

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

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Africa Clean Energy (ACE)
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Assessment of Local Manufacturing of Off-Grid Solar in Sub-Saharan Africa

**Foreign, Commonwealth and Development Office (FCDO)
Africa Clean Energy Technical Assistance Facility**

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ABBREVIATIONS

AfCTA	African Continental Trade Agreement
CET	Common External Tariff
COMESA	Common Market for Eastern and Southern Africa
GDP	Gross Domestic Product
EAC	East African Community
FDI	Foreign Direct Investments
ICT	Information and Communication Technology
LEDs	Light Emitting Diodes
MSMEs	Micro Small and Medium Enterprises
OGS	Off-Grid Solar
PAYG	Pay As You Go
REA	Rural Electrification Authority
SADC	Southern African Development Community
SHS	Solar Home System

EXECUTIVE SUMMARY

Countries are keen to promote local manufacturing and are putting in place incentives to encourage private sector investment in local manufacturing and assembly. However, currently there is limited viability of local manufacturing or assembly of off-grid solar (OGS) products across the 5 countries of study; Nigeria, Ethiopia, Zambia, Tanzania and Rwanda. Although Governments have been using different policy instruments, including faster processing of business applications, creation of infrastructure and fiscal incentives to promote manufacturing, the contribution of manufacturing to the economies of the countries is still low. In particular, investment in areas such as electronic assembly has been very limited. Private sector investment in manufacturing in the five countries has been more concentrated in areas such as agri-processing, cement, garments and minerals.

Local assembly of OGS products is restricted by several challenges including:

- ☞ Import tariffs that minimize the economic advantages of local assembly.
- ☞ Lack of quality standards for locally assembled products.
- ☞ Lack of, and inefficient implementation, of incentives and,
- ☞ Uncertainty of off-take of OGS products.

Among the 5 countries, Ethiopia and Nigeria have somewhat larger number of private companies already involved in local assembly. However, the Ethiopian companies are smaller and often struggling financially. The Nigerian companies are relatively larger compared to their Ethiopian counterparts. Rwanda has been able to attract one foreign direct investment (FDI) for OGS products and another for LED lights.

At this point, only Nigeria and Rwanda have shown traction in building local assembly of OGS products. The Rwandan policy of attracting FDI can be emulated by other African countries in the Special Economic Zones that are coming up in all the 5 countries. Nigeria, on the other hand, has promising local companies which can scale up their supply of locally assembled OGS products to the market, if supported with right programme design and policies.

In order to attract local manufacturing in OGS products, implementation of a conducive policy environment is key. Countries need to focus on the following three key elements:

- ☞ Deliberate policies and regulations that promote local assembly or manufacturing, including:
 - ☞ Import tariff rates and regulations should not put locally assembled or manufactured products from imported components at a disadvantage over the import of finished products.
 - ☞ Quality certifications and testing of locally assembled and manufactured products should be transparent and easily enforceable.
 - ☞ Making available infrastructure for local assembly and manufacture of OGS systems, such as special economic zones and industrial parks, transparent approval procedures and fiscal incentives to de-risk investment, such as exemption from taxes and duties and investment allowances. This is particularly important for attracting FDI.
 - ☞ Supporting sufficient demand for locally assembled and manufactured OGS products provided they meet quality and price standards. This can be done by ensuring end-user financing, which is anyway crucial for the OGS sector, in addition to a government-led public procurement process or financial incentives, such as tailored results-based finance (RBF) for locally assembled and manufactured OGS systems.

Well-designed policies that have promoted local assembly of solar and related electronic products in Asia have successfully addressed these four key issues and could be replicated in Africa. In particular, the local assembly of solar and solar components in countries such as Bangladesh and India have grown on the back of a market expansion programme. This gave companies the confidence to invest by clearly defining quality standards and testing methods and setting import tariffs that do not disadvantage locally assembled products.

Rwanda has attracted FDI investment in solar product and LED light assembly and shows promise. It has done so by a policy that assures off-take of the production at economic prices. The experience of these early companies will be critical in attracting other foreign investors. The Nigerian government has declared ambitious targets for local assembly, but a phased implementation approach which targets the key issues is critical for its success. The phase approach recommended by McKinsey focuses on stimulation of market demand and import substitution and considers three stages of implementation: proof-of-concept stage; scale up stage; and maturity stage to ensure success.

Ethiopia, Tanzania and Zambia should aim to develop an enabling environment that encourages local assembly and manufacturing by focusing on the elements mentioned above and try and follow Rwanda's example in attracting FDI. Ethiopia already has a few companies that have already started doing local assembly. However, it needs to provide policy and regulatory support to help them grow by addressing the key challenges they face, in particular import regulations that minimize the economic advantage of local assembly, lack of quality standards and no support for the up-take of local OGS products. Tanzania and Zambia on the other hand, have very few companies involved in local assembly and need to start by providing incentives to the private sector and an enabling policy environment for local assembly and manufacture of OGS systems.

1. INTRODUCTION

1.1 Scope and objective

The objective of this study conducted by Africa Clean Energy Technical Assistance Facility (ACE TAF) is to weigh the advantages, disadvantages and feasibility of five countries (Ethiopia, Nigeria, Rwanda, Tanzania and Zambia) to pursue a manufacturing or assembly of off-grid solar products. Initially the study was focused on four African countries, but Nigeria was included at the time of commissioning given the country's policy initiatives encouraging the manufacturing of local assembly and manufacturing in the OGS sector.

The report examines the state of local manufacturing in these countries, the policies being put in place to encourage local manufacturing and the extent of private sector participation in solar (or allied) areas. The study then tries to evaluate whether, given these countries have universal energy access goals, if it would be feasible for them to also have policies that encourage local manufacturing and assembly.

1.2 Past Studies and on-going Initiatives

Previous studies have not been conclusive in identifying the benefits of local assembly and manufacturing in Africa. A study conducted by Economic Consulting Associates Limited with funding from the Foreign Commonwealth and Development Office (FCDO) across Ethiopia, Kenya and Uganda came to the conclusion that the prices of Solar Home Systems (SHSs) would be cheapest under a business-as-usual scenario (where entire products are imported). The study compared the prices of pre-assembled imported products against three other scenarios: one where only the solar products are assembled from imported components; the other where components such as panels, cables, circuit boards and housing are manufactured; and the third all components are manufactured locally¹. Another study prepared by Precise Consult International and funded by Shell Foundation argued that local manufacturing in Ethiopia can take advantage of a regional market and a low-cost skilled labour force of Ethiopia. Local manufacturers with export markets can also contribute to foreign exchange earnings.²

The summary of the long-term economic advantages of pursuing a local manufacturing and assembly in the OGS sector are as indicated in Table 1 below. There are also possible disadvantages in case local production capacity does not grow.

Table 1: Advantages and Disadvantages of local manufacturing

Long term Economic Advantages	Possible Disadvantages (in case local capacity falters)
<ul style="list-style-type: none">☞ Contribution to manufacturing growth☞ Jobs in the manufacturing sector☞ Exports to other countries	<ul style="list-style-type: none">☞ Decrease in supply of products☞ Loss of jobs in distribution☞ Increase in prices

Beyond the studies conducted, governments are also beginning conversations around local manufacturing of solar products. A case in point is that of Nigeria where the government has embarked on a plan to actively encourage local manufacturing and assembly. The Government of Nigeria's Economic Sustainability Plan (2020) includes a solar strategy for the³ electrification of 5 million households. The programme intends to increase local content in the off-grid solar value chain.

1. Economic Consulting Associates Limited (2018) Energy Africa – Kenya, Uganda, Ethiopia,

2. Precise Consult (2018) Local Assembly of Off-Grid Solar Lighting Products I Africa

3. Rural Electrification Agency Nigeria (2020) Presentation at the Donor Coordination Meeting November 2020

The plan is expected to be implemented in three phases from October 2020 to May 2023 and the target for 100% local assembly is expected to be achieved in 2022. Local manufacturing is expected to be increased from 10% in 2022 to 15% in 2022 .

The Central Bank of Nigeria has defined local content to be components sourced from companies which are Nigeria-owned or owned by a consortium with a minimum of 70% local ownership. The Central Bank of Nigeria has declined to finance solar home system companies which have no proof of local component deployment and have no credible plan for near- term integration of local content.⁴

United Nation Sustainable Energy for All (UN SE4ALL) has concluded in a study for Nigeria that there are some areas where there are opportunities for localization, including the assembly of components such as battery pack, inverters and modules and manufacturing of appliances such as fans or fan components⁵ McKinsey is working closely with FCDO to provide support to local companies to raise capital and expand their operations.

Box 1: Assembly and Manufacturing

Assembly involves constructing a finished product from components or partially completed units. Manufacturing involves production of a finished product from raw or semi-finished material. Assembly is usually the last step within the manufacturing process. SHSs are made up of various components including the solar panel, the power box which consists of batteries and charge controllers, connection cables, LED lamps, USB hub, switch and phone charging sets as is illustrated in Figure 1. For example: the LED bulb (probably the smallest and cheapest component in a SHS) includes the LED semiconductor diode, the plastic lens, the metal holding, the polymer connectors and the electronic drivers.

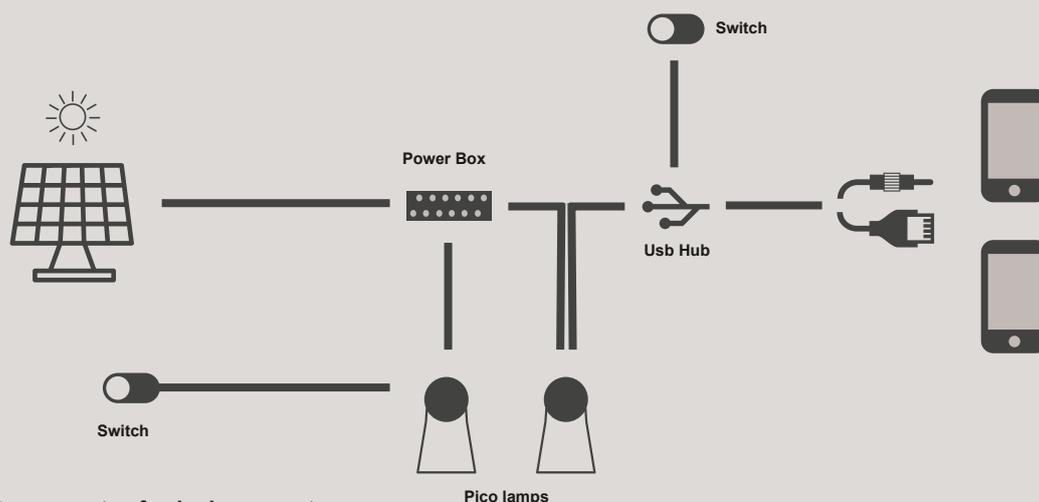


Figure 1: Components of solar home system
Source: Phocos

For products such as solar pumps, for instance, the major components are the solar panels, the water pump, the metal casing, the rubber pipes as well as the charge controller, inverter, the control panel and the remote switch. Appliances such as fans, radios and televisions also are composed of thousands of electronic components.

If they have to be sourced locally, SHSs have to be assembled locally, SHS manufacturing is a complex electronic supply chain. The core building blocks such as the solar panels and the LED lighting diodes are almost entirely manufactured in Asian countries. Countries and companies typically start from importing “knocked down” kits and assembling them. An overall target such as that planned in Nigeria, needs to be defined in terms of specifics (what level of assembly, manufacturing of each items). In this report local manufacturing and assembly are used interchangeably. It is impossible to manufacture SHSs from scratch. It is only possible to assemble them from some imported components and some locally made ones. And the locally made components are themselves assembled from some imported sub-components.

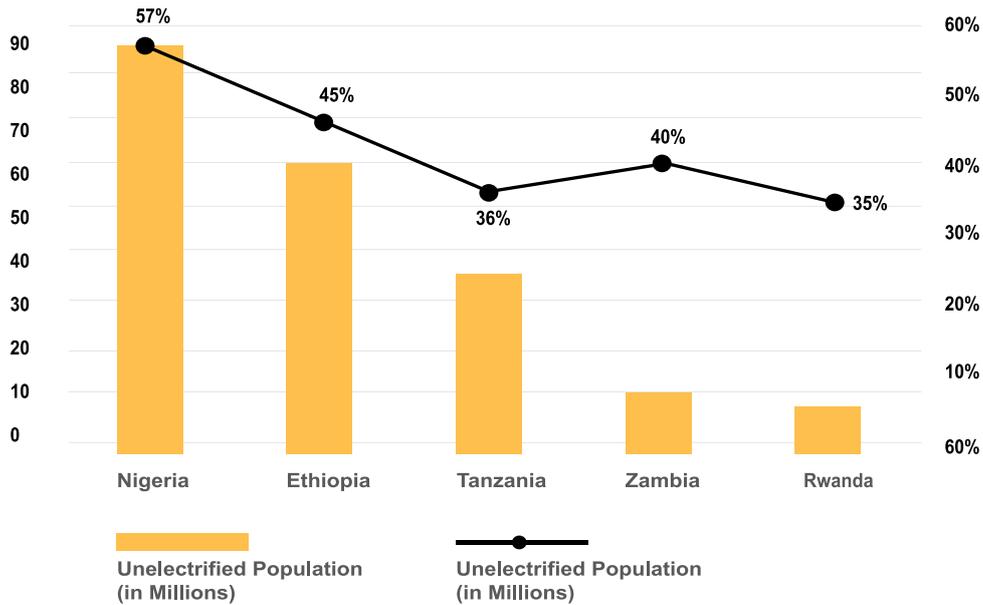
4. Central Bank of Nigeria (2020) Framework for implementation of Solar Connection Facility,
5. UNSE4All Presentation at the Donor coordination meeting November 2020

1.3 Extent of the off-grid solar market

The electrification rates in all the 5 countries remain relatively low as can be seen from Figure 2 below. The countries however remain ambitious in their targets to reach universal access by 2030, partly informed by the UN's Sustainable Energy For All's (SE4All) energy access goals.

Among the 5 countries, Nigeria has the largest unelectrified population at 85 million⁶. This is followed closely by Ethiopia with 60 million people having no access to electricity⁷. Cumulatively, these countries have close to 200 million people without access to electricity accounting for about one-third of the entire population without electricity in Sub-Saharan Africa.

Figure 2: Electrification rates and unelectrified populations in the five countries.



Source: ESMAP Tracking SDG 7 Country Reports⁸

The existing market is further evidenced by the sales volume of solar products in these countries (see Table 2 below). Ethiopia has experienced remarkable growth in the quantities of solar products sold in the country within the last two years becoming the second leading market in East Africa and globally⁹. This progress can in part be a result of the removal of duties on imported solar products and recapitalization of the World Bank funded credit line in 2018 hence increasing access to finance by private sector. The other three countries (Nigeria, Tanzania and Zambia) also registered positive growth with only Rwanda reporting decline over the two years. The decline is in part attributed to affordability¹⁰ of the products and the introduction of stringent quality control measures by Ministry of Infrastructure in 2018.¹¹

6. World Bank (2018) Tracking SDG 7: <https://trackingsdg7.esmap.org/country/nigeria>
 7. World Bank (2018) Tracking SDG 7: <https://trackingsdg7.esmap.org/country/ethiopia>
 8. ESMAP (2018). Tracking SDG 7: <https://trackingsdg7.esmap.org/countries>
 9. GOGLA (2019). Global Off-Grid Solar Market Report Semi-Annual Sales and Impact Data. July to December
 10. USAID, 2019. Power Africa Off-grid Project: Off-grid Solar Market Assessment, Rwanda
 11. USAID, 2019. Power Africa Off-grid Project: Off-grid Solar Market Assessment, Rwanda

Table 2: Sales of Off-Grid Solar Lighting Products for the past two years ¹²

Country	2018 H1	2018 H2	2018 H3	2018 H4
Nigeria	153,112	133,801	135,410	166,824
Ethiopia	147,647	338,177	293,718	717,759
Rwanda	47,741	98,723	65,030	47,984
Tanzania	103,695	102,038	87,552	176,375
Zambia	32,978	88,000	70,260	118,458

Besides opportunities in the lighting sector, productive use also offers an extensive market for solar products. Estimates by Efficiency Access Coalition indicate that close to 700,000 households in Sub-Saharan Africa (SSA) are farmers and require water pumps. The number is expected to grow to 2.8 million by 2030 with increasing household income and decreasing product price as the main drivers¹³. Beyond irrigation, several opportunities still exist within the agricultural value chain including cooling, drying, milling and threshing,

Outside the confines of the off-grid solar (OGS) market, there also exists the market for captive power for commercial and industrial application where solar is used to supplement electricity from the grid or as an alternative source of energy to power their operations. Nigeria currently has the highest capacity of solar PV at 20 MW¹⁴. The unreliability of the grid coupled with limited access in these countries makes solar rooftop an attractive option economically. The existence of these contiguous markets is important. Components such as charge controllers or inverters developed for the OGS market can find markets in the solar rooftop sector. LED bulbs can be used in urban households.

1.4 Key Issues

The low extent of electrification and the government policy to achieve universal energy access signals a significant market to attract private sector interest in meeting this un-met need for electricity. Electrification of off-grid areas can be met by private companies importing SHSs. International companies (in particular Pay-as-You Go energy access companies) have raised large amounts of capital and have built an extensive supply chain to be able to manufacture and supply SHSs. Should governments focus only on reaching electrification goals by importing or should they impose requirements on local component sourcing? Are there private sector companies already assembling solar components at scale to meet this large potential market? Does the infrastructure and policies exist to attract international companies to invest in local manufacturing and assembly? If the answers to these questions are in the negative, then a focus on policies for local sourcing may create supply side constraints to achieve energy access goals. The current level of manufacturing and the policy package that the 5 countries are putting together to attract private sector investment in manufacturing is investigated in the next chapter. The report then goes on to investigate the current state of private sector interest.

12. GOGLA (2019). Global Off-Grid Solar Market Report Semi-Annual Sales and Impact Data. July to December

13. Efficiency Access Coalition (2019). Solar Water Pump Outlook 2019: Global Trends and Market Opportunities. <https://storage.googleapis.com/e4a-website-assets/Solar-Water-Pump-Outlook-2019.pdf>

14. UNEP-DTU (2019). Clean captive power: Understanding the uptake and growth of commercial and industrial (C&I) solar PV in Kenya

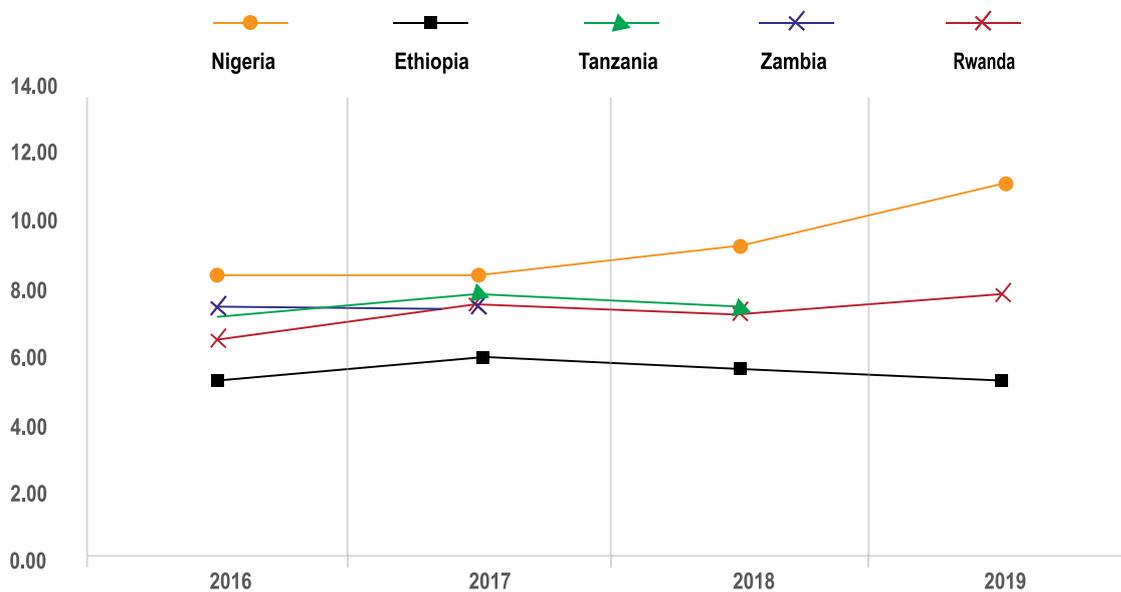
2. POLICIES TO PROMOTE LOCAL ASSEMBLY AND MANUFACTURING

This chapter discusses the importance of local manufacturing and/or assembling, what the specific country goals are and the policy instruments that the 5 countries are using to attract private sector investment in local manufacturing.

2.1 Contribution of manufacturing to national income

Manufacturing contributes a very small share of the GDP across each of these countries. Nigeria is the only country where the share is above 10% (11.52%, 2019 figures). As can be seen Figure 3 below, the share of manufacturing to GDP has remained consistently low at these levels over the last few years. The relative growth in Nigeria's share can be attributed to factors which include business reforms making it easier to do business in the country, deliberate efforts by the government to improve the business environment for manufacturing in the country and supporting local businesses in the manufacturing sector.¹⁵ Rwanda's modest growth resulted from large infrastructural development in the first half of 2019 leading to better performance of sub-sectors such as construction, wood and wood products and chemicals, rubber and plastics among others¹⁶. In Ethiopia, though the share of manufacturing remains low, the government is keen on building a robust manufacturing sector and is setting up incentives especially for textile and garments and agro-processing. Tanzania and Zambia have aspirations of diversifying their economies by building their manufacturing sector as can be seen in the development strategies. However, relatively few initiatives are on-going in the two countries to achieve the same.

Figure 3: Manufacturing as a share of GDP (%)



Source: World Bank Data

15. Manufacturing in Nigeria: Status, challenges and opportunities. (2018, September 27). How We Made It In Africa. <https://www.howwemadeitinafrica.com/manufacturing-in-nigeria-status-challenges-and-opportunities/62236/>

16. Bizimungu. (2020, March 26). What drove Rwanda's economic growth in 2019? The New Times | Rwanda. <https://www.newtimes.co.rw/news/what-drove-rwandas-economic-growth-2019>

The manufacturing sector in these countries can be classified into three main groups:

- (i) agro-processing,
- (ii) light manufacturing mostly includes chemicals, pharmaceuticals, textile and garments, wood and wood products and,
- (iii) resource manufacturing which includes mining and minerals.

Even though heavy manufacturing (e.g., manufacturing of machinery) or electronics assembly (e.g., assembly of mobile phones and solar components) is quite nascent in the countries, there are efforts by government to promote the same through their policies and strategies as discussed further in section 2.3.

2.2 Goals to increase local manufacturing

A core pillar of the development blueprints across the 5 countries is manufacturing, which has the potential for ensuring economic growth, job creation and poverty alleviation.

Through their industrial policies and plans, countries have set targets for expanding the manufacturing sector as can be seen in Table 3. Countries like Rwanda have developed policies to encourage local manufacturing. For example, the Made in Rwanda Policy 2017 focuses on developing Small and Medium Enterprises (SMEs) within the country and reducing imports through local production. The policy also amended the public procurement law thus allowing local producers to have a 15% preference on their bid scores, if they are able to demonstrate 30% local value-addition. Zambia in a similar fashion has developed the Local Content Strategy 2018-2022 to substitute importation of inputs by using the locally available resources. Through this strategy the government also aims to facilitate the establishment of Micro Small and Medium Enterprises (MSMEs) industrial yards in order to enhance productivity and value addition.

Table 3: Country's Policies and Strategies to Promote Manufacturing

Country	Policy/Strategy	Targets/support for Manufacturing
Nigeria	Economic Recovery Growth Plan 2017-2020 ¹⁷	Average annual growth of 8.5% in manufacturing, rising from -5.8% in 2016 to 10.6% by 2020
	Nigeria Economic Sustainability Plan 2020 ¹⁸	Minimizing imports by promoting local manufacturing and use of local resources
	Nigeria Industrial Revolution 2014 Plan ¹⁹	To broaden the scope of industry, and to accelerate expansion of the manufacturing sector
Ethiopia	Growth and Transformation Plan II ²⁰	Manufacturing average annual growth rate target 21.9% Manufacturing as a share of GDP 8% as of 2020
Tanzania	Integrated Industrial Development Strategy 2025 ²¹	Grow manufacturing sector by 15 % per annum on average and attain 23% share in GDP composition by 2025 Clustering of industries into special economic zones
Zambia	National Industrial Policy 2018 ²²	Increase growth of manufacturing sector from an average of 5 % to 20% by 2027 Increase contribution of manufacturing to GDP to 15% by 2027
	National Investment Promotion Strategy 2018-2022 ²³	Increase actualized domestic and foreign direct investments by 25 percent annually
	Seventh National Development Plan 2017-2021 ²⁴	Building a strong manufacturing and industrial base

17. Government of Nigeria (2017). Economic Recovery Growth Plan <https://yourbudget.com/wp-content/uploads/2017/03/Economic-Recovery-Growth-Plan-2017-2020.pdf>

18. Ibid

19. Government of Nigeria (2014). Industrial Revolution Plan. <https://nipc.gov.ng/nigerian-industrial-revolution-plan-nirp-2014-pdf/>

20. Federal Government of Ethiopia (2015). Growth and Transformation Plan. <https://www.greengrowthknowledge.org/sites/default/files/downloads/policy-database/ETHIOPIA%29%20Growth%20and%20Transformation%20Plan%20II%2C%20Vol%20I.%20%20282015%2C16-2019%2C20%29.pdfS>

21. Government of Tanzania (2011). Integrated Industrial Development Strategy 2025. http://www.tzdp.gov.or.tz/fileadmin/_migrated/content_uploads/IDS_Main_Report.pdf

22. Government of Zambia, Ministry of Commerce (n.d), Trade and Industry. https://www.mcti.gov.zm/?page_id=5176

23. Zambia Development Agency (n.d). <http://www.zda.org.zm/index.php/publications/>

24. Government of Zambia (2018). Seventh National Development Plan. <https://www.lusakatimes.com/wp-content/uploads/2017/06/Final-7NDP-07-06-17.pdf>

	National Local Content Strategy 2018-2022	To promote utilization local products and services in growth sector Ensure that 35% of inputs in growth sectors are locally procured
Rwanda	National Strategy for Transformation 1 ²⁵	Promote industrialization with the aim of growing exports by 17% annually Light manufacturing and Information and Communication Technology (ICT) are priority sectors
	Industrial Policy 2011 ²⁶	Industrial sector to contribute to 26% of GDP Developing industrial parks and special economic zones
	Made in Rwanda Policy 2017 ²⁷	Aimed at increasing economic competitiveness by enhancing Rwanda's domestic market through value chain development. Local producers have a 15% preference on their bid scores, if they meet 30% local value-addition. Government to support local production through exclusive reservation of certain tenders.
	Special Economic Zone Policy 2018 ²⁸	Provides a framework for development of special economic zones in Rwanda

2.3 Enabling environment to attract private investment for manufacturing

Governments across the 5 countries have all set up three main categories of incentives to promote manufacturing, those that:

- i) Enable faster and easier setting up of private businesses such as one stop centers for licensing
- ii) Reduce financial risk such as fiscal incentives
- iii) Provide ready-made infrastructure such as industrial promotion zones

Investment promotion agencies in the respective countries (Nigeria Investment Promotion Commission, Ethiopian Investment Commission, Tanzanian Investment Centre, Zambia Development Agency, and the Rwanda Development Board) function as 'one-stop' shops for obtaining investment permits and relevant business licenses. This helps increase the efficiency in business application processes. The level of efficiency, however, varies from country to country with Rwanda having the most efficient system where business registration taking about six hours to complete²⁹. It takes 24 hours to incorporate/register a business in Nigeria³⁰ and about 4 days in Zambia³¹, 5 days in Ethiopia³² and 7 days in Tanzania.³³

Industrial zones, also referred to as special economic zones are geographically delimited areas within which governments facilitate industrial activity through fiscal and regulatory incentives and infrastructure support.³⁴ Industrial zones, designated for export processing units, are also called free trade zones where both import and export procedures are streamlined. Ethiopia though five times smaller than Nigeria, has a higher number of special economic zones currently operational. Tanzania currently has no economic zone operational while Rwanda has only one-Kigali Special Economic Zone. Concerted efforts are there to increase the numbers as can be seen by the number of locations under development or earmarked for the same as indicated in Table 4 below.

25. Ministry of Finance and Economic Planning Rwanda (2017). National Strategy for Transformation http://www.minecofin.gov.rw/fileadmin/user_upload/NST1_7YGP_Final.pdf

26. Ministry of Trade and Industry Rwanda (2011). http://www.minicom.gov.rw/fileadmin/minicom_publications/policies/Industrial_Policy-2.pdf

27. Ministry of Trade and Industry (2017). Made in Rwanda Policy. https://nyarugenge.gov.rw/fileadmin/user_upload/REPORT/Made_in_Rwanda_Policy_-_Website_Version.pdf

28. Ministry of Trade and Industry Rwanda (2011). http://minicom.gov.rw/fileadmin/minicom_publications/documents/SEZ_Policy_-_January_2018_v2.pdf

29. Rwanda Development Bank Website (n.d). <https://rdb.rw/why-rwanda/#investment-incentives>

30. Nigeria Investment Promotion Commission (n.d). <https://nipc.gov.ng/iguide/getting-started/#osic>

31. World Bank Group (2020). Doing Business Zambia. <https://www.doingbusiness.org/content/dam/doingBusiness/country/z/zambia/ZMB.pdf>

32. World Bank Group (2020) Doing Business Ethiopia. <https://www.doingbusiness.org/content/dam/doingBusiness/country/e/ethiopia/ETH.pdf>

33. World Bank Group (202). Doing Business Tanzania. <https://www.doingbusiness.org/content/dam/doingBusiness/country/t/tanzania/TZA.pdf>

34. United Nations Conference on Trade and Development (n.d) Special Economic Zones. https://unctad.org/system/files/official-document/WIR2019_CH4.pdf

Table 4: Status of industrial park development across the countries

Country	Industrial Parks				
	Active	Inaugurated	Under Development	Planned	Total
Nigeria	8		9	7	24
Ethiopia	9	2	5	6	22
Tanzania			10	4	14
Zambia	3			4	7
Rwanda	1			9	10

Countries have also begun setting apart industrial zones for electronics manufacturing. In Ethiopia, the Adamah industrial park is focused on ICT while in Nigeria the Lekki Free Zone is inviting investments in light industries including solar panel assembly.³⁵ In Zambia Chambishi which is a sub-zone of the Lusaka East Multi Facility Economic Zone is open for engineering equipment assembly.

In addition to benefits provided within the special economic zones, investors have access to additional fiscal (monetary) incentives for establishing manufacturing operations within the various countries. The key instruments used as fiscal incentives are summarised in Table 5 below. Besides Nigeria, where the government has plans underway of giving tax relief to local assemblers of solar components under its Economic Plan and Solar Connection Project, none of the other four countries have specific fiscal incentives in place targeting local manufacturing.

Table 5: Incentives for investors in manufacturing

Country	Corporate Tax	VAT	Import Duties	Allowances
Nigeria	3-5 years tax holiday for pioneer companies . ³⁶			Rural incentive allowance R&D allowance
Ethiopia	Exemption of 8 - 10 years	No taxes on exports	0% on imports of capital goods, spare parts, raw materials and vehicles	
Tanzania		VAT Deferment on project capital Goods such as Plant	0% on Project Capital Goods and raw materials. 10% for Semi-processed goods	50% allowance for wear and tear of plant machinery in year one
Zambia	2-7% discount on income for the first year of listing on the Lusaka stock exchange.		Duty free importation of most capital goods	
Rwanda	Preferential at rate of 15% for any investor 7 years tax holiday of up to seven years	Value-added tax refund	Exemption from capital gains tax	Accelerated depreciation of 50% within the first year

35. Lekki Free Zone (n.d) Investment Sectors in Lekki Free Zone. <https://lfzdc.org/investment-sectors/>

36. Pioneer companies are those that venture into new industries or manufacture new products. Pioneer products are often listed on Nigeria Investment Promotion Website.

Restrictions in accessing investment incentives exist in Zambia, Tanzania, Ethiopia. In Zambia, only investments of more than US\$ 500,000 within an industrial park or priority sector or in a rural enterprise are entitled to fiscal incentives³⁷. In Tanzania, to access incentives offered by Tanzanian Investment Center (TIC), local investors (fully owned by Tanzanian citizens) are required to have a minimum local investment of US\$ 100,000. For foreign investors operating independently or as joint ventures, a minimum investment value of US\$ 500,000 is required³⁸. In Ethiopia, for foreign investors, minimum capital transfer of US\$ 200,000 is required for foreign owned projects and US \$150,000 for joint ventures³⁹.

2.4 Free trade zones

All the 5 countries are members of at least 1 regional trading block as can be seen in Table 6 below. Rwanda and Tanzania are part of the East African Community (EAC) as well as members of COMESA (Common Market for Eastern and Southern Africa), along with Ethiopia and Zambia. Tanzania and Zambia are members of Southern Africa Development Community (SADC). All the countries so far have also signed the African Continental Free Trade Agreement (AfCTA) which will increase trade and movement of capital across the continent. All countries, other than Tanzania, have so far ratified the treaty as well.

Table 6: Membership to regional economic block

Country	EAC	COMESA	SADC	ECOWAS	AFCTA
Nigeria		✓		✓	✓
Ethiopia			✓		Not Ratified
Tanzania	✓				✓
Zambia		✓	✓		✓
Rwanda	✓	✓			✓

These regional, and in the case of the AfCTA, continent-wide trading block, should provide export markets. The trading blocs provide an additional market to the domestic market that could be served by the entity. To achieve cost competitiveness in solar assembly, economies of scale are critical. Asian companies involved in the assembly of solar components serve large global markets. To compete effectively, African companies would need to address a larger African market. Exports would also enable the host country to earn foreign exchange, an important policy goal in promoting local manufacturing. This implies however that import tariffs between countries in the trading blocs have been rationalized to promote cross-border trade. However, a continuing challenge of the regional trade blocs is the issue of misclassification of goods⁴⁰. The regional trade blocks have been able to increase intra-African trade to 17% in 2017 from 10% in 1995. This is significantly lower than trade between Asian countries (59%)⁴¹. It also needs to be emphasized that the implementation of the AfCTA is still in the future.

2.5 Existence of a conducive manufacturing environment

As previously outlined, although the manufacturing activity in the 5 African countries is currently at a relatively low level, the governments are all keen to increase the share of manufacturing to spur economic development and have ambitious goals. The policy package includes faster processing of business applications, creation of infrastructure (industrial parks and free trade zones) and fiscal incentives.

To date, private sector investment in manufacturing in the 5 countries has been more concentrated in areas such as agri-processing, cement, garments and minerals. Investment in areas such as electronic assembly are very limited. What has been the experience of the companies which are already involved in local assembly? Are they working in a conducive environment where they are growing rapidly and would be able to cater to the large un-meet demand of electrification? This is the question that will be addressed in the next section.

37. Zambia Development Agency (2016). Zambia's Investor Guide. <http://www.zda.org.zm/wp-content/uploads/2020/12/ZDA-Investors-Guide-.pdf>

38. Tanzania Investment Center Website (n.d): <http://www.tic.go.tz/selectedIncentives#>

39. Ethiopian Investment Commission (2017). An Investment Guide to Ethiopia

40. Shepherd, B., & Twum, A. (2018). Final report Review of industrial policy in Rwanda Data review, comparative assessment, and discussion points. <https://www.theigc.org/wp-content/uploads/2018/11/Shepherd-Twum-2018-Final-report.pdf>

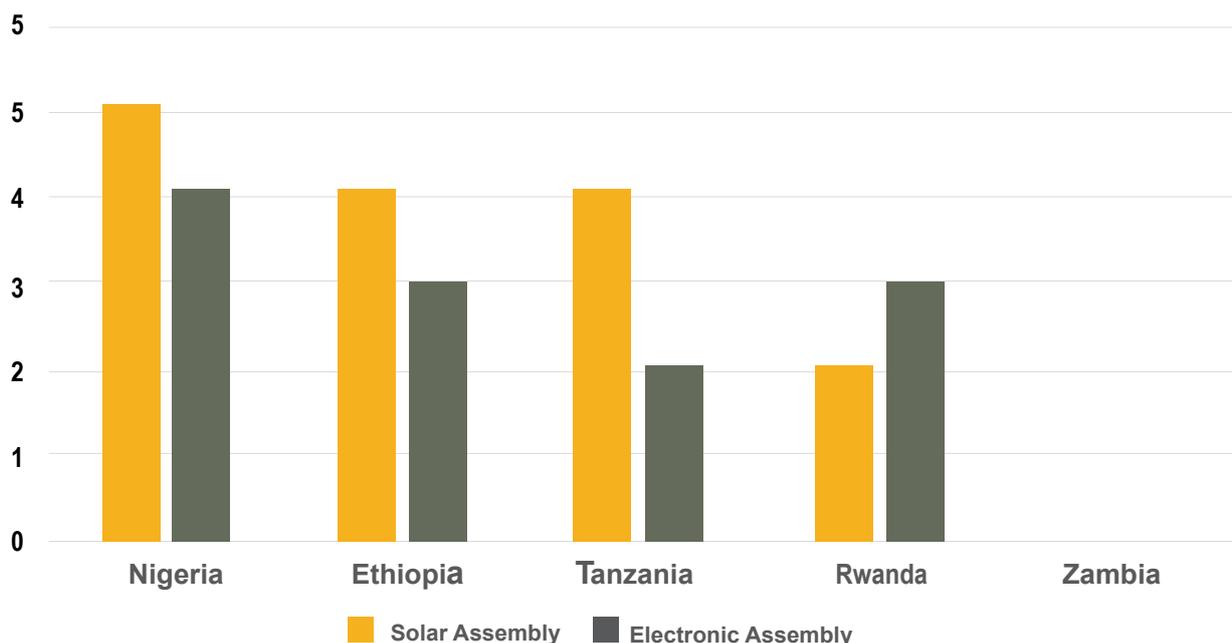
41. Brookings (2019). Intra-African trade: A path to economic diversification and inclusion <https://www.brookings.edu/research/intra-african-trade-a-path-to-economic-diversification-and-inclusion/>

3. PRIVATE SECTOR EXPERIENCE IN MANUFACTURING OF OGS PRODUCTS

3.1 Existing private sector presence

Although the number of companies currently involved in local assembly and manufacturing of solar products remain small, there is an increasing interest in local manufacturing/assembly of OGS in Sub Saharan Africa. Figure 4 below shows the number of companies assembling solar products and electronics in the 5 countries.

Figure 4: Number of companies involved in local assembly of solar and electronic components.



Note: The number of electronic manufacturing/assembling companies were obtained through desk research and thus may deviate from total numbers in the country.

Nigeria, has three companies relatively more advanced. The Ibeto Group, a diversified business house which has a unit manufacturing battery for solar home systems; Auxano Solar, which assembles solar panels, has received a US\$ 1.5 million investment from All On, a Shell-backed investment company and the Blue Camel Energy, which has a LED assembly unit.

Ethiopia has two companies, Forsera and Abramba Technologies, undertaking assembly in the country. Abramba assembles pico solar products and LED lights while Forsera assembles solar home systems (6W panels). Both these companies remain small and produce only limited number of products every year. Two other companies, Lydetco Hello Solar are also planning to set up manufacturing/assembling base in Ethiopia. Another company, an associate of the German organization, Solar Federation, closed down operations in Ethiopia during the course of this study.

Two international companies have invested in Rwanda. NOTS Solar, a Netherlands-based company has invested in the assembly of solar products and, Sahasra Electronics, an Indian LED company, has invested in the assembly of LED bulbs. NOTS got a contract from the government of Rwanda that will result in the purchase 100,000 solar home systems to be manufactured within the first two years of their operation. ZOLA Electric (formerly Off-Grid Electric) set up a facility for assembling solar TVs in Rwanda. About 25,000 units had been assembled before it closed down on account of the COVID-19 pandemic crisis.

While there is no single company undertaking manufacturing/assembly of OGS in Tanzania, there's a general interest as is demonstrated by rebranding of imported products by the local solar companies such as ProSolar, Ensol, Desert Storm and Baraka Solar. Like Tanzania, Zambia has no company involved in assembly of solar products or even electronics. However, light manufacturing of electrical appliances is considered a potential area for investment in the country.⁴²

3.2 Challenges faced by companies doing local assembly

Several systemic issues plague the OGS sector making it hard to set up and operate local assembly/manufacturing facilities in the five countries. These are discussed below:

3.2.1 Deliberate Policies and Regulations

Import tariffs and regulations

The interviews conducted indicate that there are two related problems in this category. The assembly of solar products requires the importing of multiple components to be assembled. If the import duty on the finished product is significantly lower than duty imposed on components, there will be no commercial benefit for local assembly: it will be cheaper to import the finished product. The associated problem is the many codes associated with key components. This means companies must meet onerous documentation requirements and run the risk of having to pay unpredictable amounts of duties. The companies interviewed indicated that they had to often get specific permissions to be able to import components. This leads to increase in costs and imposes uncertainty.

Lack of clear and easily enforceable quality standards

The interviews conducted indicate that the lack of quality standards for locally assembled components is a critical bottleneck for local assembly. IFC Lighting Global prescribes quality standards for finished products but quality of locally certified components is often impossible to ascertain. Quality standards are either not available or, if available, test facilities are not accessible. Ensuring the quality of solar products is of utmost importance and without a robust quality regime in place, it is impossible to build a vibrant local assembly or manufacturing industry. Rwanda with its Ministerial guidelines on minimum standards required for standalone photovoltaic system and their accessories is a good example of countries that are already putting into place quality and performance standards.⁴³

3.2.2 Lack of, and poor implementation, of incentives

The fiscal and non-fiscal incentives provided by the investment agencies though directed towards manufacturing are not specific to manufacturing of solar products. Moreover, their appropriation is inefficient and limited in most cases to the size of the companies and operations within the industrial parks/economic zones. In Ethiopia for example, 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. The Free Trade Zones and industrial parks described in the previous chapter are meant to attract the 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.

42. Government of the Republic of Zambia (2019). Foreign Private Investment and Investor Perceptions Survey Report

43. Rwanda Ministry of Infrastructure (2019). Ministerial Guidelines on Minimum Requirements for Solar Home Systems. https://www.mininfra.gov.rw/fileadmin/user_upload/Mininfra/Publications/Laws_Orders_and_Instructions/Energy/Ministerial_Guidelines_on_minimum_requirements_for_solar_home_systems.pdf

3.2.3 Uncertainty in off-take demand of OGS products

The lack of clear road map or electrification blue print for off-grid sector in the four countries except for Rwanda, causes uncertainties for private sector when it comes to demand of OGS. The traditional approach of electrification that's upheld by most governments puts emphasis on grid extension and densification without taking into consideration the role played by off-grid products. With no clear demarcation of regions or populations for OGS, there's the fear of market shrinkage and decreased cashflows. Adoption of blended approaches in electrification as is seen in the case of Rwanda provides a clear estimate of the total market that can be served by off-grid solutions in a country.

Box 2: Auxano Solar, Nigeria

Auxano Solar was incorporated in 2014 in Nigeria and started assembly of solar panels (60W and above) in 2016. The company has so far set up a facility with a capacity of 10MW. Though relatively young the company managed to manufacture solar panels of between 2.5-3MW in 2019. Solar panels are sold to solar companies, distributors and wholesalers of solar products.

The motivation to engage in manufacturing came from a quality concern point and the desire to have more control of what they were giving their end users. In addition to the control, local assembly was also a channel by which they would be able to understand the technology and to respond to any technical challenges that would arise from the use of the products.

Early in the years, the company was hit by the existing perception of "foreign is better". Persistence and pilot projects, where some of the locally assembled panels were used helped them prove the quality of their products. Additionally, the ability to quickly respond to the technical challenges of their clients given their presence in the country became a selling point for them.

Beyond the perception, the lack of support for local manufacturing companies is a great hurdle. There is a lack of proper and effective implementation of existing incentives. The strategy to promote manufacturing by giving tax holidays of between 3-5 years has never been implemented.

Lessons Learnt

- ☞ A deep understanding of the target market is a requisite for any investor interested in manufacturing. Key elements to be considered include affordability and pricing.
- ☞ It's valuable to begin small and scale later. That way you get to learn and understand the business eventually.
- ☞ Debt should be avoided at the beginning and use the available capital to test out the business idea.

Recommendations

- ☞ The government should provide financial incentives similar to those observed in Asian countries, where companies benefit from tax credits or cash (investment incentive). This reduces the financial risk that's borne by the company.
- ☞ Government to open up tenders for bidding by local companies. This way they increase market for these companies enabling them to grow and to address unemployment which is a concern for the government.

Box 3: Nayo Technologies, Nigeria

Nayo Technologies was founded in 1996 but officially incorporated in 2004 as a limited company. Nayo currently assembles SHS systems. The company imports the SHS systems as completely knocked down and manufactures the plastic moulds in-country. Last year, the company assembled close to 6,000 SHS systems. Beyond the SHS, Nayo Technologies intends to venture into manufacturing of solar mounting structures. According to their estimates, there is a market of up to 20MW for solar PV, covering mostly commercial and institutional.

The motivation to invest in local assembly of solar products came from previous attempts at manufacturing and the realization that the products manufactured locally were at par with imported products in terms of quality. The only challenge was how to scale their production. Initial products manufactured were stoves and later UPS power systems which were sold for military application to both the US and Nigerian governments.

The lack of support for local manufacturing as is evidenced by incentives that look good on paper but are not implemented, remains a deterrent in the growth of the company given the level of financial risk they have to bear. Moreover, the uncertainty when it comes to policy in the country complicates the situation further. Their plans to add to their portfolio manufacturing of smart meters in 2021, was suddenly cut short by the new policy removing all duties on imported smart meters.

Lessons Learnt

- ☞ Integrated manufacturing as is currently practiced in China and other Asian countries, in which companies produce different components would be key when it comes to local manufacturing. This approach reduces importation and the associated costs, but importantly supports the growth of the manufacturing sector.
- ☞ A deep market intelligence enables an investor to identify opportunities where they can focus. Their success so far is partly tied to their understanding of the varying needs presented by the markets they serve.

Recommendations

- ☞ Government should create robust incentives to hedge businesses against financial risks such as inflation. The result from this will be threefold: it increases access to energy; reduces stress on foreign reserve; and addresses the unemployment challenge in the country.

4. INTERNATIONAL EXPERIENCE AND LESSONS FOR AFRICAN NATIONS

4.1 International experience

Bangladesh's Infrastructure Development Company Limited (IDCOL) programme which led to the installation of 5 million SHSs provides some pertinent lessons in supporting local assembly. IDCOL started the programme with imported SHSs.⁴⁴ During the project implementation, several private companies emerged in the assembling/manufacturing of critical components. Bangladesh currently has a vibrant industry for assembling components such as solar chargers and solar pumps. One of its battery companies, Rahimafroz, exports to India and Uganda. The development of the local industry was part of a strategy of the way IDCOL set quality standards. For example: for solar chargers the quality standards were set such that it ensured locally assembled components met strict voltage standards (to ensure end user satisfaction). The standard for the efficiency of conversion was however relaxed. The quality standards allowed local companies sufficient time to learn skills and as they did so quality standards were hatched up. IDCOL set up an elaborate testing infrastructure where both finished products and components can be tested easily.

India's Energy Efficiency Services Limited (EESL) programme in disseminating LED lights provides similar lessons. EESL is a public sector company. In January 2015, EESL started a massive procurement of energy efficient light-emitting diodes (LEDs) bulbs. By March 2019, it had distributed 347.4 million LED bulbs to domestic households. It had also installed 8.49 million LED street lights.⁴⁵ EESL procured lights through a tendering process from private companies and partnered with distribution utilities and municipalities. At the time of commencement of the programme, the LEDs were all imported. In five years, all major components (other than the LED light sources themselves) could be assembled locally.

Both the IDCOL programme in Bangladesh and the EESL programme in India indicate how the public sector can address two key challenges identified in the previous chapter: uncertainty in off-take demand and lack of clearly enforceable quality standards. IDCOL ensured that there was demand for OGS products by channeling international financing possible to players who were providing SHSs to rural households. EESL created a very large demand for LED bulbs by undertaking a public procurement process. Assured of this demand, private sector companies invested in ramping up supplies. By stipulating transparent quality standards and setting up national testing infrastructure, it became easier for local assemblers to produce components which would meet the demands for local assemblers.

The 5 African nations can follow either of the two routes if they have to encourage local manufacturing in the OGS sector. One option is to ensure that there is sufficient financing available to the OGS players so that they have the ability to reach out to the large numbers of un-electrified customers. By implementing quality standards at the component level and by implementing import tariffs that do not discourage local assembly the enabling conditions would be created for the private sector to invest in local assembly.

The other route could be to encourage investment in the Free Trade Zones for large (likely led by FDI) manufacturing components that can meet not just the domestic demand but also export markets. This would create sustainable enterprises that can meet the large demand expected to arise from Africa in the coming years. A good example is seen in the case of Rwanda where NOTS has set up facilities within the special economic zone and part of the obligation involves exporting products to other markets in the region as from the fifth year of operation.

44. Sanyal S. et al, Stimulating PAYG Energy Access in Kenya and Tanzania, 2016, <https://www.wri.org/publication/stimulating-pay-you-go-energy-access-kenya-and-tanzania-role-development-finance>

45. EESL Annual Reports

4.2 Conclusion and Lessons

The relatively large off-grid population in the 5 countries, and the ambitious universal energy access goals indicated by their governments, results in an important market for off-grid products and the opportunity to achieve greater impacts through the local assembly and manufacture of solar products. The market for these products is further evidenced by the growing demands in different segments such as productive use and commercial and industrial applications.

Governments of the 5 countries are keen on encouraging local assembly and manufacturing and have been putting in place some incentives to encourage private sector investment in local manufacturing. However, the contribution of manufacturing to the economies of the countries is still low. There is, in particular, limited private sector presence in either electronics or solar assembly. Only a small number of companies in these countries are currently in the business of assembling solar products. Rwanda has attracted two foreign companies to invest in local assembly, which is creditable given the small size of the country. Ethiopia and Nigeria have somewhat larger number of companies, but they're still at an early stage of development.

Rwanda remains a promising location for local assembly and manufacturing given its supportive policies. In addition to a clear electrification plan for both grid and off-grid solutions, the Made in Rwanda policy makes it possible for local producers to compete favourably in pricing with the imported products (15% preferential price). It also provides additional incentives including import duty and tax exemptions for inputs for local production. The goodwill from the government through purchasing of locally produced goods, especially in the first few years of operation helps provide a ready market for companies.

Though Nigeria has some of the relatively larger companies with the ability to expand their capacities to cater to the OGS market, creating a conducive environment for local assembly by addressing issues of import tariffs, quality and demand off-take is still required. Moreover, lack of transparency and predictability of policies has been cited as a major deterrent to growth of the sector. The Government's Economic Sustainability Plan currently being implemented could provide an incentive for these companies to expand and other companies to make investments.

A phased approach, similar to the Roadmap developed by McKinsey for Nigeria, which recommends three stages of implementation, below, remains critical in ensuring success:

- ☞ Proof-of-Concept stage: where existing assemblers are supported to prove the potential in the sector
- ☞ Scale Up Phase: where a set of incentives and initiatives are provided to unlock the market) and
- ☞ Maturity Stage: focused on sustaining assembly and expanding to manufacturing

The first two stages call for import facilitation through tax exemptions in order to meet the energy access target and stimulate local demand.

Concerted efforts need to be put in place to attract private sector investment in solar product assembly and manufacturing in Ethiopia, Tanzania and Zambia. Ethiopian companies remain small and they seem to have gained no financial advantages in local assembly as compared to their counterparts who import the entire finished products. In Tanzania the companies are mostly engaged in rebranding and not actual assembly while local assemblers are almost absent in Zambia. Incentives for local manufacturing do not target the electronics and solar areas but are more targeted towards textiles, agro-processing and mining. The countries could also do better in implementing policies, which on paper sound quite encouraging. For instance, local assemblers could have easier access to infrastructure in industrial parks.

After the base of local assembling has been established, countries can put in place policies that prioritise local content in OGS procurement. Without this economic base, policies emphasising local content could create supply side constraints in reaching energy access goals. For example, the availability of SHSs could decrease, their prices could increase and there could be quality issues. The infrastructure to attract foreign investment in the form of industrial parks should be set up and the import tariffs rationalised. If international companies have to be attracted, because local companies lack the required capacity, negotiations would have to be carried out with them. Building an industrial base in an emerging technology area like solar should prove beneficial to the economy but the efforts required to do so should not be underestimated.

International experience suggests how well-designed policies stimulate local assembly and manufacture. There are three important areas of support:

- ☞ Supportive regulations, including predictable and supportive import tariffs and easily enforceable quality standards.
- ☞ Supportive infrastructure for local assembly and manufacture of OGS systems, such as special economic zones and industrial parks and making financing available to attract foreign companies to invest in special economic zones.
- ☞ Ensuring market demand for such products through public procurement or providing financial incentives, such as tailored RBFs for local products.

These support measures are necessary to build the enabling environment for private sector to invest, and policies that set targets for local assembly without these preconditions are unlikely to meet their goals.

ANNEX

Methodology

A two-stage approach was employed in undertaking the study: i) secondary research and ii) primary research undertaken via on-line interviews.

The secondary research conducted was to collect data on the macro economic environment, policies and infrastructure to promote local manufacturing and environment and the actual state of manufacturing in the five countries. The information collected through this process included:

- ☞ Macroeconomic performance of countries including aggregate gross domestic product (GDP), GDP growth, manufacturing as share of GDP and foreign direct investments.
- ☞ Existing industrial and manufacturing strategies and policies in particular incentives offered to attract investments and plans for establishing required infrastructure.
- ☞ The actual state of manufacturing: products manufactured in the five countries and patterns of manufactured good export.

The primary Interviews were conducted with two main categories of stakeholders: i) local stakeholders, which included policy makes involved in developing manufacturing strategies and local companies already involved in local manufacturing/assembly; and ii) international stakeholders composed of international companies who could invest in local manufacturing/assembly and development partners supporting industrialization. Stakeholders interviewed were identified during the data collection process in consultation with the country management teams of ACE TAF.

Interviews with the local stakeholders was geared towards understanding the preparedness and viability of these countries to establish manufacturing plants and it covered the following groups:

Interview Protocol of Local Stakeholders

Interview Group	Interview Objective	Interview Details
Companies already doing solar product assembly in the country and companies in related areas of assembly such as electronics	<p>Is there a cost competitiveness of local manufacturing/assembly?</p> <p>Is there a conducive environment for local manufacturing and environment?</p>	<p>Products manufactured and target markets</p> <p>Source/origin for raw materials/inputs</p> <p>Availability of factors of production</p> <p>Ease/difficulty of maintaining quality standards and technical service</p> <p>General experience in acquiring the necessary permits in establishing the business</p> <p>incentives the company has benefitted from</p> <p>Sources of financing for the operations.</p>
Industrial Parks / Economic zones	What is the status of incentives and infrastructure available to attract local manufacturing and assembly?	<p>Strategies and activities being implemented in the country to promote manufacturing</p> <p>General incentives for operations within the economic zones</p> <p>Any existing restrictions for foreign investments</p> <p>Any specific comments/interest in the solar industry?</p>
Others e.g., Development Banks/National Banks	Are there financial schemes available for local manufacturers and assemblers and is there a demand for these loans	<p>Access to finance for companies involved in manufacturing</p> <p>Collateral requirements for loans</p> <p>Current interest rates on loans</p>

Table 2 International stakeholders Interviewed

Group	Type of information obtained
International companies	- Interest, ability and challenges to locate manufacturing and/or assembly facilities in these countries
Development partners	- Type of programme being implemented - Targeted beneficiaries/main sub-sectors/sectors covered - Comments on the overall investment readiness of the country - Any major success stories of investment in manufacturing/assembly



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