Challenges in the Solar Home Industry in Mozambique

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Document Overview

The purpose of this document is to identify the challenges faced by the Solar Home System (SHS) industry in Mozambique and propose solutions that can help make the market more viable and that will help achieve the objective of universal access to energy by 2030 as set out in SDG[1] 7 of Agenda 2030 and the National Electrification Strategy.

The core challenges of the industry are:

- High product costs, largely driven by the cumulative impact of VAT on goods and services, duties, VAT and fees on import and high fixed costs which require high volume sales to recover.

- Despite Mozambique having projected connecting over 4M off grid households by 2025 using SHS, these are predominantly very low income. Even with over $40M of donor subsidies made available to date, less than 650 thousand households (less than 22%) of this 4 million target can in fact afford entry level SHS.

The key proposed solution is the introduction of permanent exemptions on import duties and a VAT holiday of 5 years for imports and domestic transactions in SHS, including core accessory components,. We expect the impact of these incentives to be as follows:

- Import duties and VAT on SHS in Mozambique constitute approximately 45% of the cost to the customer, their removal will lead to a large reduction to end-user prices, and a huge increase to the addressable market (total market demand), from 650k to 1.8M households.

- Due to the vastly increased size of the addressable market, and price-sensitivity of these target customers, the rate of sales will greatly increase, contributing over 1,290,000 households to pro-energia targets.

- Employment in the sector will increase, with over 800 employees and 1,500 commission based sales agents by 2030.

- A net increase in tax revenues from the SHS industry, when taking into account: corporate income tax, VAT on derivative goods and services transactions, IRPS and INSS employee contributions.

The 5 year VAT holiday will demonstrate that the impact of these exemptions is a win-win; they lead to the SHS sector contributing far more towards the Pro-Energia goal of rural electrification, increased employment, and a net increase in tax revenues. At the end of the 5 year period, the VAT holiday should be reviewed and, as demonstrated, renewed. With a renewal until 2030, projected sales of SHS in Mozambique will surpass 2,000,000 households.

[1] Sustainable Development Goal/Objecto de Desenvolvimento Sustentável

Overview of Industry

In the PAYG solar industry[2], for-profit companies such as Fenix Intl, Ignite, SolarWorks! and Epsilon Solar purchase high-quality, plug and play solar home systems complete with lights, radios and TVs to sell to low-income, rural off-grid households that are still using dirty, dangerous fuels such as kerosene and candles for lighting their homes. Many of these people walk to trading centres to charge their phones, buy low quality batteries to power their radios, and watch TV at the barraca with the grid connection.

Because there is a disconnect between those that can afford these solar products with an upfront payment and those in most need of an electricity supply, PAYG Solar companies have innovated a hybrid energy supply and financial service model, first pioneered by M-Kopa in rural Kenya. In this model, the customer pays a small deposit (~700MZN) to take home the basic solar kit, and then on a daily, weekly or monthly installments denominated in units of electricity, until they have paid off the equivalent value of the kit, typically over 2 or 3 years. With this model, the product instantly gives access to electricity, while substituting customer spending on kerosene, phone charging and batteries and making it easier for the customer to afford. To incentivise timely payments the device will lock if a customer is late for a payment and then unlock when the customer tops up again - like CREDELEC.

There are two main challenges facing the PAYG SHS industry in Mozambique:

The ability and willingness to pay for energy in Mozambique is nearly the lowest of any major market

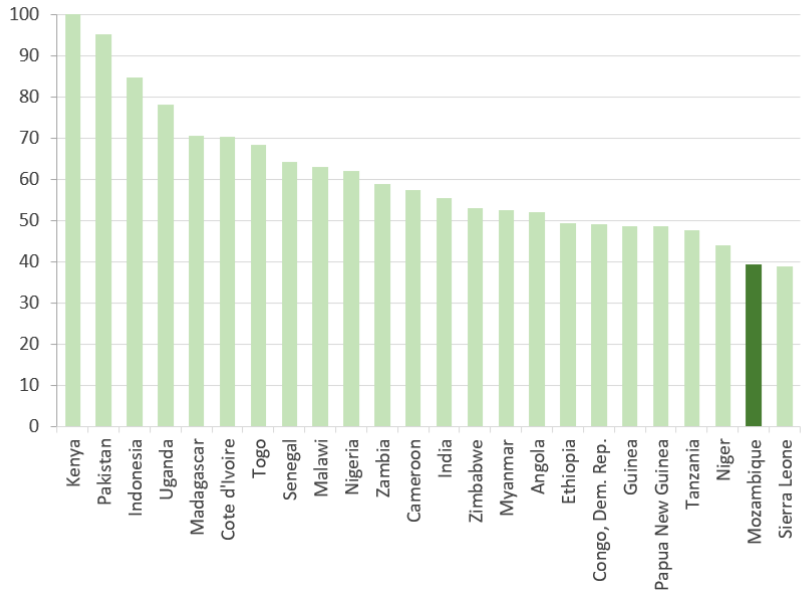


Figure 1. *Lighting global market attractiveness index Excel model. This country weighting is 50% willingness to pay / 50% ability to pay compared to other countries based on their research.*

[2] Pay-as-you-go (PAYGO) is a financing technology that allows end-users to pay for solar energy in weekly instalments or whenever they are financially liquid. PAYGO is a pioneering, game-changing credit system that removes the initial financial barrier to solar energy access by allowing consumers to make a series of modest payments to purchase time units for using solar electricity instead of paying upfront for the entire solar lighting system. https://energypedia.info/wiki/Pay-as-you-go_Approaches_(PAYGO)

The lack of fiscal incentives makes SHS more expensive in Mozambique than any other country in Africa.

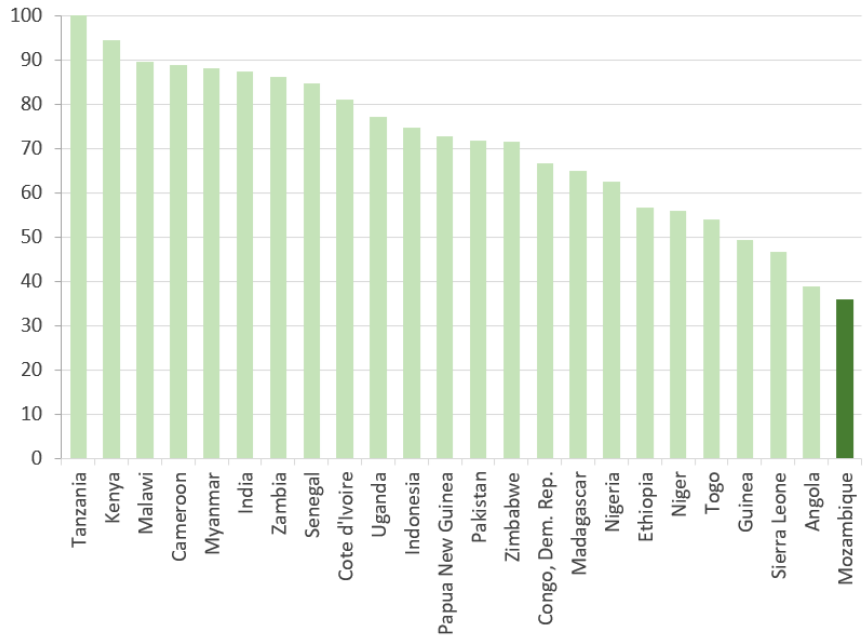


Figure 2. *Lighting global market attractiveness index Excel model. This country weighting is 50% Legal & Regulatory (includes taxation, quality standards, etc…) Environment and 50% Trade & Commerce (legal rights, ease of doing business, cost to import, etc. Another study that reinforces this ranking can be found on the Africa Energy portal)*

The importance of fiscal incentives to the success of a PAYG solar business is baked into the foundations of the business model. The business requires borrowing money to purchase inventory and to then finance customers' purchase of the SHS equipment. VAT and duty are paid at the time of import, and VAT is paid again at the time of sale. These costs need to be built into the customer price, as well as other financing and service costs. In Mozambique with 17% VAT and a 7.5% import duty, the impact on the cost-to-customer isn't 24.5%, due to incremental costs it's closer to 45% (as illustrated in Figure 6).

The typical SHS customer is rural with low financial stability and any increases in price have vast impacts on accessibility and total addressable market. Further, the curve of affordability is not linear. Small increases in price exponentially reduce the addressable market for any product targeted at these customers. We will examine the Mozambican customer segments in the next section.

The Challenge: High Costs & Low Income Customers

As outlined above, the fundamental challenge faced by SHS companies is the disconnect between a price that covers retail costs and the target customers' ability to pay.

In 2019 USAID, through the Southern Africa Energy Program, ran an affordability survey of 2,500 off-grid households across Mozambique and found that just 22% can afford the unsubsidised cost of an entry level solar home system, at $7.50 a month, leaving a total addressable market of just 880 thousand from the total 4,000,000 off-grid households. Further, from industry experience, at this price these Middle-

Income households are rarely willing to purchase an entry-level, lighting only SHS. Much of their prior energy spend is on peripheral, incremental costs, such as batteries for radios which are not replaced by a lighting only SHS.

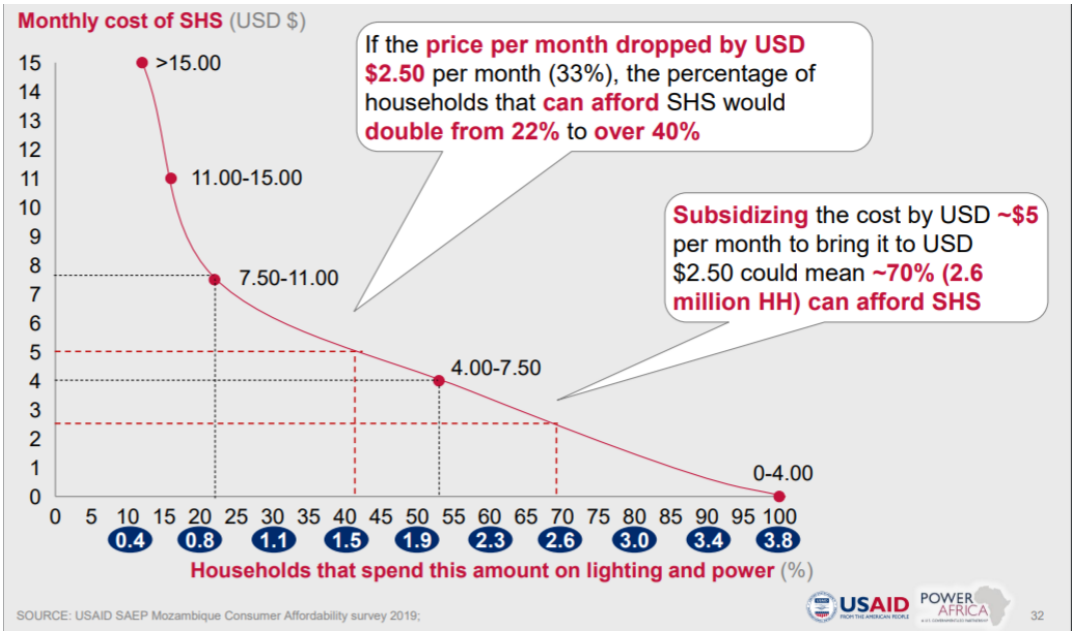


Figure 3. *Graph indicating number of households that can afford a solar home system at different monthly rates. Study funded by USAID/Power Africa.*

Fortunately there has been an influx of results-based donor programs, providing supply-side subsidies of varying amounts, allowing SHS companies to reduce the end-user price and enlarge the addressable market. The committed funding for SHS subsidies is currently estimated at USD 40M.

This may seem like a lot, but when we examine the different income and spending capabilities of the entire off-grid population, we soon realise it is nowhere near enough. In fact, as demonstrated in the following analysis, the $40M of subsidy financing only truly unlocks a market of around 630,000 households, or even less than the market initially deemed accessible without grant funding by the USAID study.

- **$7.50 per month: Middle Income, 22%**
  In the experience of current SHS companies in Mozambique, a $35 subsidy is needed to enable the addition of an attractive product to this segment, usually by adding a radio to the kit and thus substituting their spend on batteries as well as candles or kerosene. Without the subsidy SHS kits remain a niche product that only a handful of customers will purchase.

- **$5.00 per month: Low Income, 20%**
  To unlock these further 800,000 households and double the addressable market, a per-unit subsidy of around $50 is required on an entry level SHS.

- **$2.50 per month: Very Low Income, 28%**

To unlock the last customer segment, defined as 'Very Low Income' who spend at most $2.50 per month, and represent a further 28% of the addressable market, or 1.2M households, a $125 subsidy is required.

- **Less than $2.50 per month: Lowest Income, 29%**
  These households are not expected to be viable customers at any retail price-point and should be targeted by donor programs.

For the purposes of this study, the total addressable market shall only include the Middle Income, the Low Income and the Very Low Income markets, with a total of 2,840,000 households ("Total Addressable Market").

Scenario 1: No VAT and Duty Exemptions								
Customer Segment	Segment Size	Unit Subsidy Needed	Total Households	% allocation of grants	Households Addressable	Total Grant Allocation	Total Grants Needed	Funding Deficit
Medium Income ($7.50pm)	22%	$35	880000	20%	228571	$8,000,000	$30,800,000	-$22,800,000
Low Income ($5.00pm)	20%	$50	800000	30%	240000	$12,000,000	$40,000,000	-$28,000,000
Very Low Income ($2.50pm	28%	$125	1120000	50%	160000	$20,000,000	$140,000,000	-$120,000,000
				Totals	628571	$40,000,000	$210,800,000	-$170,800,000

Figure 4. *Breakdown of grant allocation to customer segment given no VAT & Duty exemptions. N.B. grant allocation between customer segments is estimated by private sector organisations and should be seen as directional rather than exact.*

In this scenario:

- $40M of grant funding will help unlock a market of around 630,000 of a total 2.8 million households to be electrified by SHS by 2030.
- No segment reaches over 30% electrification.
- Less than 20% of the Very Low Income segment is electrified.
- To unlock the entire off-grid market of 2.8M households, an additional $170,800,000 of donor funding would be required.

The Solution: VAT & Duty Exemptions

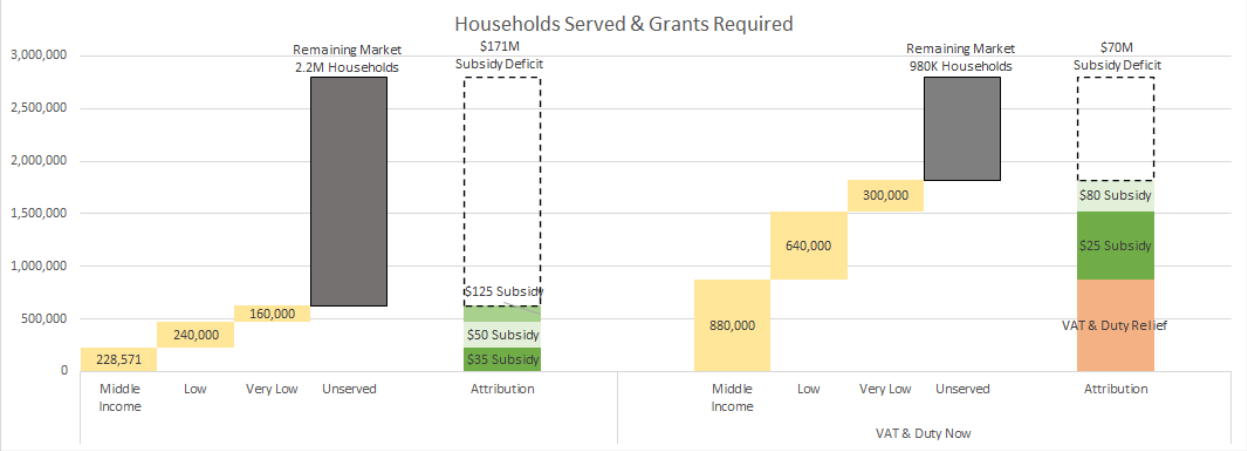


Figure 5. *Impact of VAT & Duty Exemptions on addressable households given existing grant financing of $40M.*

To increase the size of the addressable market, and thereby reduce the volume cost per unit as well as the grant funding gap required for SHS to meaningfully contribute to Mozambique's goal of universal energy access by 2030, we propose the government introduce fiscal incentives for the SHS sector in the form of:

- A 5 year holiday on VAT for SHS systems sold to household and productive use customers
- Import duty and VAT exemptions for SHS including all core SHS components

These two incentives represent an effective subsidy of around $44 on an entry level SHS, allowing a price reduction of $80 ($2.50 per month) for the customer. The lower taxes translate to a lower net default (because higher cost products are less affordable and have higher default rates), lower cost of financing (SHS companies spend less money on importing the kits and pay back periods shorten), a lower required profit per unit sold (due to higher volumes), and reductions in other variable costs per unit sold.

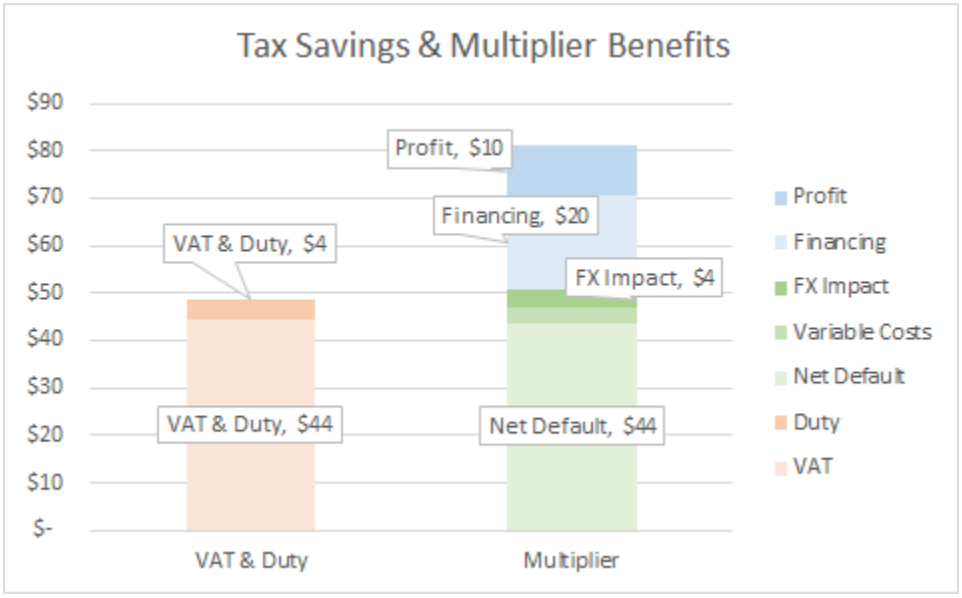


Figure 6. *Illustration of the impact of VAT & Duty exemptions on cost-to-customer due to self-reinforcing nature of PAYG SHS pricing*

Through this price reduction, we project the addressable market for entry level SHS to increase from 630,000 households to 1,820,000 households. The funding deficit to reach the remaining 980 thousand households will be only $70M.

Scenario 2: VAT and Duty Exemptions

Customer Segment	Segment Size	Unit Subsidy Needed	Total Households	% allocation of grants	Households Addressable	Total Grant Allocation	Total Grants Needed	Funding Deficit
Medium Income ($7.50pm)	22%	$0	880000	0%	880000	$0	$0	$0
Low Income ($5.00pm)	20%	$25	800000	40%	640000	$16,000,000	$20,000,000	-$4,000,000
Very Low Income ($2.50pm)	28%	$80	1120000	60%	300000	$24,000,000	$89,600,000	-$65,600,000
				Totals	1820000	$40,000,000	$109,600,000	-$69,600,000

Figure 7. *Breakdown of grant allocation to customer segment given VAT & Duty exemptions.*

In this scenario:

- SHS companies can price to reach all of the 'Middle Income' customer segment with no donor subsidies.

- The larger volume of sales allows the SHS companies to reduce their per product cost margin and thereby contribute to the lowering the cost per unit.
- 'Low Income' customers can be reached with a donor subsidy of only $25 per unit.
- A larger percentage of donor funds can be dedicated to reaching the Very Low Income' segment that can only afford $2.50 per month. There is still a large funding gap here, with around $70M required in this scenario to reach these households.

If the VAT holiday is extended beyond 5 years, all of the Very Low Income households will be addressable, due to efficiencies of scale replacing the $25 subsidy after the first 5 years of operation. We will see the impact of this in the industry sales projections section below.

How Pricing Impacts Sales

Solar Home Systems, at the right price, become an essential good rather than a luxury or non-essential good, substituting relatively over-priced low-quality, inefficient goods for the same service. For this reason, the price elasticity of demand experienced by SHS customers throughout Africa is extreme. Fundamentally, every rural household requires lighting and phone charging, so that as the monthly cost of a SHS approaches the cost of the alternatives, sales rates grow rapidly due to the higher quality service provided by SHS.

Fenix has run pricing tests in 6 markets across Africa and has noted extreme price elasticity of demand for entry level systems. When the key price features of deposit and daily rate are reduced together, proportionally (Fenix aims for a deposit of around 7% of the total finance price), greater sales rates can be unlocked and repayment rates often improve as the daily rate of the product approaches the customers normal daily energy and phone charging spend.

With the three major price points described in the customer segments described above, Fenix's price elasticity data, based on over one million sales across the continent of Africa would project sales growth of up to six times the baseline if the $2.50 per month price point can be unlocked through subsidies and fiscal incentives.

Illustration of price elasticity of demand for entry level SHS.

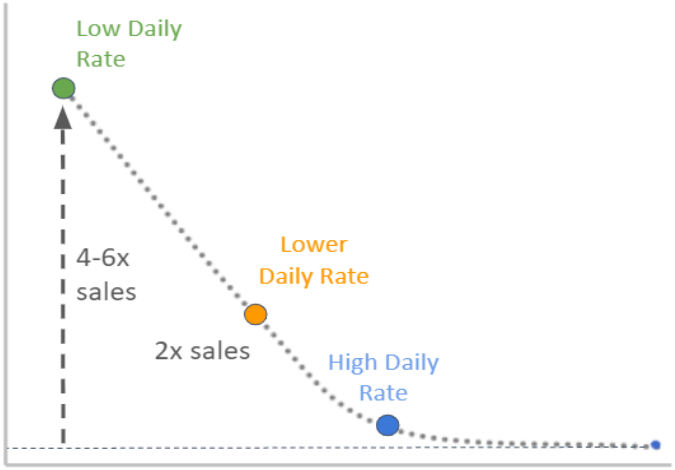


Figure 8. *'High Daily Rate'= $7.50 per month, 'Lower Daily Rate' = $5 per month, 'Low Daily Rate' = $2.50 per month*

Fenix ran an entry level price test in Mozambique in 2019. The entry level price point was decreased from 500MZN ($7.50) to 300MZN ($4.50). Sales increased by 3x in the following 60 days.

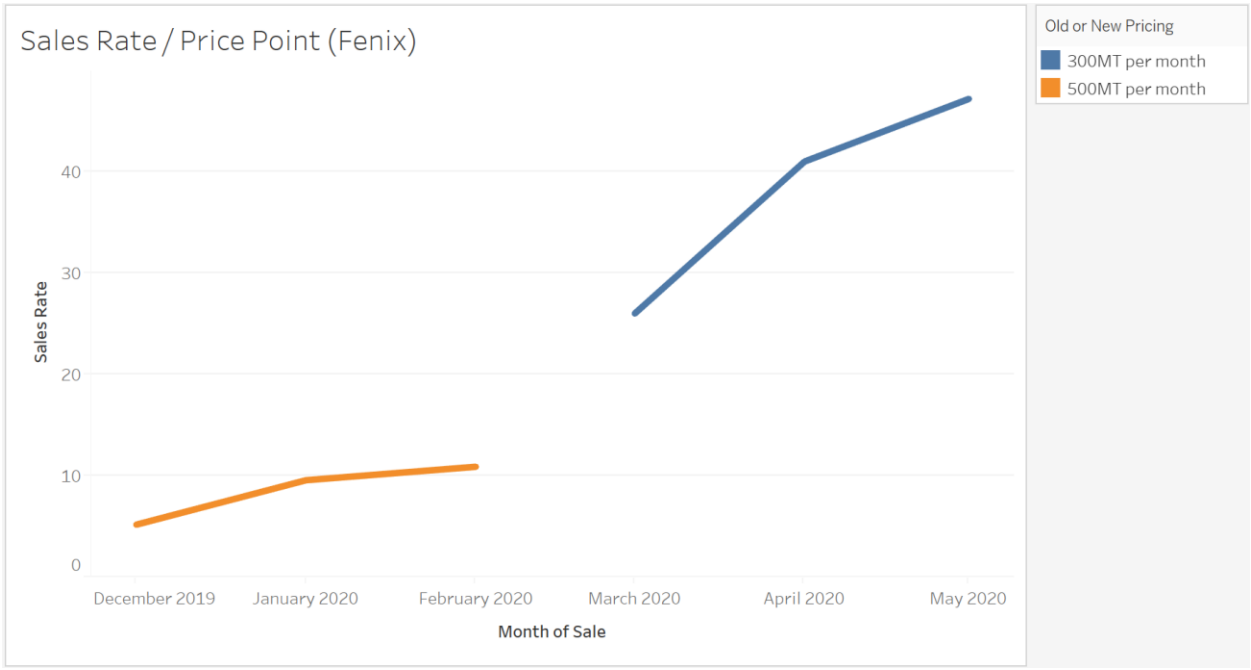


Figure 9. *Sales rates from December 2019-May 2020 price changes showing a 3x increase in sales from a 200MZN drop in the monthly price to the customer.*

This local data point allows us to confidently extrapolate that further reducing the monthly cost to $2.50 will comfortably double sales rates again. In fact, this is a conservative assumption when we compare with Fenix's experience in other markets.

How Fiscal Incentives Will Affect Industry Sales Numbers

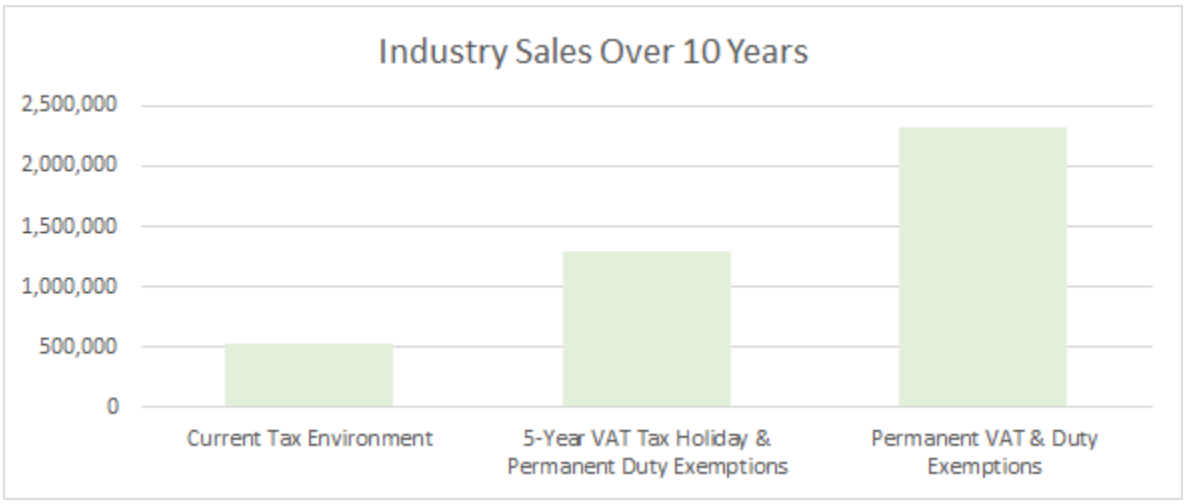


Figure 10. *Fenix Mozambique internal financial model and pricing model modeling on current and feasible sales rates under various tax environments; extrapolated to the entire industry. BRILHO estimates 20% of sales to be Tier 2 or above based on existing grant allocation.*

The industry is capable of selling 530k units over the next 10 years with no change to the current tax environment. A 5-year VAT holiday on imports and post-import transactions, and permanent Duty exemptions would allow for the industry to sell 1.3M solar home systems over the next 10 years. With permanent VAT & Duty exemptions magnifying the impact of the grants, the industry could sell 2,330,000 solar home systems over 10 years, with around 20% coming from Tier 2 systems (50W) or above. The difference between a tax holiday and permanent tax exemptions is the scale that any one company could reach before they would need to raise prices at the end of the holiday period.

While it may be counter intuitive given that Mozambique derives the majority of its tax revenue from VAT, providing VAT & Duty exemptions will actually result in more tax revenue overall (as well as greater electrification and rural employment) due to the compounding nature of taxation on the SHS business model.

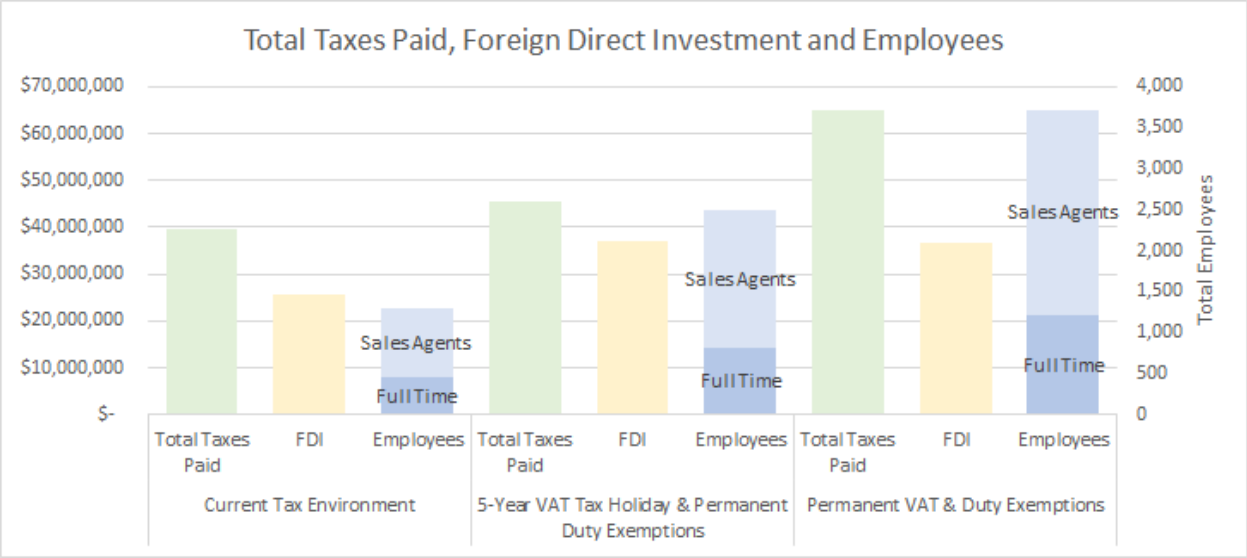


Figure 11. *Total taxes paid, foreign direct investment, and employment by solar home system industry based on tax environment. Total taxes paid include corporate income tax, VAT paid on revenues (where applicable), VAT paid on expenses (when revenues are not VAT eligible), duties (where applicable), employee taxes, and INSS.*

In the current tax environment the industry will pay $40M in taxes over the next 10 years. With a 5 year VAT tax holiday and permanent duty exemptions, the industry will pay $46M in taxes over the next 10 years. The loss in VAT & Duty on the product import and post-import sales is offset by much greater taxes on VAT paid in operations, payroll tax, and corporate income tax. Finally, permanent VAT & Duty relief would allow the solar home sector to scale to maximum capacity, resulting in even higher overall tax payments of $65M over 10 years.

Impact on **high need** areas of Mozambique will be greatest in the final scenario. If the government were to provide permanent VAT & Duty relief now, the combination of that relief and the grant funding will allow the SHS industry to reach the highest need, hardest to reach populations across Mozambique as competition ramps up and companies expand further into rural areas to find customers.

The Importance of Fiscal Incentives on Industry Sustainability

If No Incentives are Offered

Without any tax incentives or adjustment in policy towards the SHS industry, the industry will drastically scale down after all grant funding is allocated. This will likely result in some competitors going into hibernation and only collecting cash flow on the units already sold, effectively stopping new sales. Another bi-product of this situation is that only peri-urban populations and those closest to population centers will be served. The areas most in need will be left unserved due to the additional costs of reaching those customers and impact on electrification goals will be limited. In this scenario only 25% of the off-grid addressable market will be reached.

If Incentives are Offered Now

With full tax incentives and the committed grant money to rural electrification Mozambique has an opportunity to enable the fastest rural electrification program seen in Africa. It is feasible for the industry to electrify more than 2.5M households over a 10 year period because the cost of SHS will be equal to or lower than kerosene and torches, allowing all households to substitute for those products without increasing their expenses and while providing a much higher level of service through high quality light and phone charging capability.

Other Sector Challenges

The implementation of fiscal incentives is imperative to the success of the SHS sector in Mozambique, but there are other challenges which are important to address in due course to ensure the sustainability and health of rural electrification via SHS in the medium to long term.

Lack of Import Quality Standards

There is currently no enforced standard of quality for imported solar home system components, leading to a high number of low-quality units in the market. Low-quality units can have a life-span of less than 6 months, which leads to a bad perception of solar energy in the market.

It would be pertinent to enforce quality standards on imported solar home systems, especially to qualify for eligibility for fiscal incentives. There is an existing quality standards framework and certification program through the Lighting Global organisation which is ready made for this purpose. Alternatively, the government could create its own guidelines (such as was done in Rwanda) however this can be complex and lead to unexpected outcomes.

Bad Debt Provision

With the way the industry is structured and the high default risk of the off-grid customer, the regulations around bad debt provisions create an undue burden for SHS companies. The bad debt provision is capped at 6% spread over 4 years, which is a much lower default rate than that experienced by the average SHS company and disincentivizes SHS company outreach to the lowest income customers segments. As a result, a meaningful portion of recognized, but never received revenue is taxed which results in a reverse subsidy on the industry.

Lifting the cap on the bad debt provision for SHS companies will solve this problem.

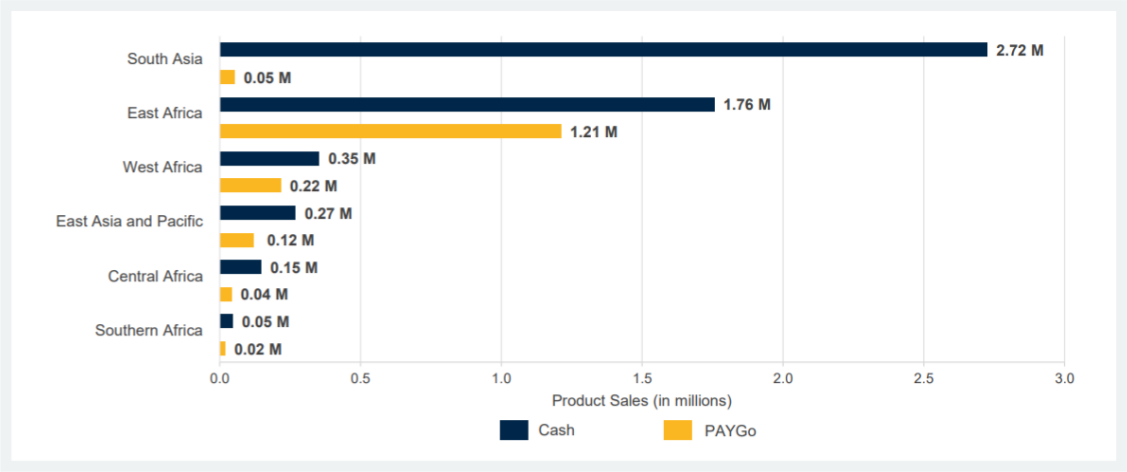
Taxation of Grants

Funds provided by foreign governments and international organisations to private commercial entities for social and economic programs and activities do not have specific treatment under current legislation.

We propose clear regulations to ensure tax authorities do not consider grant income as taxable under the corporate income tax, to ensure that SHS companies are properly incentivised to pass these donations onto the end consumer.

Appendix

Pan-African Fiscal Incentive Landscape



Source: Vivid Economics and Open Capital Advisors analysis of GOGLA sales data.

Figure 12. *Lighting Global data on regional SHS sales across Africa from the GOGLA 2020 report.*

The East African Community introduced VAT & Duty import exemptions for solar home systems in 2013, leading to the first boom in off-grid rural electrification. Zambia followed suit in 2017 and has seen great success. Since the industry's inception in 2012, over 3 million households have been electrified with PAYG Solar in Uganda and Kenya alone. Zambia has seen over 200,000 households electrified in just 3 years, almost entirely by Fenix International.

In West Africa, where off-grid electrification has been more modest, fiscal incentives are inconsistent or opaque in their application to off-grid solar. In Nigeria, with an off-grid population of over 85 million and per capita GDP 3x that of Mozambique, there have been fewer than 500,000 households electrified.

There are no VAT exemptions for solar products (though VAT is only 7.5%), and duties are enforced inconsistently. Cote d'Ivoire has seen similar struggles; with no VAT exemptions available and opaque duties levied on systems, in 4 years of multiple large companies operating, there have been less than 100,000 households electrified. The sole unequivocal success stories of West Africa come in Togo and Benin, where the governments have taken an enabling approach, with both VAT and duty exemptions available for core systems. In both countries (with a combined population of < 20M people) there have been over 100,000 households electrified in just the last 2 years with no signs of this rate slowing.

In Mozambique, VAT is high at 17% and the duties framework is opaque. There is no official HS [3]code for solar home systems, but most SHS companies pay 7.5% on core components as "Solar PV Assembly", and 20% for additional appliances and accessories. Together, these raise the barrier for affordability in a market where the average income of the rural household is lower than any market previously mentioned.

[3] The 2022 HS draft includes new classifications of SHS as a form of generator powered by solar energy : https://energypedia.info/wiki/Quality_Standards_for_Solar_Home_Systems_(SHS). http://www.wcoomd.org/en/media/newsroom/2020/january/wco-has-published-accepted-amendments-to-hs-2022.aspx