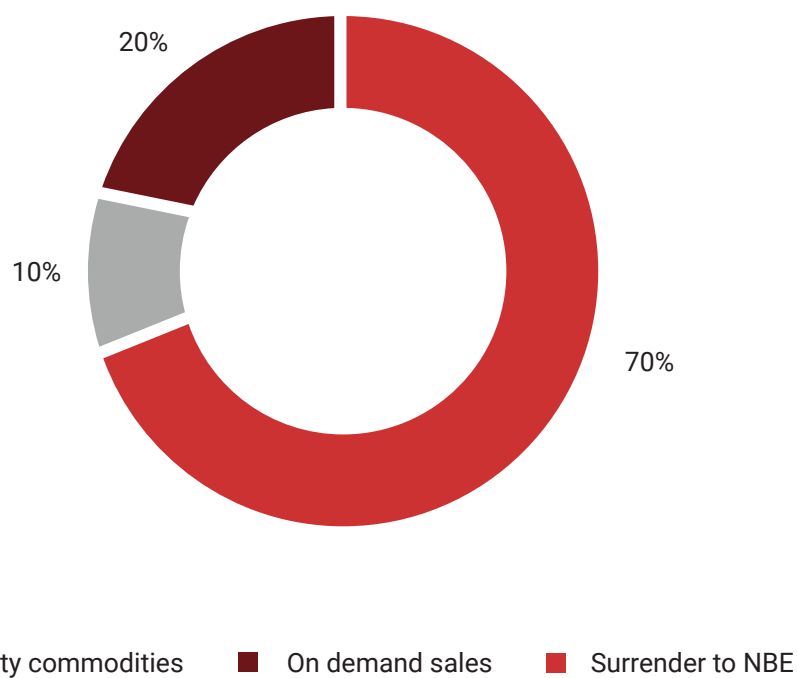


Figure 15: Individuals' FOREX retention

Source: FOREX retention and utilization directive FXD/79/2022



Moreover, importers that belong to non-priority lists must deposit at least 50% of the proforma invoice into a blocked account to register for FOREX requests. They are required to wait between six months and a year for approval of the LoC (Letter of Credit). The FOREX scarcity and the rules enacted to overcome the challenge altogether narrow the chances of accessing and utilizing FOREX for solar companies. The supply of solar products, which is highly dependent on imports, is thus greatly limited.

II. DBE Facilities

Donor-supported credit facilities are playing a pivotal role in providing much-needed support to players in the solar energy sector in Ethiopia. These facilities not only provide solar companies with working capital when required, but they also offer access to foreign currency, which has become increasingly difficult to obtain through traditional banking channels. As a result, solar enterprises that have been struggling to secure foreign exchange are now able to leverage these credit facilities to drive the supply of solar energy products to the local market.

Two financing facilities, namely MDCL and ADELE, have emerged as key players in providing critical support to the solar energy sector. These facilities have been instrumental in enabling solar companies to access the funding they require to grow and expand their operations.

Market Development credit Line (MDCL): The Market Development Credit Line (MDCL) is a component of the Electricity Network Reinforcement and Expansion Project (ENREP) under the June 2012 financing agreement Ethiopia and the International Development Association (IDA). It was created in response to growing demand for renewable energy technologies and products among customers not connected to the electricity grid. It has been the largest source of SAS sector financing via its USD 45 million fund which has contributed almost 90% of total investment in the sector.

MDCL highly supported private solar companies/importers in fulfilling their need for liquidity and access to FOREX at affordable rates to bring market leading international technologies to Ethiopia. Yet the facility did not favor local manufacturing and local value-adding sectors. Thus, emerging enterprises could not benefit from the facility as they couldn't meet the eligibility requirements.

Access to Distributed Energy and Lighting in Ethiopia (ADELE): The World Bank collaborated with MoWE, EEU, and the development bank of Ethiopia (DBE) and approved a USD 500 million loan to Ethiopia in March 2021 to increase access to reliable electricity for households and social institutions. This includes a 40 million USD access to finance facility that focused on providing a line of credit for accessing FOREX for SHS import purposes. The intention was that reflows from these transactions will capitalize further windows to support working capital businesses and support consumer financing via MFI's and provide partial loan guarantees to share risk with commercial banks.

The ADELE money is planned to be distributed to applicants through the DBE based on their eligibility. Among the applicants expecting the loan, local assemblers and manufacturers benefit the least due to the generic pre-requests which they could not fulfill. The pre-requests do not separately entertain local value-adding applications.⁴⁰

III. Grants and Funds

Grants from several development partners focused on renewable energy development have been sources of FOREX for solar item importers and manufacturers. Lately however, as Ethiopian solar companies are not allowed to retain more than 20% of the FOREX they might secure from grants and funds, these companies do not seek out international financing opportunities⁴¹.

⁴⁰ Requirements of the ADELE facility is annexed.

⁴¹ Access to FOREX and its impact on renewable energy- 2023

5.2. Loan Financing

The state-owned Development Bank of Ethiopia (DBE) was the single most important lender to OGS players in Ethiopia, through the credit line provided by the World Bank. This credit line provided access to FOREX and working capital loans to suppliers of Solar products.

The remaining financial institutions contributed very little to loans provided to OGS companies. The total loan portfolio for off-grid solar companies (which is about 0.6 Bn Birr) represents less than 0.05% of the total bank loan portfolio in Ethiopia. This shortage of financing could potentially hinder the development of off-grid solar systems.

Banks require collateral of value up to 178 percent of the total loan requested by small to medium scale enterprises (SMEs). This stringent collateral demand of banks does not align with the financial capacity of off-grid companies, especially assembly, and manufacturing firms. Most OGS companies in Ethiopia are SMEs demanding high working capital, thus short-term loans requiring little-to-no collateral is a better suit. Unfortunately, the financing demand of these companies is higher than that provided by non-collateralized MFI offers and is too risky for banks to invest in for no collateral.

The high interest rates of commercial banks, which go as high as 17 percent, is another hindrance to the application of loans towards OGS companies.

5.3. Challenges in the SHS Financing Landscape

The major challenges in adequately financing the sector are:

- FOREX Credit facilities deprioritizing local assemblers/manufacturers: Credit facilities that have brought appreciable results in the solar market do not prioritize local assemblers and manufacturers leading to the sector's performance dependence on grants and imports.
- Banks' perception of the sector. Banks consider the off-grid solar sector high risk and even those who could have dared investing are refrained by the working culture of banks as their operations are more concentrated on directly executing the central bank's strategic rules focused on specific sectors.
- High interest rates: High interest rate of banks is an additional reason why emerging solar enterprises do not access bank loans to finance their working capital and expansion needs.
- Requirement for cumbersome collateral: Inability to present collateral of value requested by banks impedes companies from accessing LC from banks. Lowering their demand of collaterals should be considered. With the updated capital threshold of MFIs, there is a chance of MFIs growing to the capacity of being able to adequately finance solar companies sparing them unreasonable collateral requests.
- Relationship based lending; Finance institutions see the trustworthiness of loan seeker from prior history of his/her debt returning capacity. That means applicants with a good track record of paying back are prioritized and it lessens the room for new entrants into a lending relationship with banks.
- Lengthy lending procedure: Lengthy procedures are exposed to wrong-doings and degrade the level of trust on the institutions.



6. Socio-Economic Feasibility of SHSs' Local Manufacturing/Assembling

6.1. Overview of Local Assembly and Manufacturing

Solar home system products are available in various models, with the basic model consisting of a solar panel, a power box that includes batteries and charge controllers, connection cables, LED lamps, a switch, and phone charging sets. It is important to note that these systems are not manufactured entirely from scratch and require a combination of locally produced and imported parts.

This assessment shows that currently there are some firms engaged in local assembly and manufacturing and a lot more are interested in shifting to the business following some support and promotion of the government to local value-adds. Through localizing value addition, it's common to attain some degree of cost and FOREX benefit in any other sectors (agriculture, textile). Yet, the electronics manufacturing sector in Ethiopia is not advanced and the supply chain for start-to-end manufacturing may not be reliable. However, due to the availability of cheaper resources such as human labor and utilities, local assembly of semi-knocked down (SKD) components appears to be a more practical intermediate step between importing finished products and investing in local manufacturing.

6.2. Cost and FOREX Saving in Local Assembly/Manufacturing

In order to take advantage of abundant and cost-effective resources and conserve scarce foreign exchange, it can be beneficial to localize smaller value-added processes, such as final assembly. Evidence suggests that as the level of localized value-added increases, so do forex savings and associated economic benefits. Therefore, manufacturing and locally sourcing components for assembly can result in even greater forex savings. This strategic approach can help boost the local economy and support the growth of the solar energy sector in the country.

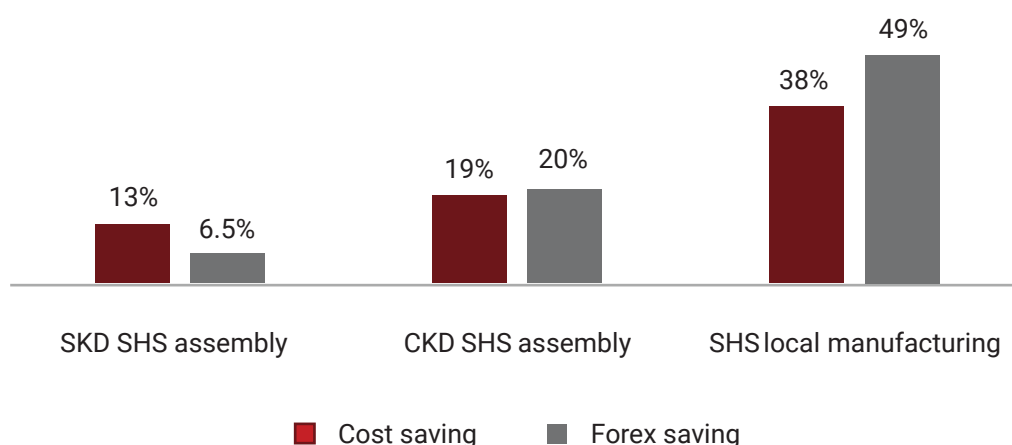


Figure 16: Cost and FOREX savings in local assembly & manufacturing of SHS as compared to import.



To show the cost and FOREX need comparison between importing CBU SHS and local SKD assembly, the cost build-up of a lighting and phone charging purpose SHS has been used. The cost of an imported CBU item is compared to the cost of a locally assembled similar item. To build up the cost of local assembly, the following assumptions were made.

- SKD assemblers import all modules in a single package and thus no cost saving is achieved on shipping.
- The imported SKD/CKD items are subject to five percent duty tax whereas CBU items are subject to fifteen percent duty tax.

- In CKD assembly locally available components such as cables, packaging materials, LED bulbs and plastic casings are locally sourced.
- All payments made to foreign purchases are 100 percent in USD. Whereas local purchases are in ETB. As such, current SKD and CKD assemblers' average expense to import a partially assembled three-bulb lighting system is calculated and other costs such as shipping, overhead, and wages per unit are computed and added to get the total assembly cost.⁴⁵

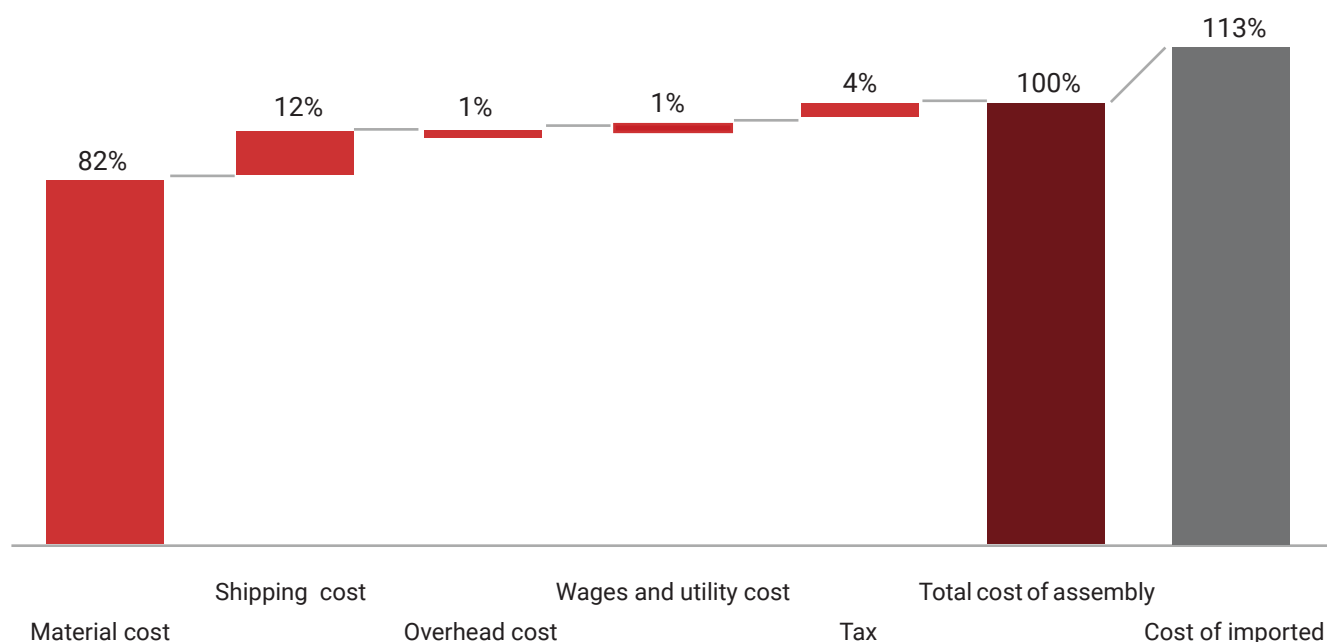


Figure 17: Total cost of locally assembling SKD SHS compared to total cost of importing a similar item.

Source: Precise analytics

⁴⁵ Key Informant Interview Reports

The result shows that SHS used for lighting and phone charging purposes can be provided to the wholesale market at a 12.7 percent discount compared to an equivalent completely built-up (CBU) imported item. This is possible due to the cheaper labor and utility cost available in the country, as well as the 10 % duty tax reduction SKD assemblers are subject to.⁴⁶ Given the price sensitive market of off-grid solar products, the cost reduction will have the potential to increase the products affordability.

Additionally, localizing value-adds through SKD assembly reduces the FOREX needs of solar companies by 6.5 percent per unit⁴⁷. This reduction, which is only due to paying for human labor and utility

costs in local currency, means the FOREX needed to import 100,000 SHS a year could be used to locally assemble 106,873 similar items.⁴⁸ That is lighting up that same number of additional off-grid families every year for no additional FOREX expense due to the minimum value-addition.

The FOREX saving achieved through local assembly can go as high as 24 percent per unit, if locally available components such as plastic molds, cables, and packaging materials, are sourced from local manufacturers.⁴⁹ Additionally, local sourcing allows assemblers to purchase components for upto 15 percent less price than imported components.

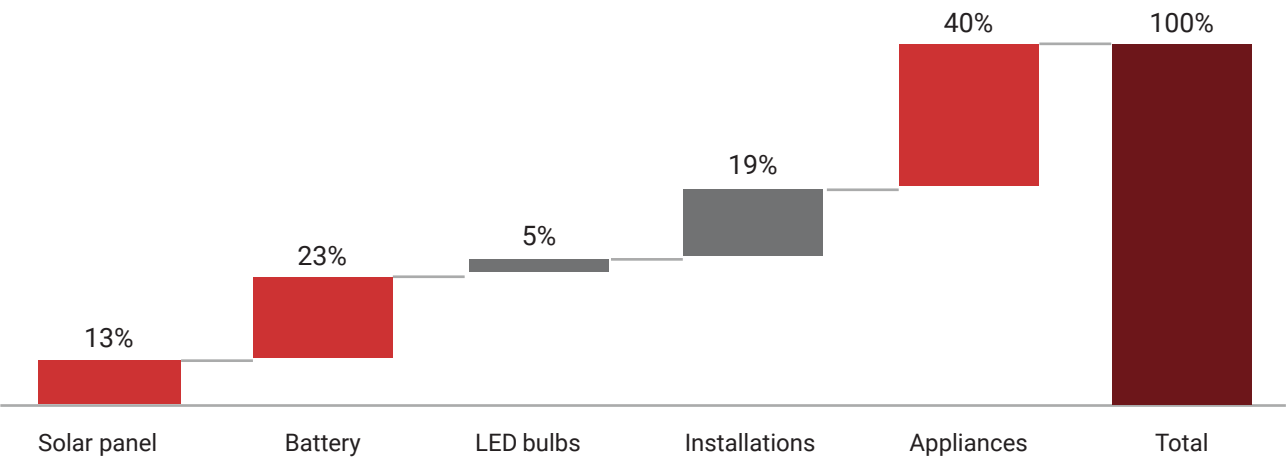


Figure 18: FOREX need of sourcing main components as a percentage of the whole.

Source: Precise analytics

⁴⁶ CBU importers are subject to 15% duty, while SKD importers pay 5%

⁴⁷ Interview with assemblers, Precise analytics

⁴⁸ Market Survey

⁴⁹ Innovative local and international sourcing pilot, 2023

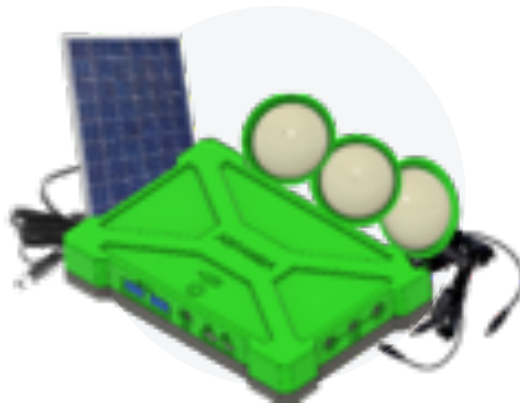


Figure 19: 10W SHS model with 3 light sources, two USB Type A, one USB Type C and one Micro-B ports.

Case Study I: Local Manufacturing

Abramba Technologies is a solar products manufacturing firm in Ethiopia located in the city of Bahir Dar. The company is set up to locally design and manufacture solar lanterns, solar home systems, and other off-grid/on-grid products including stand-alone solar panels, larger solar home systems, LED bulbs, LED tube-lights, and other grid-connected efficient lighting products. At this time, Abramba's annual manufacturing capacity is 100,000 solar home systems.

The model shown above is one of Abramba's quality certified SHS products that features three LED light sources and several USB ports used for charging.

Abramba designs and manufactures the system natively using modern printed circuit board (PCB) assembly processes and quality certified production system. All of the sub-systems such as the LED bulbs, main controller board, and the battery pack are locally manufactured. At this time, Abramba outsources its solar panel but it has future plans to bring the panel

assembly process in-house. In an effort to increase local footprint, the company has also incorporated the plastic case manufacturing aspect within its facility. The company sources the electronic components it uses within its designs, the battery cells it uses in its battery packs, the solar panel modules, cables, and other raw materials from various local and global suppliers.

Abramba's 10W SHS model requires about 50 percent lower FOREX need than importing a similar CBU system. The most significant FOREX savings in Abramba's locally manufactured systems is attained due to the fact that the system design itself (including all of the systems engineering) is home-grown and is not outsourced. Other significant factors that contribute to FOREX savings in Abramba's manufacturing model (amounting up to 20% in savings) come from the local assembly/manufacturing of all of its major subsystems such as the controller boards, the lighting systems and even the local manufacturing of the casings.

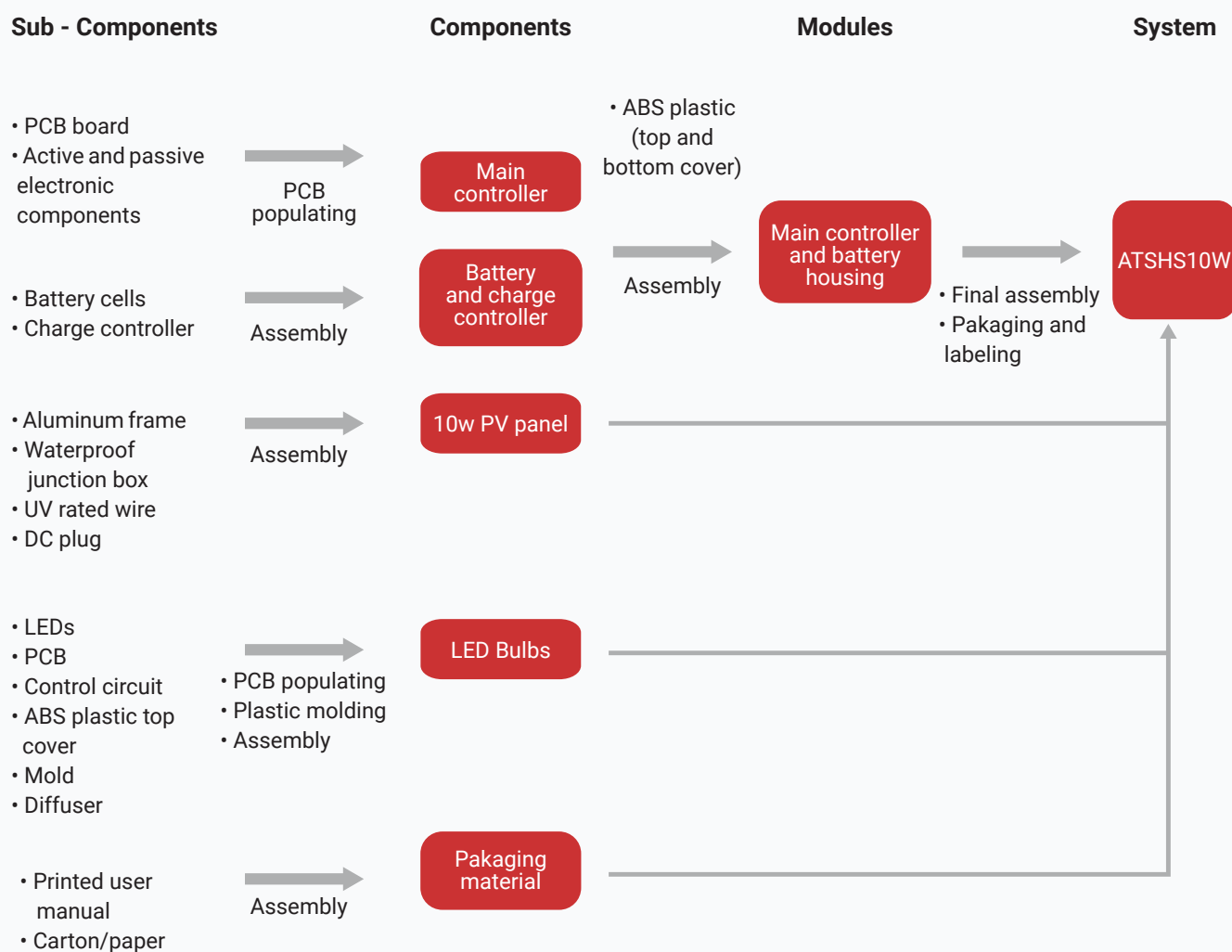


Figure 20: FOREX saving operations in manufacturing 10W SHS.

Source: precise analytics

The FOREX needed in local manufacturing is mainly used for importing sub-components and raw materials.

The cost breakdown of locally manufacturing systems shows the potential cost savings that can be obtained in start-to-end manufacturing of solar systems. The total cost of system manufacturing is the sum of sub-system manufacturing, company tax and other costs such as warranty, logistics, and conversion.

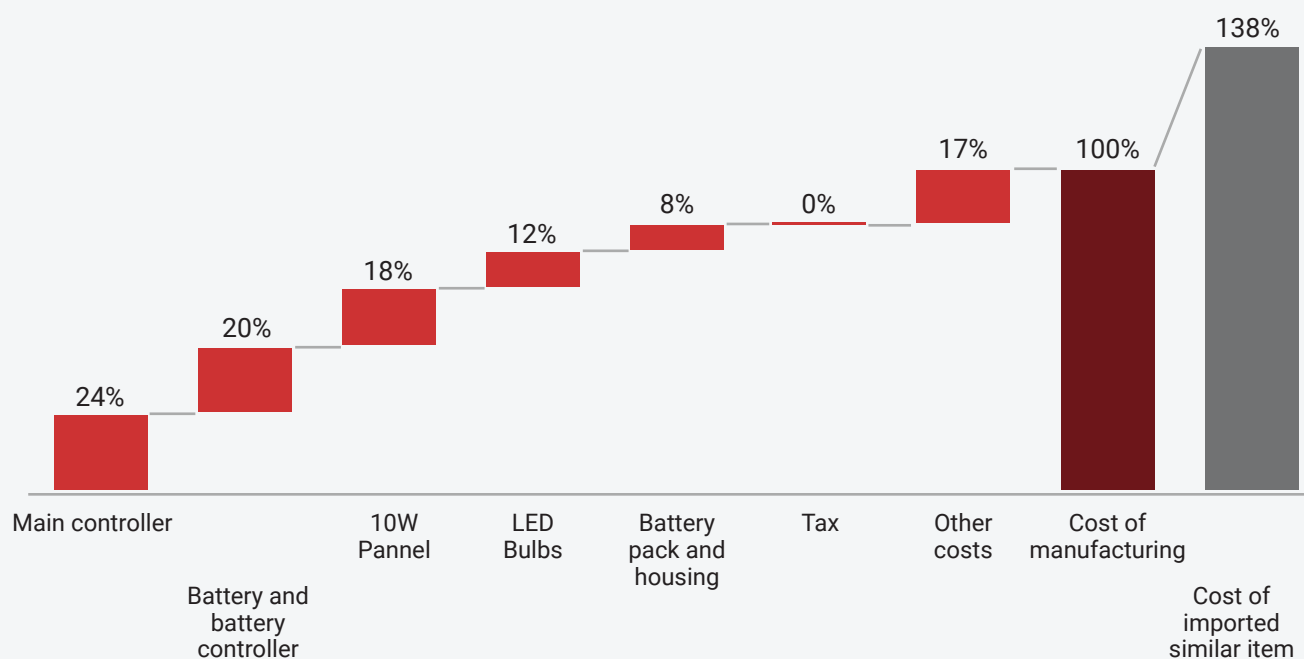


Figure 21: Cost buildup of locally manufacturing 10W SHS. vs importing CBU similar SHS

Source: Precise analytics

The manufacturing cost of each component indicated above includes sub-components cost, import tax, shipping and wages per unit. Other costs include overhead cost, conversion, and warranty. The import price of a similar CBU SHS is 42 percent more than the cost of manufacturing it locally. Assuming a per unit freight cost of 6%, import duty of 15 % and 5% minor expenses, the cost of imported similar item becomes 38 percent more than the manufacturing cost. Thus, locally manufacturing systems such as Abramba's 10W SHS has shown a total cost reduction of 37.8 percent as compared to importing a similar CBU SHS.

NEP 2.0 estimates the need for USD 1.4 billion in FOREX to connect the 9 million off-grid people throughout the 7 years. Yet, this total need can be reduced by USD 98 million, if the number of locally assembled/manufactured SHSs is progressively increased in the coming years.

	2023	2024	2025
NEP 2.0 target connection (Million)	2	1.2	1.3
FOREX need (USD million)	300	180	195
SHS assumed to be locally assembled (as a percentage of target)	22.50%	52.10%	46.15%
FOREX savings due to the assumed local assembly (in USD million)	5.95	6.94	7.94
SHS assumed to be locally manufactured (as a percentage of target)	7.50%	14.50%	15.40%
FOREX saving due to the assumed local manufacturing (million)	22.05	25.73	29.4
Yearly FOREX saving(USD million)	28	32.67	37.34
Total FOREX saving (USD million)	98		

Table 2: Yearly savings in net FOREX (million USD)

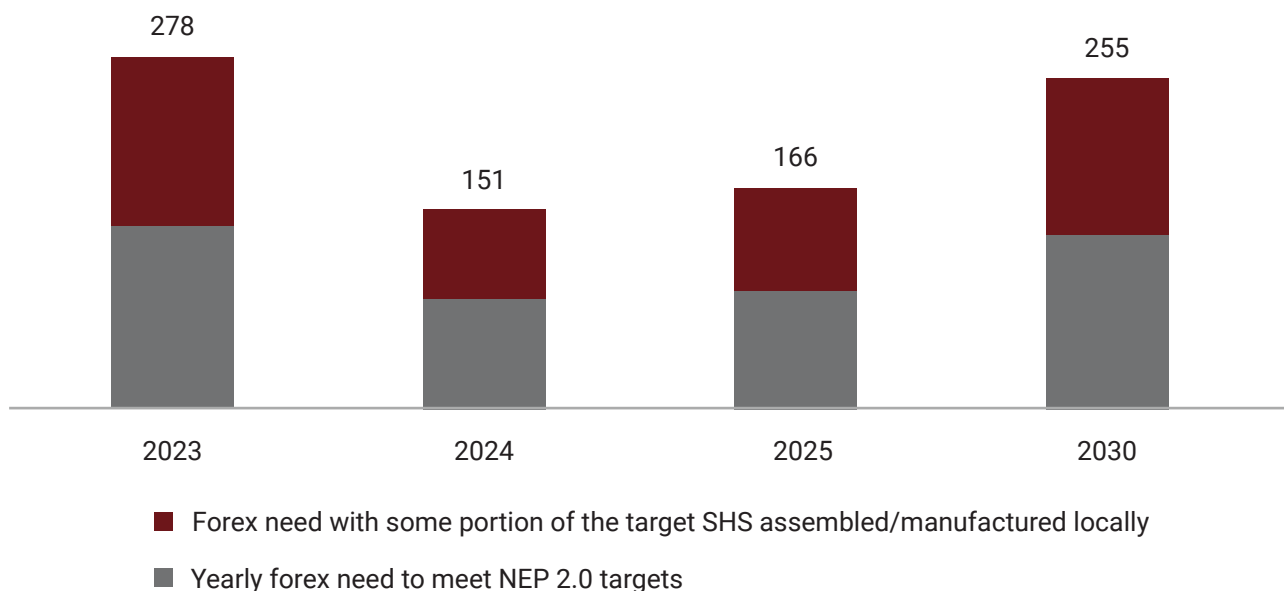


Figure 22: Yearly FOREX reduction due to the assumed local assembly/manufacturing (in million USD)

Source: Precise analytics

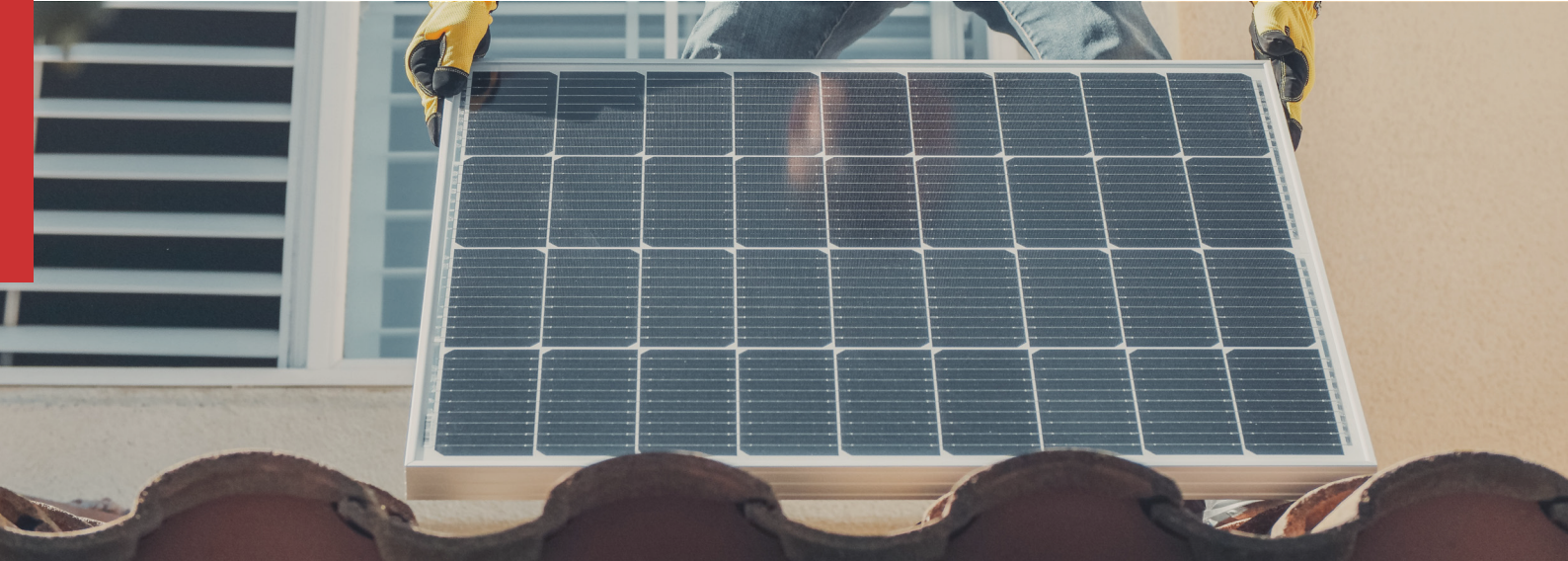
The overall cost needed to connect the yearly targets of NEP 2.0 including the net FOREX need, operational costs and capital investment, can be reduced by 151 million USD within the coming three years if some portions⁵⁰ of the targets are replaced by locally value added SHS⁵¹. This amount is the total cost needed to achieve more than 560,000 connections.

	2023	2024	2025
Target connection (Million units)	2	1.2	1.3
Operational and capex cost (USD millions)	536.4	321.86	348.69
FOREX need (USD millions)	300	180	195
Total cost (USD million)	836.44	501.86	543.69
Locally value-added SHS as a percentage of target connection	22.50%	52.10%	46.15%
Total cost savings due to local assembly (million USD)	12.75	14.85	17
Locally manufactured SHS as a percentage of target	7.50%	14.50%	15.40%
Total saving due to manufacturing (million USD)	30.48	35.56	40.64
Yearly cost saving (USD million)	43.23	50.44	57.65
Total Cost saving (USD million)	151.3		

Table 3: The total cost reduction due to the assumed local assembly and manufacturing.

⁵⁰ 22.5%, 52.1%, and 46.2% of the target connection are the portions to be met by locally value-added products in 2023, 2024, and 2025 respectively.

⁵¹ Solar appliance manufacturing SAM initiative targets.



In addition to the ease in rural electrification efforts, the combination of import, assembly and manufacturing in the supply has socio-economic benefits associated with the cost reduction of the SHS units. Some of these benefits are.

Increased Adoption of solar Technologie

Better after-sales services can increase customer confidence in SHS products, leading to higher adoption rates and a greater number of households benefiting from clean, renewable energy.

Enhanced System Reliability

Improved maintenance and repair services can result in more reliable SHS products, ensuring that rural households have consistent access to electricity and reducing the need for alternative, less environmentally friendly energy sources.

Strengthening the Local Supply Chain

Importing SKD components and promoting local assembly can help develop a robust local supply chain, reducing Ethiopia's reliance on fully finished SHS imports. A strong domestic supply chain can contribute to increased self - sufficiency and economic resilience in the face of global market fluctuations.

Encouraging Export Potential

As the domestic solar industry grows and becomes more competitive, Ethiopia may be able to export locally produced SHS products to neighboring countries. This can generate additional foreign exchange earnings, further improving the country's trade balance and economic stability.

Strengthened Local Economy

The growth of the domestic solar industry can create jobs and stimulate economic development in rural areas. This can help to alleviate poverty and improve living standards for millions of Ethiopians.

Table 4: Additional benefits of local assembly/manufacturing



6.3. Impact of local manufacturing/ assembly on after-sales services

Case Study II

Forsera is one of the suppliers we interviewed to understand the state of after-sales services in Ethiopia. The company provides after-sales services for the products it sells to end-users within the warranty period and/or post-warranty after payments. The service is delivered by nearby distribution agents (youth groups) trained by the company. Thus, although the company has only one after-sales service providing center in Bahirdar, its customers at any corner of its operating regions can rely on the after-sales services from nearby providers.

After-sales services play a crucial role in the success of Solar Home System (SHS) adoption in rural electrification efforts. Rural communities often face unique challenges, such as limited access to energy infrastructure, low income, and a lack of technical expertise, which make after-sales services even more critical.

Ensuring System Reliability and Functionality	<p>Rural households often rely on SHS as their primary source of electricity. Given the lack of alternative options, ensuring the reliability and functionality of these systems is of utmost importance. After-sales services such as regular maintenance, troubleshooting, and repairs help ensure that SHS products continue to deliver consistent power to rural households, enabling access to essential services like lighting, communication, and education.</p>
Supporting Local Capacity Building	<p>Effective after-sales services can contribute to capacity building in rural communities by training local technicians and creating employment opportunities. Training local technicians on system installation, maintenance, and repair can foster self-reliance and reduce the dependence on external support. This approach can lead to a more sustainable SHS industry and improved access to energy services in rural areas.</p>
Enhancing Customer Trust and Adoption	<p>Rural customers, who may have limited experience with SHS products and their benefits, need assurance of the system's reliability and long-term performance. Providing comprehensive after-sales services, including customer support, warranty, and replacement services, can help build trust and confidence in solar technology. This can contribute to higher adoption rates and a greater number of rural households benefiting from clean, renewable energy.</p>
Facilitating Access to Financing and Affordability	<p>After-sales services can also help facilitate access to financing for rural customers. By offering maintenance and performance guarantees, solar companies can collaborate with microfinance institutions and other financing partners to develop affordable payment plans and financing schemes. This can make SHS products more accessible to low-income households and encourage the adoption of clean energy solutions.</p>
Addressing Unique Rural Challenges	<p>Rural communities often face specific challenges, such as harsh environmental conditions, poor infrastructure, and limited access to technical expertise. After-sales services tailored to the unique needs of rural customers can ensure that SHS products are designed and maintained to withstand these challenges, ensuring long-term performance and durability.</p>
Encouraging Community Engagement and Ownership	<p>Effective after-sales services can involve engaging with rural communities to ensure that they understand the benefits of SHS products and feel a sense of ownership over their energy solutions. This can involve organizing community workshops, training sessions, and awareness campaigns, empowering communities to take an active role in their energy future.</p>

Table 5: Importance of after-sales services in SHS industry

6.4. Job Creation with Local Assembly and Manufacturing

This section focuses on the local job creation with SHS assembly and manufacturing. It is a value addition in:

Expanding the Skilled Workforce: The lowest tiers of energy access such as small SHS tend to be more labor intensive. In the import of SHS, the majority of employees tend to be sales agents. Nevertheless, with the localization of SHS, there will be a surge in demand for skilled labor to perform tasks such as installation, data analysis, and after-sales services. Promoting local production and assembly of SHS products can lead to the development of a well-trained workforce equipped with the necessary knowledge and technical expertise to design, assemble, install, and maintain solar systems.

According to WEF future jobs 2023 rating, respondents to a survey anticipate rapid growth in the renewable energy sector. This includes renewable energy engineers, solar energy installation, and system engineers. This is indicative of significant potential for this industry to create new and fast-growing job opportunities.⁵³

Supporting Ancillary Industries: The development of a local solar industry can create demand for ancillary industries such as manufacturing of raw materials, production of solar system components, and provision of services related to installation, maintenance, and logistics. This can create a wide range of job opportunities across various sectors, contributing to economic growth and diversification.

Research and Development Opportunities: A growing domestic solar industry can foster research and development (R&D) initiatives in clean energy technologies. This can create job opportunities for

scientists, engineers, and researchers who can work towards advancing solar technology and improving its efficiency, affordability, and sustainability.

Promoting Entrepreneurship and Innovation: Encouraging local production and assembly of SHS products can stimulate entrepreneurship and innovation in the solar industry. This can create opportunities for new businesses to emerge, offering innovative products and services that cater to the unique needs of the Ethiopian market.

Attracting Talent and Investments: A thriving domestic solar industry can attract talent and investments from both local and international sources. This can bring additional expertise and resources into the country, further driving the development of a skilled workforce and a competitive solar industry.

The occupations may take the form of direct or indirect employment. The direct jobs of a project are determined by the number of jobs created among its recipients, regardless of whether it was done directly through service providers or partner organizations. Typically, direct jobs are the result of a company's economics (including design, manufacturing, marketing, installation, and maintenance). Indirect jobs refer to jobs created at the level of the forward and backward linkages that cannot be directly attributed to the project direct intervention.

⁵³ WEF_Future_of_Jobs_2023.pdf



7. Recommendations

To achieve the socio-economic gains implied in local assembly/manufacturing of SHSs in the above section, improvements in the sector enabling environment are mandatory. Fortunately, the biggest hurdles hindering the sector can be tackled simultaneously if the right countermeasures are taken.

Local manufacturing of Solar Home Systems (SHS) technologies offers an excellent opportunity to drive NEP 2.0 targets by adding local value and optimizing FOREX to purchase more solar units per available dollars. Despite the tremendous opportunity, local manufacturing of solar home systems is at a nascent stage in Ethiopia due to limited access to foreign and local currency finance for local manufacturers, limited regulatory incentives and insufficient data about market opportunities among others.

Allowing Franco-Valuta import for SHS assemblers/Manufacturers. Local businesses that assemble or manufacture solar home systems (SHS) could play a significant role in driving growth in manufacturing and electrification areas, provided they are given adequate access to foreign exchange. By allowing these businesses to use their own source of foreign exchange, Franco-valuta, to import inputs for production, the challenge of accessing foreign exchange from banks could be resolved.

Due to the ongoing forex shortage in Ethiopia, the Ministry of Finance has permitted the use of Franco-valuta for the importation of various essential items, such as basic food items, pharmaceuticals, industrial inputs, fertilizer, petroleum products, clothing, in an effort to reduce the gap between demand and supply. Granting similar privileges to SHS assemblers/manufacturers could have a positive impact on the sector as well.

Value-creation based FOREX allocation: Allocating the FOREX from credit facilities of DBE such as ADELE for applicant companies based on the value creation could help in improving the FOREX scarcity local assemblers/manufacturers are facing and efficiently utilizing the resource. The overall goal of the facilities could be better achieved when the resource is allocated to those who could get the most out of it and thus local assemblers and manufacturers should be specifically reserved some percentage of the total resource (50%), for the additional value they create in the sector including;

- More products for less FOREX
- Reliable after-sales service
- Better affordability
- Technology transfers and
- Jobs creation

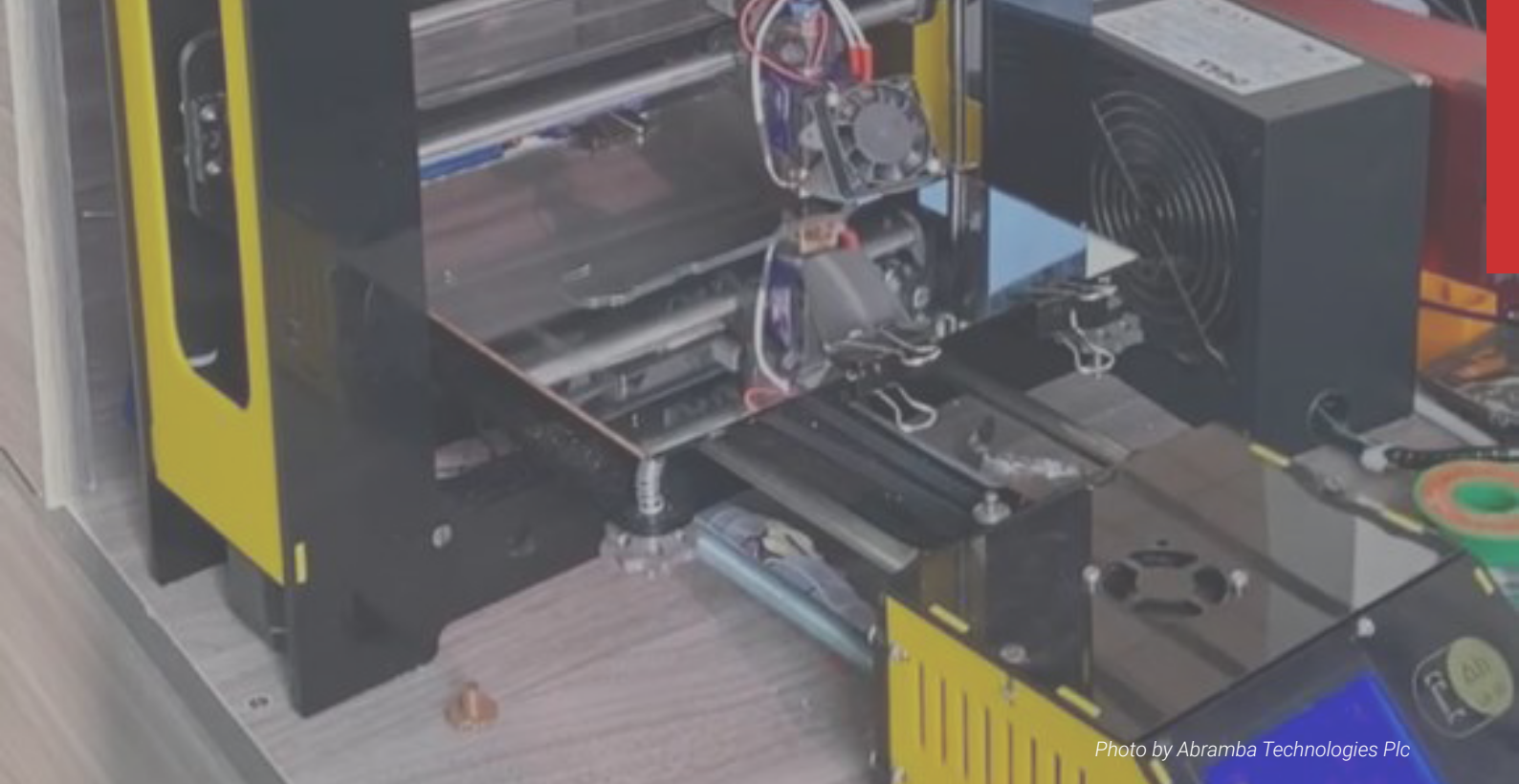


Photo by Abramba Technologies Plc

Employing consistent tax regulations and providing capacity building trainings:

Tax regulation trainings should be given to implementers in the customs commission. Tax policies frequent amendments and implementation inconsistencies lengthen the importation process. This in turn exposes assemblers and manufacturers to unnecessary up and downs. Fair tax regulations and proper categorization of components that assemblers and manufacturers import will help incentivize the sector. Timely communications among Ministries and government agencies regarding policy changes and quick update to customs officers will also be very beneficial in implementing up-to-date policies, which will help assemblers and manufacturers in reducing their cost of production.

Collateral support: Many small companies had previously and will also hereafter have problems bringing up sufficient collateral to make significant use of loan programs such as ADELE and working capital loans from commercial banks. ADELE is one of the biggest financing opportunities for solar companies and thus manufacturing supportive amendments in the program could benefit the sector well. If for instance DBE tries to implement a 'changing window' facility only for assembly and manufacturing with commercial banks that would help reduce the impact of not having sufficient collateral. The suggestion is to offer T/T transfers with foreign currency and apply fees that provide a similar profit to banks as if the same amount was provided via a loan facility.

Through such amendments, ADELE would increase chances of securing the necessary FOREX for local assemblers/manufacturers.

Increasing the capacity and scope of locally available quality certification programs and testing labs:

ECAE have come a long way in increasing capacity to perform necessary tests and conducting certification programs of SHS. In growing its scope, ECAE should get accreditation by Vera sol to perform Quality Test Method (QTM). This is a method which is designed to confirm the overall performance and quality of the product. It is the necessary accreditation to grant selling of new product of local manufacturers in the international market. Enterprises that apply to Versal certification can then acquire QTM testing in addition to the currently available Initial Screening Method (ISM) and Market Check Method (MCM) testing locally at ECAE. This will further increase the local capacity building and improve the technology manufacturing sector.

Additionally, SHS and related product certifications obtained from ECAE should be accepted by any program that is being implemented in Ethiopia.

Appendices

ANNEX 1: Important stakeholders

Organization	Role
Ministry of Water and Energy	MoWE oversees the Ethiopian electricity sector and coordinates off-grid energy solutions in the country with other organizations. The ministry is a regulatory body which involves the planning, development and management of resources, preparation and implementation of guidelines, strategies, policies programs, and sectoral laws and regulations to ensure citizens access to clean water and energy.
Ministry of Finance	MoF is responsible for general financial management and economic policy of Ethiopia, in addition to the allocation of economic assistance. In SHS supply, MoF is responsible for tax exemptions, levying and approving manufacturing components list.
Ethiopian Investment Commission	EIC is an autonomous institution mandated for promoting investment opportunities for foreign and domestic investors. It responsible for determining eligibility of importers and retailers, issuing business license and investment permits.
Ethiopian Electric Utility	EEU is an Ethiopian electrical power industry and state-owned electric producer. It is engaged in development, investment, construction, operation, and management of power plants, power generation and power transmission.
Ethiopian Customs Commission	Responsible for implementing custom rules and regulations passed by MoF regarding solar home systems in this case.
Ethiopian Standards Agency	ESA has the mandate to set quality standards to both imported and locally assembled/manufactured SHSs.
Ethiopian Conformity Assessment Enterprise	ECAE is the responsible body for quality assurance and testing of SHSs and PVoC of imported solar items.
Development Bank of Ethiopia	DBE is the biggest lender for solar companies and distributor of the biggest FOREX accessing facilities for solar products supply; ADELE and MDCL.
National bank of Ethiopia	NBE is the central bank regulator in charge of enacting FOREX and monetary rules and regulations. All commercial banks in Ethiopia operate based on NBE directives.
Ministry of trade and regional integration	Responsible for checking that imported products are in compliance with standards before they are cleared from customs.

ANNEX II: Private Institutions and Distribution Channels

Importers/Manufacturers	Role
Ethiopian Solar Energy Development Association	ESEDA is an independent non-profit association Established in 2010 by dedicated Solar energy market stakeholders aiming to facilitate the growth and development of Solar energy business in Ethiopia.
Abramba Technologies	The sole SHSs manufacturer in Ethiopia designing and manufacturing different size tier-1 solar products.
Fosera manufacturing	Fosera is the pioneer in local SHS assembly in Ethiopia. Has been importing SKD Fosera brand SHSs using its special linkage with Fosera international for the past eight years.
Hellosolar Technologies	Hellosolar is an Omni voltaic SHSs assembler and distributor that has been engaged in the business since 2018. It is the first company to pilot functional PAYGO technology in Ethiopian market.
Ethiopian Power Engineering Industry (EPEI)	Under the state-owned Ethio-engineering group, EPEI has been locally assembling solar panels and lanterns starting from 12 years back. Currently the solar assembly has ceased. But EPEI has plans to get back to the business with increased capacity.
V-nex	V-nex is an international solar items installer and distributor that has an assembling facility in Ethiopia.
Winsol green power	Winsol green is a local solar home systems assembler that has been in business for more than 6 years. As part of its aspiration to step-up to manufacturing, it has started plastic molding SHS cases and thus is considered one of the potential local component suppliers.
Wasihun Asmamaw solar	Wasihun solar is an SHS assembling firm in Bahirdar, Amhara. It has been in the solar sector for the past 8 years and since a year ago it has assembled 3000 units. If FOREX accessing issues are resolved and local input sourcing chances are enhanced, Wasihun solar sees itself assembling up to 15,000 Omnivoltaic systems a year.
Kaledawit Electronics	Kaledawit Electronics is mainly control circuit designer and manufacturer. The company has prototyped and distributed a thousand solar home systems.

ANNEX II: Private Institutions and Distribution Channels

Importers planning to assemble/manufacture	Role
Lydetco PLC	Lydetco is a solar lighting and thermal systems importer and installer engaged in the business since 1996. It's known for its Sunlight brand SHS which it distributes in Amhara and SNNP regions. Relying on its distribution network and trained manpower in the area, Lydetco is planning to start local assembly of the same brand products in partnership with Greenlight Planet.
Vera international	Vera international has been importing and distributing solar lighting and home use appliances for 16 years. The company has planned to start local assembly and prepared an assembly line with annual production capacity up to 65,000 SHS units.
Meseret Mare solar importer	Meseret Mare is a solar systems importer and distributor focused on lighting products currently (from 2023 onwards) about to start local assembly of Solar run SHS in partnership with Shenzhen solar run limited for parts supplying and technical support.
Green scene	Green scene is a solar lighting and productive use (irrigation) products importing and distributing company. With its 7 years of experience in the sector, Greenscene plans to start a local assembly of solar pumps and SHS starting from January 2023.
Romel Electrical	Romel is an electrical and electronics assembling and importing company of its own brand, Romel. The company is Interested in solar home systems assembly and sales relying on its 5 plus years of manufacturing experience, technical know-how and supplier and distribution network.
General Mercantile	General mercantile is a manufacturing/assembly firm that has been assembling motorbikes and power equipment for 20 years. The company has the capacity and interest to engage in local assembly/manufacturing of SHS and other solar products as well.

Main product distribution channels(retailers)

Government formed youth groups

These are groups formed in districts by the regional energy bureaus to provide distribution and maintenance services for solar energy companies that have agreements with the regional bureaus.

Finance institutions

Solar companies sometimes partner with microfinance institutions to provide solar products directly to end-users. MIs also provide loans for end-users to make the products more affordable.

Company sales agents

Solar companies hire sales agents in each region or district to sell their products through direct relations with their customers.

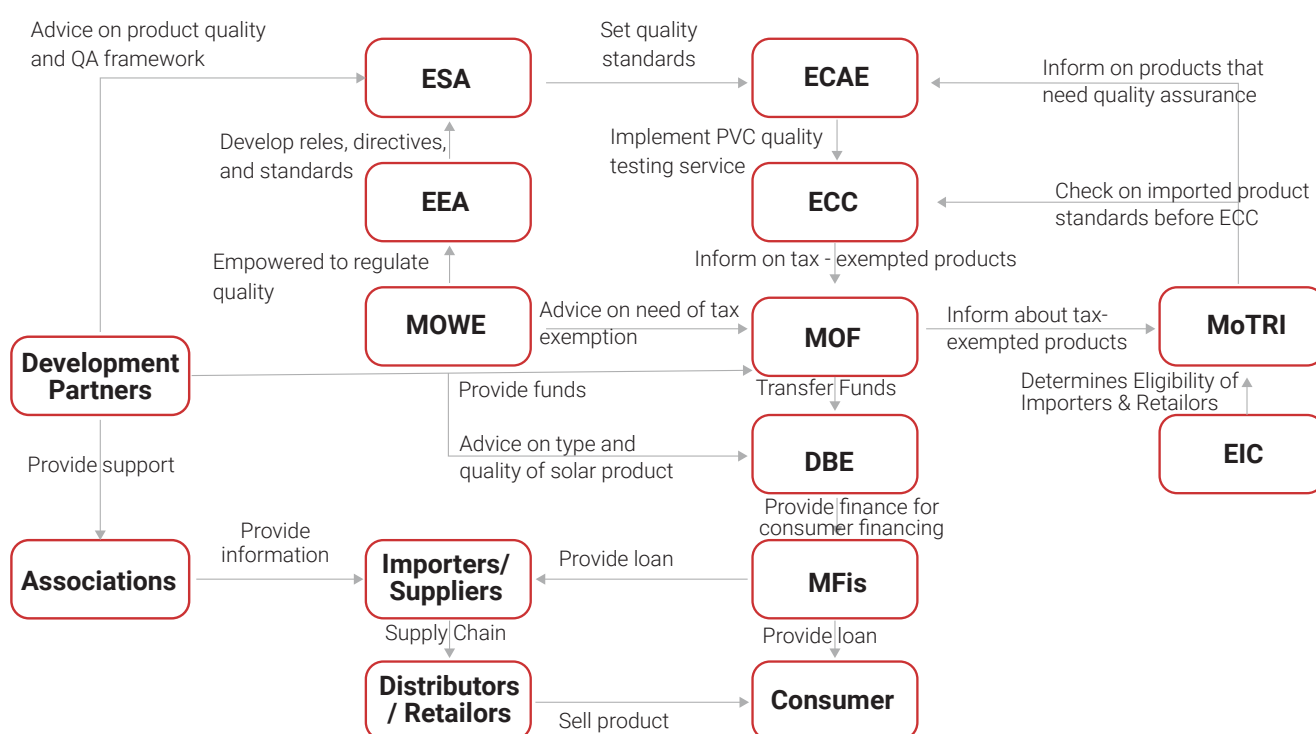
Women groups

Some women are recruited and trained by NGOs to distribute solar products in the areas they live to earn off-farm income. For example, Solar Development, in collaboration with Care Ethiopia, has provided Little Sun lamps for about 750 women groups.

Hidasie Telecom Share companv

Hidasie telecom is a share company that works on distributing telecom products. They distribute solar lanterns and solar home systems. Major solar brands distributed by tris group include d. light, Sunking, Renewit, Futurasun, and Newa.

Annex III: Integrated Regional Energy Strategy Relationship



Annex IV: Qualification criteria of NBE, DBE and Commercial Banks

NBE

According to NBE directives, access to foreign loans and suppliers' credit is the exclusive right of exporting firms and Foreign Direct Investment (FDI) companies. The National Bank of Ethiopia's (NBE) current FOREX allocation policy does not clearly show SHS product importation as the priority for FOREX access or for foreign currency-denominated loans and suppliers' credit.

The national bank of Ethiopia's FOREX allocation directive 77/2022 lists down commodities based on their priority. As such, the commodities under first second and third priority are the below listed.

Allocated FOREX in percentage		Items
First Priority	45	Pharmaceuticals (medicine, input for manufacturing of pharmaceuticals and laboratory regents), inputs for manufacturing of edible oil and liquified petroleum gas.
Second priority	40	Input for agriculture (fertilizer, seed, pesticide and chemicals) and input for manufacturing (raw materials, chemicals).
Third priority	15	Motor oil and lubricants, agricultural inputs and machinery (irrigation pumps, animal feeds, machinery and equipment, tractors, harvesting machinery, and spare parts, animals hybrids), pharmaceutical products (laboratory equipment, medical equipment and appliances), manufacturing industries requests for procurement of machinery, equipment, spare parts and accessories, import of nutritious food for babies, spare part for construction machinery for own use, educational materials (exercise book, ball pen, pencil and printing papers), profit and dividend transfers, transfer of excess sales of foreign airlines, sales from share and liquidation of companies by FDI.

Ethiopian FOREX allocation directive 77/2022 prioritization



DBE

The DBE functions as an implementing agency responsible for distributing ADELE World Bank funds to designated beneficiaries. In this role, the DBE will closely oversee the performance of Private Finance Institutions (PFIs) to ensure that they consistently meet the eligibility criteria outlined in the DBE manual for the project.

The manual states that all private sector enterprises engaged in the OGS system value chain, which are duly established, registered, and in compliance with tax and other applicable federal and local regulations, are eligible for participation under the ADELE funded project components, subject to compliance with Private Finance Institutions and Private Micro Finance Institutions credit risk criteria.

ADELE-funded components will offer financial support for both working and investment capital to facilitate the importation, distribution, installation, repair, and recycling of OFS systems or their parts. Additionally, maintenance and recycling of these systems are included. The financing covers a range of products, including plug-and-play systems, component-based systems, and spare/replacement parts for any off-grid solar standalone system.



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