

# Energy Africa – Zambia

Technical assistance to model and analyse the economic effects of fiscal policy options for off-grid technologies in Zambia

*Final report*



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# Executive Summary

*This report suggests a set of changes to the tax regime in Zambia that is pro-poor, creates better living and working conditions for women in particular and will serve to create jobs and support rural development.*

**Low access to clean, affordable, and sustainable energy acts as a major constraint on rural economic development.** 72% of the population of Zambia does not have access to electricity. In rural areas this share increases to 96%. Only 16% of the population has access to a clean cooking solution. This lack of access to clean and affordable energy acts as a constraint on development, especially in rural areas where access is lower. In many cases the use of traditional energy sources may cost more for households than the cleaner technologies now available. Many households in Zambia use torches or candles for lighting, and firewood or charcoal on traditional and inefficient *mbaula* stoves for cooking.

**Traditional cooking methods contribute to Zambia's high deforestation rate and up to 10,675 premature deaths each year.** Zambia's high deforestation rate of 250,000-300,000 hectares per annum is one of the highest in the world. Unregulated and illegal charcoal production contributes to the problem. Shifting to more efficient cookstoves, which might still use charcoal but less of it, and sustainably produced fuels could help to reduce deforestation. More efficient stoves can also help to reduce household air pollution, which contributes to premature deaths that result from respiratory problems.

**Off-grid solutions such as Solar Home Systems ("SHS") and improved cookstoves can play a major role in helping Zambia to meet Sustainable Development Goal No. 7 ("SDG7").** Zambia is committed to achieving universal access to clean and affordable energy by 2030 through SDG7. Analysis suggests that off-grid solutions are likely to be the most cost-effective means of delivering this access across large parts of the country, especially in rural regions. Off-grid solutions can also help contribute towards progress on other Sustainable Development Goals, including but not limited to:

- **SDG3: Good health and well-being:** moving away from traditional lighting and cooking technologies will reduce negative health outcomes associated with household air pollution.
- **SDG5: Gender equality:** women and girls in particular will benefit from the deployment of off-grid technologies as they are most likely to be involved in fuel collection and cooking.
- **SDG9: Industry, innovation, and infrastructure:** off-grid solar can be used to power a wide range of appliances, and to support the growth of enterprise in rural areas.

In addition to the SDGs, the solutions will help to contribute towards progress in the key results areas highlighted in Zambia's 7<sup>th</sup> National Development Plan ("NDP7"), specifically key results areas 1 (economic diversification and job creation) and 4 (enhanced human development).

**Increased deployment of off-grid energy solutions is likely to disproportionately benefit the poor, those in rural areas, and women and girls.** Because off-grid solutions are the most cost-effective solution in rural areas – where it is unlikely to be cost-effective to extend the grid in the short to medium-term – these solutions will disproportionately benefit communities in rural areas, which are likely to include some of the poorest people in the country. Off-grid energy is likely to be especially beneficial to women and girls, who will benefit most from reduced household air pollution and time savings from fuel collection, for example.

**Fiscal policies can play a key role in helping to accelerate the roll-out of off-grid energy solutions.** This report analyses both the fiscal costs and the benefits of specific fiscal policy options that could help increase the deployment of off-grid solar solutions and/or improved

cookstoves and sustainable fuels. It helps to identify where tax exemptions might deliver value for money and, indeed, increase tax revenues in the medium-term. This is important for Zambia given its focus on reducing overall Government debt. It is, however, important to note that while fiscal policies could help to accelerate deployment, they will not be sufficient to meet SDG7 with no further intervention. In particular, further interventions will be required to ensure that off-grid technologies are within reach of the poorest households who may be unable to afford off-grid solar without Government assistance.

**Inconsistent application of import duties for solar discourages some off-grid solar companies from investing in Zambia and can increase operating costs for companies operating in the sector.** Solar and battery technologies were exempted from both import duties and zero-rated for VAT in 2008 with the enactment of two statutory instruments. However, these exemptions have been inconsistently applied, and some companies operating in the market have reported having to pay taxes on occasional imported shipments. This is partly a result of the exemptions not being well defined, or at least not having kept up with the SHS and Solar Lantern (SL) products that have such potential in helping Zambia to meet SDG7. In addition to issues with the drafting of the exemptions, companies note that the application of the exemptions sometimes differs from one entry point to another: customs officials at some entry points use a stricter interpretation of the exemption than other officials. It is understood that this is an issue that extends beyond solar products to imported goods more generally. Given the quantum of the taxes (25% for import duties and 16% for VAT) this amounts to a significant uncertainty both for companies already operating in Zambia and for investors evaluating the Zambian market. The inconsistent application of taxes has been an important consideration in discouraging some off-grid solar companies from entering the market.

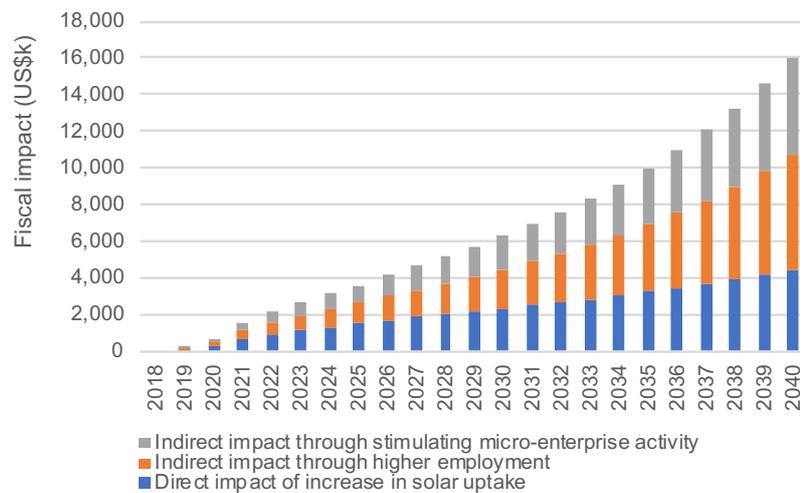
**Our analysis suggests consistent application of updated tax exemptions for off-grid solar, reflecting technologies in the market today, could yield an NPV benefit to Zambia of \$35.3m between now and 2040.** Because the exemptions are applied to most imported SHS and SL shipments the lost revenues are likely to be negligible: our analysis suggests that even as early as 2020 the policy would yield a net fiscal benefit of >\$700k p.a., and this would increase to >\$6m p.a. by 2030. The policy could result in ~190,000 additional households benefiting from off-grid solar by 2030, with this increasing to almost 300,000 additional households by 2040.

**The fiscal benefit is the result of increased tax revenues as off-grid deployment increases disposable income, creates jobs, and stimulates the growth of micro-enterprises.** There are three main drivers of the \$35.3m net benefit cited above:

- The first, which is shown by the blue bar in the graph below, is that many of the households benefiting from the accelerated roll-out of off-grid solar will be saving money, as well as experiencing an improved level of service. These households will have a higher level of disposable income, which may be spent on goods and services within the scope of VAT.
- The second – shown in orange – is the benefit of higher employment in the off-grid solar sector compared to the energy solutions that are replaced. In total, it has been estimated that a robust SHS market in Zambia could lead to the creation of 25,000 new jobs. This policy alone could result in >2,400 new jobs by 2030. The individuals that benefit from those jobs will have more disposable income, which may lead to higher VAT receipts. A small part of the orange bar also relates to income tax receipts from more senior staff. Income tax receipts could be increased if the threshold for personal income tax was reduced.
- The third driver – shown in grey – is the impact of increased micro-enterprise activity as small privately-run businesses in rural areas benefit from a more reliable and more affordable supply of energy. This could increase turnover tax receipts from these businesses.

In addition to the above benefits – all of which result in higher revenues for GRZ – evidence suggests that the accelerated deployment of off-grid solar solutions would also increase the

number of study hours by >150m additional study hours by 2030. The increase in educational attainment that might result could of course result in further fiscal benefits in future that we have not estimated as part of this study.

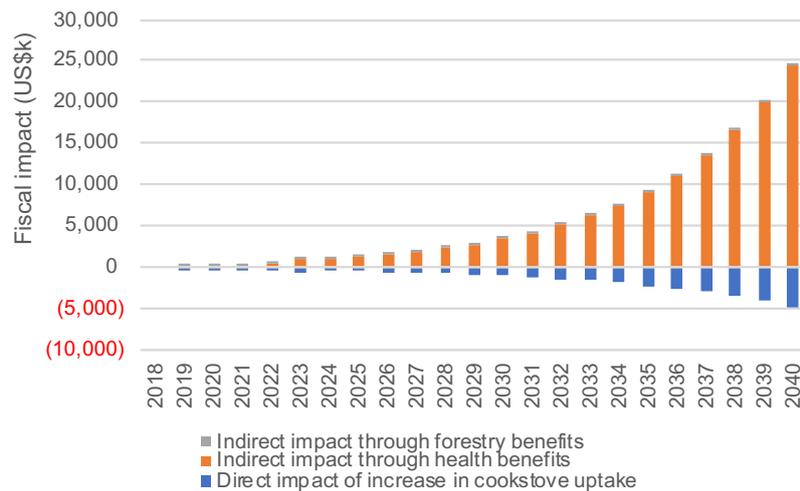


**Therefore, the business case for improving the drafting of tax exemptions for off-grid solar products seems clear.** It is recommended that the re-drafting of these exemptions is taken forward as a priority through the 2018 budget process over the coming months. A starting point for the new drafting is attached to this report in Appendix B. It is proposed that the scope of the exemption is focused on the core components of a SHS or SL: solar panels, batteries, charge controller, and efficient lighting. This is likely to require the establishment of new HS codes to (a) reduce the scope for inconsistent application, and (b) to ensure that the exemptions cannot be applied to a wider set of products than is intended. The argument for extending exemptions to more advanced appliances (TVs, radios, fridges, etc.) is more nuanced, but there are likely to be policy benefits, including fiscal policy benefits, of exempting a small number of DC appliances.

**To further minimise the risk of inconsistent application of taxes at the border, work should continue on improving customs processes.** We understand that ZRA is already proceeding with reforms so that taxes on imported good are largely administered electronically. This should help to streamline the customs process for all imported goods, including off-grid solar. Accompanied with a more clearly drafted exemption this should help minimise the opportunity for different interpretations by different customs officials. It might also be beneficial to establish a ‘Green Lane’ for imported solar products, which could help to streamline the customs process.

**Cookstoves are already exempt from import duties; zero-rating cookstoves for VAT could help accelerate the market for what is a very price sensitive purchase.** Evidence from our literature review and stakeholder engagement suggests that demand for improved cookstoves is very elastic. While stoves are already exempt from import duties it has been suggested that the 16% price decrease that would result from a zero-rating improved cookstoves for VAT could lead to a significant increase in demand.

**Our analysis of zero-rating improved cookstoves for VAT suggests that the policy could again deliver a net fiscal benefit.** Our Base Case assumptions show an NPV benefit between now and 2040 of \$16.8m. However, because there is a clear fiscal cost (i.e. in the form of lost VAT revenues) that results from this policy, this business case is more dependent on the benefits shown in our analysis being realised. It takes longer for this policy to deliver a net benefit: it is 2023 before the annual fiscal impact of the policy is positive. However, the analysis still shows the policy to have a positive impact over the long-term, so it is recommended that it is implemented.



**Health benefits are the biggest driver of the business case for zero-rating improved cookstoves for VAT.** The graph above shows the breakdown of the fiscal impact of zero-rating improved cookstoves for VAT. As noted above, this shows a negative direct fiscal impact (indicated by the blue bar) because of the forgone VAT revenues. However, the positive health impact shown by the orange bar more than outweighs this lost revenue. It is estimated that the policy could reduce premature deaths from household air pollution by ~500 per annum by 2030. As well as having obvious benefits for public health, this results in a significant fiscal benefit because of the income earned and taxes paid by the affected individuals.

**The fiscal benefit of reduced deforestation is relatively small, but the policy still makes a significant contribution to reducing deforestation.** It is estimated that the policy could reduce the deforestation of *miombo* by ~8,000 ha p.a. by 2030, with this increasing to ~30,000 ha p.a. by 2040. This in turn has an impact on carbon emissions, with a reduction in emissions of ~1,200 ktCO<sub>2</sub> by 2040.

**In addition to the fiscal measures proposed above, a further review should examine the options for reforming levies and incentives for cooking fuels.** It is understood that Zambia does have levies in place to discourage charcoal production, but that collection of these levies is poor. There is some evidence that collection rates have declined as a result of increases in the levies over the past 20 years. It is also understood that charcoal retail prices reflect the levies that should be paid, meaning that improved enforcement might have limited impact on end consumers. Recalibrating these levies and/or introducing incentives for more sustainable fuels could further help to accelerate the uptake of more sustainable cooking solutions.

**GRZ should take forward a number of actions based on the evidence and analysis presented in this report.** The actions that need to be taken to implement the fiscal policies proposed in this report are listed in the table below.

Action	Responsible party
<p>Update of the tariff exemptions for solar power through the 2019 budget process. Discussion on the scope of good that should be covered by the re-drafted exemption is presented in Section 2.1. A starting point for re-drafting the exemption is attached in Appendix B.</p> <p>We understand that the key milestones in the budget process are as follows:</p> <ul style="list-style-type: none"> <li>• A call for proposals is likely to be issued by MOF during May 2018, which will allow MOF to collect ideas and evidence for policy changes to be made through the budget process. The evidence in this report will need to be presented in response to that call. It is possible that the call for proposals requires evidence to be presented in a specific format.</li> <li>• In parallel, MOF will be consulting with key industries to collect evidence on where changes in fiscal policy might be required.</li> <li>• The proposals will then be considered by a Tax Policy Review Committee during June and July. This process is run by MOF but is likely to consult DOE and ERB. Those proposing policy changes can be called to give evidence during this period.</li> <li>• After the Committee stage, a recommendation is made to cabinet. Cabinet will make a final decision in August or early September. Again, further evidence could be sought during this period.</li> <li>• Finally, the full budget package enters parliament, with a final vote expected in November. Parliament will vote on the package as a whole, so it seems less likely (but is not impossible) that further evidence on a detailed line item in the budget is requested at this stage.</li> </ul>	<p>MOF, with support from DOE and ZRA</p> <p>Donors could support with advice on the drafting</p>
<p>Expedite ongoing work to transition customs administration to electronic systems. Combined with an unambiguous coding to apply to imported goods, this should mitigate the risk that similar or identical imported shipment are treated differently, for example if they are inspected by different customs officials.</p> <p>Establishing a “Green Lane” for approved products and/or companies could also help to speed up the processing of imports.</p>	<p>ZRA</p>
<p>Preparation of a VAT exemption for improved cookstoves. Discussion on how such an exemption should be scoped is presented in Section 2.2.</p>	<p>MOF, with support from DOE and ZRA</p> <p>Donors could support with advice on drafting</p>
<p>The impact of the solar and cookstove interventions should be monitored where possible to evaluate whether the policy is yielding the expected returns for GRZ. In particular, GRZ might re-consider the VAT exemption for improved cookstoves if the increase in uptake is less than expected, although sufficient time needs to be allowed for this to occur.</p>	<p>DOE</p> <p>Donors could support DOE in establishing the monitoring capabilities to perform this task</p>
<p>GRZ should perform a comprehensive review of charcoal levies, with the aim of establishing levies that are much better enforced than is the case today. This might include responsibility for these levies being allocated to ZRA, rather than local councils as is currently the case. The review should analyse the opportunity for interventions through the full charcoal value chain and should consider whether incentives might be appropriate for alternative, more sustainable fuels.</p>	<p>MOF, DOE, ZRA, local councils</p> <p>Donors could support this analysis</p>

**The business case for this action plan is clear and is well aligned with the Government’s policy priorities.** As noted above, under our Base Case assumptions the fiscal policies proposed for both off-grid solar solutions and for improved cookstoves have a clear fiscal net benefit. While not the focus of this study we would also suggest there may be options for a broader review of other exemptions in the energy sector, particularly as part of a broader re-balancing that is more pro-poor, pro-renewables and enables a stronger contribution overall towards revenue mobilisation. For example, this could include removing exemptions from diesel generators which are used almost exclusively by businesses and wealthier residents, as well as acting as distorting competition with the renewables industry and the higher job creation opportunities that it offers.

**In addition to the direct fiscal benefits outlined in the report, the proposed policies help to advance rural development through extending access to affordable and sustainable energy and could benefit some of the poorest regions of the country.** Many of the benefits highlighted in the report are likely to accrue disproportionately to women and girls. It is important to note that these interventions will not by themselves lead to SDG7 being met, but it is recommended that the policies are implemented on the basis of the business case presented here.

# 1. Introduction

## 1.1. Background and scope

In Zambia, 72% of the population does not have access to electricity, and in rural parts of the country this increases to 96%. There is heavy reliance upon candles and torches for lighting in rural areas in particular. Kerosene use is less commonly used for lighting in Zambia (1.3% of the population<sup>1</sup>) than in some countries in Sub-Saharan Africa (“SSA”). Further, only 16% of the population has access to clean cooking fuels and technologies<sup>2</sup>. Most of Zambia’s population relies upon either firewood (~51% of the population) or charcoal (~30% of the population) as their primary cooking fuel<sup>3</sup>.

Deforestation is a major issue. Zambia’s estimated deforestation rate is between 250,000 to 300,000 hectares per annum, which is one of the highest rates of deforestation in the world<sup>4</sup>. Zambia’s Intended Nationally Determined Contribution (“INDC”) under the Paris Climate Change Agreement recognises this. The INDC lists Sustainable Forest Management, including the use of more sustainable cooking technologies and fuels, as a priority area for CO<sub>2</sub> emission reductions. Renewable energy, energy efficiency, and sustainable agriculture are also listed as priority areas in the INDC.

Beyond the INDC, Zambia has indicated the importance of household solar products in its own domestic policy. The 2008 Rural Electrification Master Plan<sup>5</sup> (“REMP”) sets a target of increasing access to electricity to 100% of households in urban areas, and 51% of households in rural areas by 2030. The REMP recognises that this would be achieved through a combination of grid-based and off-grid technologies, including stand-alone pico-solar products and Solar Home Systems (“SHS”). Zambia has not formally revisited these targets but would need to achieve universal access to electricity by 2030 to meet Sustainable Development Goal No. 7 (“SDG7”).

Domestic policy is less well-defined with respect to the promotion of clean cooking solutions, although there are initiatives driven both by private sector companies and by donors that focus on both efficient cookstoves and on sustainable cooking fuels.

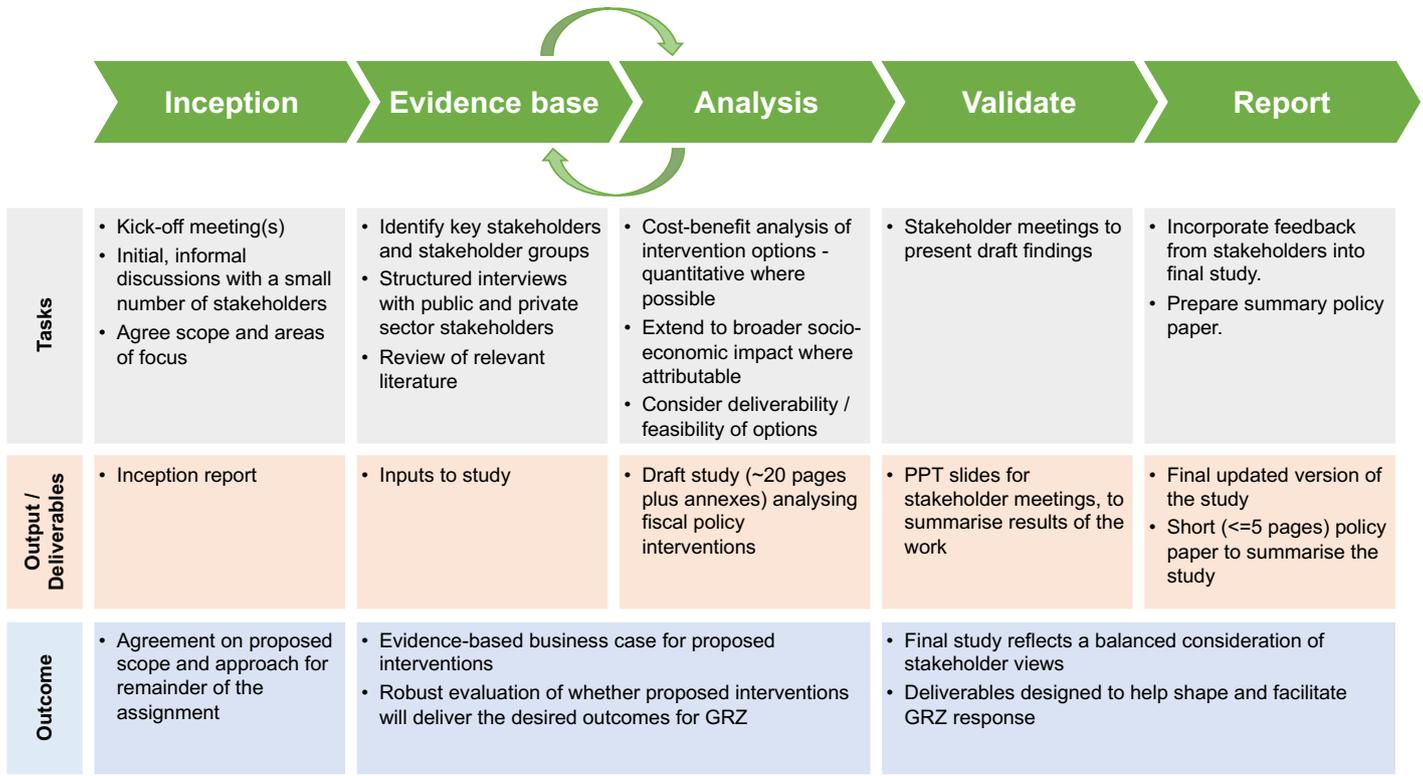
This report evaluates fiscal policies that could be used by Zambia to help stimulate uptake of both household solar products and improved cookstoves and fuels. The main focus of the report is exemptions from VAT and import duties. If well designed and carefully targeted, fiscal policy could be used to advance the Government’s development goals. Such policies could even result in a net fiscal benefit as jobs are created and as small enterprises benefit from improved energy services. The analysis presented in this report aims to identify where fiscal policy interventions are justified and where such ‘win-win’ outcomes might be attainable for the Government of the Republic of Zambia (“GRZ”).

The approach used in completing the analysis is summarised by the schematic in Figure 1. As shown in the figure, the conclusions drawn in this report rely on two main sources:

- A comprehensive **evidence base** collated through an extensive literature review and structured stakeholder interviews. Stakeholder engagement covered a wide range of GRZ stakeholders, donors and implementing organisations, private sector actors, and trade bodies.
- A quantitative **analytical model**, built to model the fiscal and non-fiscal impacts of the policy options under consideration. The model uses information from the evidence base to evaluate policy options, so that GRZ has a robust business case in place for any policies that it decides to take forward. The model has been shared and a training workshop has been provided to both the Ministry of Finance and the Department of Energy in Zambia.

The evidence base was primarily assembled through stakeholder engagement that took place during January to March 2018. Meetings were held to validate the project’s findings in April 2018. A list of the key stakeholders engaged during this project is attached to this report as Appendix A.

Figure 1 Overview of project approach



## 1.2. DFID and Energy Africa

During 2017 the UK’s Department for International Development (“DFID”) developed an “Energy Africa Compact” in partnership with GRZ. The Compact identified some of the key actions to be taken forward by GRZ to help increase access to clean and affordable electricity and to clean cooking solutions. The Compact identifies fiscal measures as an area where action is required:

- The Compact suggests that existing exemptions for VAT and import tariffs do not cover all solar products, and that the scope of exemptions should be reviewed.
- The Compact also notes that the application of existing rules is not consistent, and that action is required to improve the implementation of rules by customs officials.

Tax exemptions have been an important component of creating an enabling environment to accelerate the deployment of off-grid solar solutions in other countries<sup>6</sup>. Further, DFID has previously commissioned analysis covering Mozambique and Malawi that suggests tax exemptions can lead to a rapid acceleration in the deployment of household solar and clean cooking solutions<sup>7</sup>.

This report aims to provide a robust evidence base that GRZ can use to take forward some of the actions identified in the Compact. The report critiques the fiscal policy actions that were proposed and defines the recommended actions in more detail with the aim of ensuring that these are both well targeted and that the fiscal benefit can be properly justified.

Beyond the Compact, Zambia is also listed as one of the countries to be targeted by DFID’s upcoming Africa Clean Energy (“ACE”) programme, which looks to accelerate the uptake of solar energy products to increase access to energy over 4 years starting in 2018. Zambia is also one of four countries being targeted by the Africa Enterprise Challenge Fund’s (“AECF”) Renewable

Energy and Adaption to Climate Technologies (“REACT”) solar window, which was launched in 2017.

### **1.3. Structure of this report**

The remainder of this report is structured as follows:

- Section 2 presents an initial overview of the fiscal policy interventions that are analysed in this report, along with the rationale for each intervention.
- Section 3 presents the analytical approach used in the quantitative evaluation of the proposed policy options, including an overview of the input assumptions to the analysis.
- Section 4 presents the detailed outputs from the cost-benefit analysis, including an evaluation of the net fiscal impact of each proposed policy intervention.
- Section 5 summarises the recommendations made based on the analysis presented in this report and sets out a clear action plan on how GRZ can proceed with policy interventions that it decides to take forward.

# 2. Context and the rationale for intervention

## 2.1. Access to electricity

Through its commitment to the Sustainable Development Goals, GRZ has committed to extending access to affordable, reliable, sustainable, and modern energy to all by 2030. This objective is captured in SDG7. As noted in Section 1.1, GRZ has yet to formally reflect this target in domestic legislation or strategies. The most up-to-date Rural Electrification Master Plan<sup>5</sup> is from 2008 and commits to just 51% of rural households having access to electricity by 2030.

However, the Minister of Finance, Felix Mutati MP, recognised in his 2018 budget speech<sup>8</sup> the importance of “increasing the energy mix through promotion of off-grid electricity generation and alternative energy sources”. This commitment is critical if Zambia is to meet SDG7. 72% of the population does not have access to electricity, and this figure increases to 96% of rural areas<sup>2</sup> (although it is noted that Zambia’s Central Statistical Office reports<sup>1</sup> that 7.4% of rural households use a solar panel for lighting, in addition to 3.7% using electricity, which is assumed to mean grid-based electricity). The Central Statistical Office (“CSO”) reports that 70.6% of rural households use a torch as their main source of lighting.

It is generally the poorest that live in rural areas, where access to electricity is low, and hence it is the poorest who lack access to energy. In this broad sense, any policy initiative that is successful in accelerating the roll-out of off-grid solar products can therefore be seen as a progressive policy, where many of the benefits of the policy would accrue to poor communities in Zambia. Increased uptake of off-grid solar could yield the following benefits:

- For many customers there may be a cost saving when compared against their current use of traditional alternatives such as torches and/or candles. A solar product could increase their disposable income and increase tax revenues, for example through VAT raised on additional spend.
- While solar companies today are often not profitable, it is expected that this would change as the sector gains critical mass. In future the companies will be paying corporation tax, again increasing Zambia’s tax revenues.
- Solar companies will take on more employees and create jobs as they grow. Some of these jobs will result in income tax being due to Government, and job creation will create consumers with disposable income, yielding VAT revenues for Zambia.
- Some solar systems will be sold to households who are then able to use the system to start a new enterprise, or to extend opening hours of an existing enterprise. This again contributes to broader economic growth and may lead to additional tax revenues.
- In addition to the potential fiscal benefits outlined above, off-grid solar products can benefit the poorest societies in other ways: for example, the use of mobile money could increase financial inclusion, education outcomes could improve as children are more easily able to study in the evenings, households save time as traditional fuels no longer need to be collected or procured. These benefits in particular tend to disproportionately accrue to women and girls.

Acknowledging these benefits, GRZ has already exempted some renewable energy and energy efficiency products from VAT and/or import tariffs. Import tariffs would otherwise be 25% for many of the products concerned and Zambia’s VAT rate is 16%, so the total impact on the cost of systems is ~40%. However, there have been inconsistencies in the exemptions that off-grid solar

products have secured. Most shipments of SHS being brought into the country have successfully claimed an exemption from import duties and zero-rating for VAT. However, a small number of shipments have been subject to import duties. It is understood that there are two factors that have driven the inconsistency:

- Since the SI was drafted in 2008 new products have entered the market, such as SL and SHS products. These products are also often bundled, i.e. with a solar panel, battery, lighting, and maybe other appliances all in one box. This can make it difficult to categorise these products.
- It is not clear what code best describes these new products and therefore whether it is intended that they are exempt or not. New codes to describe these new products have not been defined. In some cases, different companies have used different customs codes, and customs officers will often see products that are quite different from other products that use the same code.
- The Statutory Instruments that establish the exemptions (SI No.32 and SI No. 33 of 2008) are not precise in defining what products should be exempt. For example, the SIs refer to “solar panels” and “solar batteries”; they do not explicitly reference solar lanterns, SHS, or any associated energy efficient appliances.
- Partly as a result of the above, the treatment of imported product has sometimes varied from one entry point to another. This appears to have been a particular issue for solar lanterns, which have often been imported using a customs code that relates to fluorescent lights. Customs officers have sometimes – understandably – charged duties on these shipments where the product is clearly not a fluorescent lighting product. As a result, companies tend to avoid entry points where they know that exemptions are less likely to be applied. It is understood from ZRA that this challenge is not unique to solar products.

Table 1 presents a summary of import duties and VAT rates that apply to relevant equipment. The table includes the Harmonised System codes allocated to different types of import by ZRA. The Harmonised System (“HS”) is an international standard, where the first six digits of the code are consistent internationally and individual countries can then define additional subcategories with additional digits. Note that in the table:

- The ZRA tariff guide summarises the substantive tax rates in force for each product.
- SIs are then used to provide relief from these substantive rates, meaning that the tariff guide still shows duties and VAT applying to products that are granted exemptions through SI No.32 and No.33 of 2008.

Currently this means that companies importing goods under the SI No.32 exemption are required to:

- Include a Customs Procedure Code (“CPC”), national code 445, to flag that they are using this exemption, and
- Use an HS code that is listed in the exempted items in SI No.32.

Table 1 Existing relevant tariffs and VAT rates in Zambia

Coding	Description	Import duty	VAT rate
<b>ZRA Consolidated Tariff Guide, updated January 2018<sup>9</sup></b>			
85.02	Electric generating sets and converters and converters. <i>Explicitly includes:</i>	Free	16%
8502.31.00	<i>Wind-powered generating sets [sic.]</i>		
85.03	Parts suitable for use solely or principally with the machines of heading 85.01 [electric motors and generators] or 85.02	5%	16%
85.04	Electrical transformers, static converters, and inductors	Free 5% for parts	16%
85.07	Electric accumulators, including various battery technologies	Free 5% for parts	16%
8539.31.00	Fluorescent lighting (tubes and bulbs)	15%	16%
8541.40.00	Photosensitive semi-conductor devices, including photovoltaic cells whether or not assembled into modules	Free	16%
<b>Statutory Instrument No. 32 of 2008: The Customs and Excise (Electrical Machinery and Equipment) (Suspension) Regulations, 2008</b>			
8539.31.00	Fluorescent lighting (tubes and bulbs)	Free	n/a
85.07	Solar batteries	Free	n/a
8504.40.00	Static converters (invertors for solar power)	Free	n/a
85.02	Diesel or semi-diesel generators	Free	n/a
<b>Statutory Instrument No. 33 of 2008: The Value Added Tax Act (Zero-Rating) (Amendment) (No. 2) Order, 2008</b>			
	Discharge lamps other than ultra-violet lamps (energy efficient lighting lamps)	n/a	0%
	Solar water heaters (solar geysers)	n/a	0%
	Solar panels	n/a	0%
	Solar batteries	n/a	0%
	Static converters (invertors for solar power)	n/a	0%
	Electric generating sets	n/a	0%

Review of Table 1 highlights several issues with the existing exemptions and documentation of those exemptions:

- The descriptions of some products do not map to the HS codes used by customs officials. For example, solar lanterns or SHSs are not explicitly mentioned in ZRA's Consolidated Tariff Guide.
- SI No.33/2008 on the VAT zero-rating does not include any coding references, which does not help to facilitate consistent application.
- Diesel generators currently qualify for an exemption. Government could improve revenue collection by removing this exemption. As sustainable alternatives (e.g. solar) become more readily available removing the exemption would also help to accelerate a shift towards those alternatives.

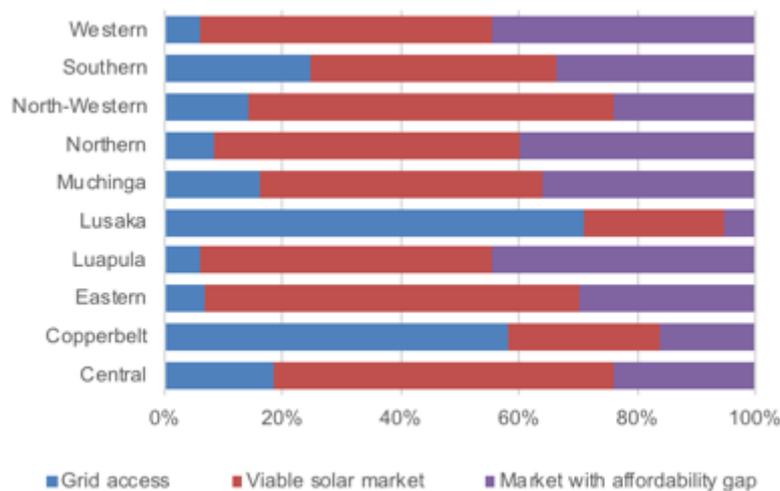
These issues, as well as the inconsistent application of exemptions noted above, can hinder investment in Zambia by solar companies. From our stakeholder consultations it is clear that the inconsistent application of exemptions and the lack of clarity over what is exempt has been a factor preventing some companies from entering the market. This might be acting as a constraint on the supply of solar systems into the Zambian market. We can estimate the quantum of this constraint by assuming that households without a solar system or any other form of electricity access either:

- Cannot afford a solar system or will not achieve any savings relative to spend on traditional energy solutions today. This is a demand-side constraint.
- Are not yet aware of solar solutions or are unable to acquire a suitable product for their household locally. This is a supply-side constraint.

The size of this supply-side constraint can be estimated:

- First, it is assumed that ~70% of the current energy access gap is tackled with off-grid solar. This assumption is informed by analysis using the World Bank’s energydata.info website which uses a geo-spatial planning algorithm to evaluate the least cost energy access solution based on different user input assumptions.
- Previous analysis of monthly incomes in Zambia (using data from the CSO’s 2015 Living Conditions Monitoring Survey<sup>1</sup>, summarised in Figure 2) performed for DFID suggests that ~26% of households are unlikely to be able to afford a basic SHS (assumed to be a simple solar lantern plus phone charger, which would equate to Tier 1 access under the SE4All multi-tier framework)\* at current pricing. This equated to ~780,000 households in 2015.

Figure 2 Solar affordability gap by province, Zambia



- The gap between the maximum size of the market (70% of the energy access gap) and a sum of existing solar sales and the demand-side constraint quantified above can be attributed to supply side constraints. It is estimated that supply-side constraints reduce solar sales by about **160,000 units p.a. in 2018**, but without intervention this can be expected to increase as the population grows.

While it is unlikely that all of this supply-side constraint can be attributed to the inconsistent application of tariffs, the size of the constraint combined with the evidence that this has held companies back from entering the market suggests that a policy intervention to improve on the definition of the current exemption is likely to be worthwhile.

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\* This analysis estimates that ~4% of households will not be able to afford a basic solar lantern (even where the cost is spread over a year), a further ~22% cannot afford a basic lantern plus charger, and a further ~28% cannot afford a simple Tier 1 multi-room SHS.

## **Intervention 1 – Improve the consistency in application of VAT and import tariff exemptions for solar products**

As noted above there are two related interventions that are required to improve the consistency in application of tariff exemptions for solar products.

### 1a) Improving the definition of the exemptions

The drafting of the exemption should be reworded and clarified so that there is less scope for this being misinterpreted and misapplied. The current exemption (defined in Statutory Instruments, or SI, no. 32 and no. 33 of 2008) includes exemptions for various products, including “solar panels” and “solar batteries”. However, the SI does not make reference to systems that incorporate such components (such as a SHS) and the SI does not state how a battery used to store solar energy should be distinguished from a battery used for a different application (which might use exactly the same technology).

The Ministry of Finance has proposed that the revised exemptions are implemented not through a Statutory Instrument, but through the 2019 budget process. This means that the substantive tax rates for certain HS codes would change, which would also remove one source of the current confusion. Some of the industry stakeholders that we have spoken to in preparing this report have suggested that the exemption should apply to the following products:

- Pico-PV (e.g. Solar Lanterns) and Solar Home Systems. There has been some suggestion that the exemption could be tied to the quality of the product, for example through compliance with the Lighting Global Quality Standards<sup>10</sup> developed by the IFC. However, while the importance of effective standards is acknowledged, it would be unusual to create HS codes that are tied to certain standards and so it is recommended that the standards and customs processes remain separate.
- LED lighting – the existing SI grants an exemption to “florescent lamps”, but not to LED lighting, which is clearly more energy efficient. This omission is likely to simply be a reflection of technology having advanced since the SI was drafted. It is recommended that the updated legislation addresses this omission and includes a broader exemption that covers both CFLs (Compact Fluorescent Lamps) and LEDs.
- Solar-powered electrical appliances – many stakeholders are keen for exemptions to extend to solar appliances, such as TVs, radios, fridges, etc. This is a more complex area, and the case for these exemptions could be argued to be less strong than for the exemptions noted above. Our view is that there is an argument for exemptions to be extended to a limited range of DC appliances, where there is a clear development benefit and/or an obvious fiscal benefit. This is discussed in further detail below. Clear guidance will need to be prepared for customs officials so that they are able to distinguish between equivalent AC and DC appliances, so that these exemptions cannot be exploited by importers of AC appliances. Note that regardless of whether appliances are duty exempt, we strongly recommend that companies are required to code appliances contained within a SHS separately when importing more complex systems. This should greatly reduce the scope for confusion and inconsistent application of tariffs.

Wording that could be used by GRZ in an updated SI is proposed in Appendix B of this report.

### 1b) Remove opportunities for the variable treatment of imports at Zambia’s entry points

The Zambia Revenue Authority (“ZRA”) is already in the process of transitioning its customs administration to an electronic system, which will partly de-link customs administration from the entry point that is used for importing goods. This electronic system will still require a clearly defined exemption, as noted above, and will also need HS codes to be defined that can be used for identifying different types of good in the online system. The codes will need to distinguish between components that are eligible for exemptions and components that are not exempt (for example, any appliances that are bundled with a SHS that are not included in the exemption). The system should

reduce the risk that different shipments of the same product are treated differently, simply because they use a different entry point and are inspected by a different customs officer.

We understand that most of the products covered by the existing Statutory Instruments pass through a “Yellow Lane” at customs, i.e. they are subject to a document check. A “Green Lane” could be established by ZRA for off-grid solar products that qualify for the exemption, or that have a Solar Importer licence from ERC. The intention is that in future the ERC licence will be tied to adherence with Zambian quality standards. In Sierra Leone, for example, it has been proposed that Green Lane status be awarded to solar companies that are certified as adhering to International Electrotechnical Commission (“IEC”) standards, which are consistent with the aforementioned Lighting Global standards. Alternatively, Green Lane status could be tied to participation in Government-approved programmes, such as the Beyond the Grid fund. Green Lane status, combined with an electronic customs process, would allow solar companies to reduce the time taken for products to clear customs.

As noted above, there is scope for debate regarding what should be included within the scope of updated tax exemptions for off-grid solar. One of the most extensive and clearly defined sets of exemptions is that defined by Rwanda’s Ministry of Finance and Economic Planning<sup>11</sup>. This could be used as a model for Zambia’s MOF and ZRA in updating its exemptions. As noted above, our initial view is that GRZ could introduce an exemption for a limited number of DC appliances, in addition to the core SHS (such as the solar panel, battery, associated control systems, LED lighting). A starting point for the re-drafted SI is attached to this report in Appendix B.

The analysis presented in Section 4 of this report is focused on the case for clarity around exemptions for basic solar products such as solar lanterns and basic, multi-room SHS. The case for exemptions for these products could be made on the basis that these goods are targeted at poorer citizens who can use the product to gain a basic level of access to electricity. The policy would be progressive.

Some stakeholders have argued for broader exemptions, covering solar powered electrical appliances for example, as is the case in Rwanda. In this case, the pro-poor argument is less strong. A solar TV or solar fridge, for example, will be useful for off-grid households, who will generally be poorer than the urban, grid-connected population, but will remain out of reach for many of the rural poor. However, a solar TV in one house might be seen by citizen outside of that household, who might be less well off.

While arguments can be made both ways, our recommendation is that the exemption is tightly scoped and focused on a few key appliances, as proposed above. GRZ might also ensure that any exemptions for appliances benefit core public services (e.g. a solar fridge that is used by a clinic, or a solar TV used in a school). The exemption could also include appliances that are likely to be primarily used for community benefit, for example solar water pumps. Two overarching arguments for extending the exemptions to DC appliances to be used with solar relate to the current high cost of the appliances, when compared to the equivalent AC appliances:

- The high price of appliances means that uptake is currently very low. This means that very little revenue would be lost if an exemption was granted.
- The low volume is itself one reason why prices are high. An exemption could help increase sales volumes, helping manufacturers to achieve economies of scale. This might in turn lead to a fall in wholesale prices, making the appliances affordable for a larger share of the population. Coordinating any exemption with neighbouring countries would increase the opportunity for higher sales volumes to drive down prices.

Further, for some appliances there are additional fiscal and policy drivers for granting exemptions, which are summarised in Table 2.

Table 2 DC appliances and the rationale for granting them exemptions

Appliance	Rationale
TV	5 Kw per month TV levy, VAT revenues on TV subscriptions Increased access to information and public announcements
Radio	Increased access to information and public announcements
Fan	Potential for increased comfort and higher productivity
Fridge, freezer	Ability to store medicines in remote areas Increased storage life of perishable agricultural produce, increasing rural incomes and potentially yielding additional tax revenues
Water pumps	Provision of water to village communities Use for irrigation to improve productivity of agricultural enterprises, potentially yielding additional tax revenues

If exemptions are granted to any of the appliances listed above customs officials would need clear guidance on how they could reliably distinguish between DC and AC appliances. Without this, there would be a significant risk of lost revenues if exemptions are incorrectly claimed for AC appliances.

Our understanding is that some imported solar products may have been awarded exemptions on appliances bundled with SHS as a result of the lack of clarity over the current SI. Other solar companies split out the exempt solar panel and battery on their customs invoice and pay duties and VAT on components that are not explicitly referenced in the SI. While we are unable to put an exact number on this, it is possible that a more precisely drafted SI could lead to positive fiscal impact if more revenues are collected on appliances. Regardless of whether appliances are granted exemptions we recommend that appliances should be split out on customs invoices, even if included as part of a sophisticated SHS. This should reduce the opportunity for confusion inconsistent application of taxes.

The above discussion regarding exemptions for appliances raises a broader point. Even the most basic SHS will be out of reach for some households, as was illustrated in Figure 2. To the extent that the poorest are unable to afford a SHS, the exemption from VAT and duties will benefit middle-income, rather than the poorest, Zambian citizens. While exemptions may help to accelerate deployment, they will not by themselves achieve universal access. More ambitious and redistributive fiscal policies are likely to be necessary to achieve this goal.

While the analysis presented in this report focuses on exemptions for stand-alone systems for individual households, any re-drafting of the SI could consider whether exemptions should apply for any further technologies and components that would be used in mini-grids. As noted in Table 1, ZRA's Consolidated Tariff Guide suggests that import duty exemption apply to a wide range of (if not all) generation technologies, as well as other equipment required for a mini-grid such as transformers. The table shows that standard rate VAT would apply to these imports, whereas the Rwandan VAT exemption<sup>11</sup> cited above includes exemptions for wind generation equipment, and equipment related to biomass or biogas energy. However, we note that it should be possible for generators to reclaim VAT incurred on generation equipment as they are selling a VAT-able supply: electricity.

An argument against removing import duty exemptions for any product, including off-grid solar products, would be the risk that such an exemption undermines domestic production. However, we are not aware of any domestic production of the solar products being targeted here in Zambia, so this risk seems minimal. However, as the industry grows and matures, the potential impact on domestic production should be monitored. DFID is currently analysing the potential role for local manufacturing of off-grid solar products in East Africa – the forthcoming report<sup>12</sup> should provide a useful reference on these issues.

## 2.2. Cleaner cooking

Zambia's commitment to reach SDG7 extends to clean cooking. As of 2014, only 16% of Zambians had access to clean fuels and technologies for cooking<sup>2</sup>. According to the CSO Living Conditions Monitoring Survey<sup>1</sup>, 51% of Zambians (85% in rural areas) use firewood as their main source of energy for cooking and 34% (13% in rural areas) use charcoal. While precise data on the use of improved (e.g. higher efficiency) cookstoves is not available, our engagement with stakeholders suggests that the use of such cookstoves is very low (much less than 1%).

The use of improved cooking solutions can yield many benefits, both for Zambia as a country and for the individual households using them:

- While an improved cookstove can involve a significant upfront capital investment, improved thermal efficiency can reduce a household's regular outgoings as fuel consumption decreases. As with household savings achieved through the use of off-grid solar, these savings could increase household disposable income and the VAT revenues raised by Government on the spend that results.
- It is well documented that cooking on traditional stoves, such the *mbaula* that many households in Zambia use, can lead to respiratory health problems and related premature deaths. The Institute for Health Metrics and Evaluation<sup>13</sup> estimates that there were 10,675 premature deaths in Zambia in 2016 attributable to household air pollution. This impact could be significantly reduced through the use of better stoves (which burn fuel more efficiently and hence emit less smoke, carbon monoxide, and particulates) and the use of cleaner fuels. Ultimately a healthier population translates to a larger workforce, economic growth, and fiscal returns from that growth. These health benefits are also likely to disproportionately benefit women and girls.
- Zambia has one of the highest deforestation rates in the world, estimated to be between 250,000 to 300,000 hectares per annum<sup>14</sup>. Zambia's Intended Nationally Determined Contribution<sup>15</sup> ("INDC") under the Paris Climate Change Agreement recognises this. The INDC lists Sustainable Forest Management, including the use of more sustainable cooking technologies and fuels, as a priority area for CO<sub>2</sub> emission reductions. Forestry managed in a sustainable manner can have value to Zambia, both in supporting forest-based industries and in providing environmental value in the form of erosion control and carbon storage. The industries supported by Zambia's *miombo* forest resources again make a fiscal contribution.
- As with off-grid solar companies, companies selling improved cookstoves are not very profitable today, but with higher volumes of sales are likely to become more profitable and to make a fiscal contribution through corporation tax.
- Improved cookstove companies will also be a source of employment as they expand, and their employees will have increased disposable income and contribute to Zambia's fiscal balance through VAT and potentially income tax. However, it is acknowledged that the impact of improved cookstoves on employment is complex, given the importance of the charcoal value chain in generating jobs, albeit low value jobs that are mostly in the informal sector.

Cookstoves are already exempt from import duties but are subject to VAT of 16%. Both the literature (e.g. a paper on the elasticity of demand for non-traditional cookstove technologies in Bangladesh<sup>16</sup> by A.M. Mubarak of Yale University) and our engagement with cookstove companies suggests that demand for improved cookstoves is very sensitive to price, and hence that there might be a case for zero-rating improved stoves for VAT.

### **Intervention 2 – Zero-rating of improved cookstoves for VAT**

Zero-rating of improved cookstoves for VAT purposes should be considered to increase uptake of such stoves. As with solar, the enforcement of standards, such as the IWA (International Workshop

Agreements) standards<sup>17</sup> (the development of which was led by the Global Alliance for Clean Cookstoves), can be important to ensuring that the full benefits outlined in this analysis are realised. However, again as with solar, it is recommended that standards are enforced separately and that the zero-rating of stoves is not itself explicitly tied to adherence with standards.

Implementation of zero-rating would be straight-forward. Once implemented cookstove companies would continue to complete a VAT return but would log their sales as zero-rated.

Suggested wording for the zero-rating is included in the attached Appendix B.

Zambia has levies in place that apply to charcoal, which should also help to encourage consumers to use more efficient stoves that use less charcoal, and/or to use more sustainable fuels, such as sustainably produced biomass fuels. However, these levies are rarely enforced. They are administered by local councils, rather than by ZRA, and a number of sources<sup>27,30</sup> suggest that private taxation by officials often takes the place of the levies. Some stakeholders have also suggested that levies are incurred on some sustainably produced fuels because the producers do not avoid checkpoints that charcoal producers might avoid.

We also understand that customers often do not benefit from the avoidance of levies, with charcoal prices being kept artificially high by traders. This suggests that end consumers may not be adversely impacted by better enforcement of levies, although further validation is required. A study is currently underway at the University of Zambia's Department of Geography and Environment to analyse the cost stack for charcoal in Zambia, which would provide a valuable input to further analysis in this area.

Moving responsibility for administering the levies to ZRA might improve the collection of levies on charcoal. ZRA does not currently have a significant presence in the rural areas of Zambia but is already considering moves to improve the collection of taxes in rural areas. This might include opening offices outside of the urban areas, but the move towards taxation being monitored and administered electronically could also help improve compliance in the rural areas. As ZRA considers its broader strategy for collecting taxes in the rural areas, the potential to expand ZRA's role to cover levies on charcoal could also be considered.

A paper by the Centre for International Forestry Research on the dynamics of charcoal trade in Zambia<sup>27</sup>, published in 2013, suggests that levies increased by more than a factor of 30 over the period 1995 to 2011 and that this increase in levies has led to many traders not paying the levies. The paper quotes production fees of 108 ZMW per cord (3m<sup>3</sup> of cut wood) and conveyance fees of 5.4 ZMW per bag of charcoal.

### **Intervention 3 – Review of levies and incentives on production of cooking fuels**

Evidence from the literature and from stakeholder engagement suggests that levies on charcoal are not enforced. A comprehensive review of charcoal levies could explore whether the levies could be improved:

- **Quantum of charcoal levies:** There is some suggestion that enforcement of levies on charcoal may have worsened as the levies increased over the period 1995-2011. A review could consider the most appropriate level for the levy to be set. It is possible, for example, that a lower levy might be more successful (i.e. result in higher actual revenue collection) and more easily enforced.
- **Collection responsibility:** Responsibility for collecting charcoal levies currently rests with local councils, who do not have as much expertise in collecting taxes and levies as ZRA. As part of ZRA's strategy to improve tax collection in the rural areas more generally, reassigning responsibility for charcoal levies to ZRA could also be considered.

Such a review could also consider whether additional funds raised through improved enforcement of levies on charcoal could be used to fund any incentives to encourage the production or use of more sustainable fuels, and/or fuels that could yield significant health benefits.

The review needs to consider the complexity of the charcoal value chain, and how interventions at different points in that value chain would realise a different subset of the benefits analysed in this report. For example:

- More sustainable forestry practices would have benefits in terms of reducing deforestation but would not realise all other benefits.
- The use of more efficient kilns would again reduce demand for forest resources but would not itself lead to additional benefits.
- The use of more efficient charcoal stoves would also reduce the demand for wood to be used in charcoal production, and may have significant health benefits, but is unlikely to realise the full benefit analysed in this report.
- Use of fully sustainable and clean fuels might achieve the maximum benefit available, but these stoves are generally likely to be more expensive.

Better designed and better enforced levies could help to encourage switching to improved cooking solutions: better stoves, and better fuels. In addition to collecting more revenue (which could perhaps then be used to ensure that the poorest communities are able to afford alternatives to firewood and charcoal), the intervention could help to mitigate the issues around household air pollution and deforestation that have already been discussed above.

# 3. Impact assessment approach and assumptions

## 3.1. Analytical framework

In this section we describe the analytical framework used to evaluate the fiscal impact of:

- Improving the consistency in application of VAT zero-rating and import tariff exemptions for solar products, and
- Zero-rating improved cookstoves for VAT.

For each policy intervention we have identified the key fiscal and non-fiscal costs and benefits associated with implementing the policy, and wherever possible we have attempted to quantify the impact. The detailed assumptions used when estimating the quantitative impact of the policies are presented in Section 3.2. The evaluated costs and benefits are then input to a net present value framework to evaluate whether the policy is likely to result in a net benefit or cost to GRZ.

Figure 3 and Figure 4 present schematics showing the costs and benefits evaluated for each of the interventions analysed. In each case we have analysed the likely impact of the proposed intervention on the supply of and demand for goods, whether solar PV or cookstoves. For each intervention this change in uptake is then translated to a set of fiscal impacts, some of which are a direct consequence of the intervention, other being an indirect consequence.

Fiscal impacts include any immediate reduction in tax receipts that result (e.g. from extending a tax exemption) as well as the direct consequences of increased uptake, such as higher corporation tax receipts from solar companies, or lower tax receipts from enterprises that are adversely affected (e.g. enterprises selling dry cell batteries). Further indirect fiscal benefits result from increased employment and the growth of micro-enterprises that might benefit from using solar energy, for example.

Figure 3 Schematic of the costs and benefits modelled to evaluate the impact of improved implementation of solar tariff exemptions

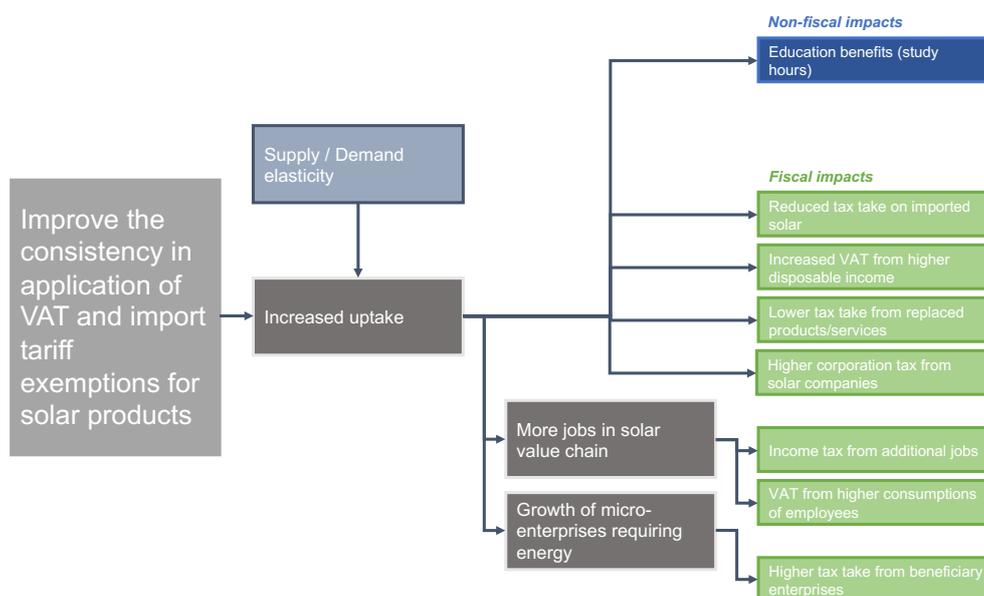
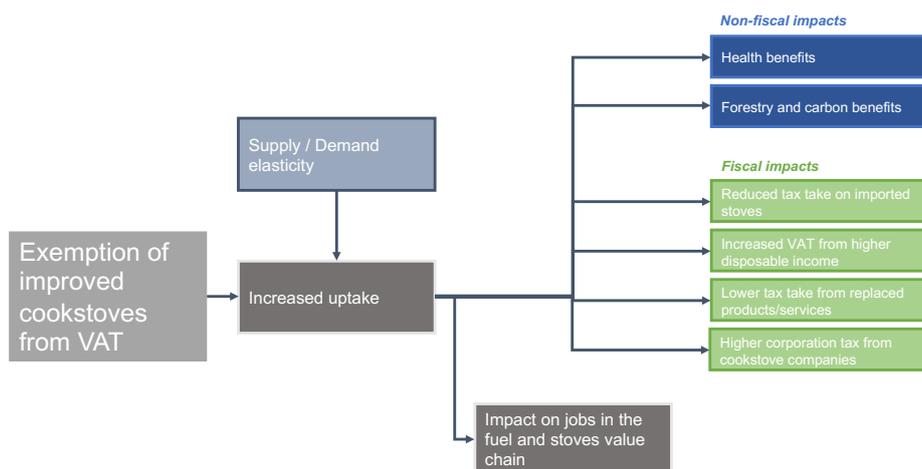


Figure 4 Schematic of the costs and benefits modelled to evaluate the impact of zero-rating improved cookstoves for VAT



In the case of zero-rating improved cookstoves we have not attempted to quantify the impact on jobs, acknowledging the complexity of the interaction between new employment in the value chains for improved cookstoves and sustainable fuel, and employment in the charcoal value chain. This is discussed further in Section 4.3.

In addition to fiscal benefits, the analysis also estimates notable non-fiscal benefits that are important to GRZ. These include the benefit of increased study hours in the case of off-grid solar, and health benefits and the benefits of reduced deforestation in the case of improved cookstoves. For health and forestry benefits we have also valued these for GRZ.

### 3.2. Detailed modelling assumptions

Table 3 presents a summary of the key modelling assumptions made in evaluating the impact of improved consistency in the implementation of solar tariff exemptions, and Table 4 presents a summary of the key assumptions made in evaluating the impact of zero-rating improved cookstoves for VAT. The assumptions columns in the table also highlight where we have performed additional sensitivity testing, with ‘upside’ and ‘downside’ assumptions, the outputs of which are presented in Section 4.

Table 3 Assumptions for evaluating the fiscal impact of improved implementation of solar tariff exemptions

Cost or benefit	Explanation	Assumption	Values
<i>Accelerated uptake</i>			
Increased uptake of off-grid solar products	Uptake projections assume that consumers by a range of solar systems, from \$5 solar lanterns up to more sophisticated solar systems costing \$220. Uptake is distributed across the range of solar products. Cost assumptions are informed by recent (unpublished) analysis performed for the WB in Zambia and are validated through our engagement with stakeholders. The breakdown of uptake between the different categories is informed by global sales data collated by GOGLA <sup>18</sup> , the Global Off-Grid Lighting Association.	Cost of SL	\$5
		Cost of basic SHS	\$100
		Cost of sophisticated SHS	\$220
		Share of uptake – SL	35%
		Share of uptake – basic SHS	55%
		Share of uptake – sophisticated SHS	10%
		The cost of solar panels and batteries has decreased	Nominal cost reduction

Cost or benefit	Explanation	Assumption	Values
	significantly in recent years and this trend is expected to continue. Solar cost reduction assumptions are based on recent analysis of solar PV costs in Africa by IRENA <sup>19</sup> . We have assumed a lower rate of cost reduction, assuming that solar and battery costs account for ~50% of SHS costs.	2015-2025	Upside: 50% Downside: 15%
	A replacement rate is assumed for all solar assets, which is the inverse of the expected lifetime of the asset.	Solar lantern	50% p.a. Upside: 33% Downside: 100%
		Basic SHS	33% p.a. Upside: 25% Downside: 50%
		Sophisticated SHS	25% p.a. Upside: 20% Downside: 50%
		Demand elasticity	60% Upside: 110% Downside: 25%
	<p>It is assumed that demand for SHS responds to the reduction in cost over time.</p> <p>The elasticities presented in this table are expressed such that a value of 50% means that a 2% reduction in price would lead to a 1% increase in uptake.</p> <p>A number of sources were considered in determining an appropriate assumption for demand elasticity:</p> <ul style="list-style-type: none"> <li>• Analysis of income distribution across Zambia from the CSO Living Standards Monitoring Survey<sup>1</sup>. The income distribution data is used to estimate the increase in the number of households able to afford a SHS as prices continue to fall.</li> <li>• Evidence from a field experiment in Kenya performed by ETH Zurich<sup>20</sup>.</li> <li>• Evidence presented by GOGLA to the East African Community (“EAC”) when some tariffs on solar were re-introduced in the EAC.</li> </ul>		
	Stakeholder consultations have suggested that misapplied tariffs have resulted in some increase in the price of solar products.	Misapplication rate	10% Upside: 20% Downside: 5%
		Time taken for prices to fall once the policy is implemented	3 years Upside: 1 year Downside: 5 years
	As noted in Section 2.1, it can be estimated that sales of solar products in Zambia are reduced by ~160,000 units in 2018 by supply-side constraints. We can assume that some portion of the supply-side constraint is attributable to the inconsistent application of tariff exemptions.	Attributable supply-side constraint	25% Upside: 50% Downside: 10%
<b>Fiscal impact</b>			
Reduced import duties on solar products	<p>Calculated by multiplying the misapplication rate – above – by the baseline uptake of solar products and by the import duty rate.</p> <p>It is assumed that misapplied VAT can be reclaimed through a company’s VAT return.</p>	Import duty	25%
Reduced turnover tax from sales of candles and torches /	Monthly spend on alternatives to solar power are based on (unpublished) analysis recently performed for the	Monthly spend on candles	\$11/month

Cost or benefit	Explanation	Assumption	Values
dry cell batteries	WB in Zambia.	Monthly spend on torches / dry cells	\$6.50/month
	The baseline monthly cost of alternatives to solar could be lower if the solar uptake reaches less affluent sections of the population.	% of monthly spend assumed	100% <i>Upside: 100%</i> <i>Downside: 50%</i>
	New solar users are assumed to have switched from using either candles or torches / dry cell batteries. This assumption is based on the CSO Living Conditions Monitoring Survey <sup>1</sup> .	% households previously using candles	20%
		% households previously using torches	80%
	The above assumptions are multiplied by each other and by the turnover tax rate, which applies to small enterprises. It is assumed that enterprises selling alternatives to solar are registered for tax, but below the corporate income tax threshold.	Turnover tax	3%
Reduced turnover tax from mobile charging	Monthly spend on mobile charging is also based on the WB analysis cited above. Spend is again multiplied by a % factor as was the case for lighting spend, and then by the turnover tax.	Monthly spend on mobile charging	\$4.50/month
	Recognising that not all households in Zambia have a mobile phone, mobile charging spend is also multiplied by mobile phone penetration. These assumptions are taken derived from GSMA's Mobile for Development database <sup>21</sup> .	Mobile phone penetration, 2015	75.7%
		Mobile penetration rate of change	2.6% p.a.
VAT benefit as consumers have more disposable income	Consumers switching from using alternatives to solar can save money, increasing their disposable income. Assumptions on savings are again taken from recent analysis performed for the WB in Zambia. Note that these are the initial savings expected for a household that switches, rather than the savings modelled dynamically over the lifetime of a product to consider changes in replacement rate, for example.	Monthly saving switching from candles to a solar lantern	\$14/month
		Monthly saving switching from candles to a basic SHS	\$12/month
		Monthly saving switching from candles to a sophisticated SHS	\$10/month
		Monthly saving switching from torches to a solar lantern	\$9/month
		Monthly saving switching from torches to a basic SHS	\$7/month
		Monthly saving switching from torches to a sophisticated SHS	\$5/month
		The savings noted above are assumed to translate directly into disposable income, that is spend on goods and services subject to VAT.	VAT
Corporation tax on the net margin of solar companies	Sales by solar companies are multiplied by an assumed net margin, which increases over time as the industry matures.	Net margin until 2020	0%
		Net margin, 2025	5%
		Net margin, 2030	10%
	The inferred net margin is then multiplied by the corporate income tax rate.	Corporate income tax	35%
<b>Indirect fiscal impact of new jobs</b>			
Additional income tax on new	Jobs created in the off-grid solar value chain are	Jobs in solar value	30

Cost or benefit	Explanation	Assumption	Values
workers	<p>estimated based on research presented in a UNEP report<sup>22</sup> on employment in the sector.</p> <p>The earnings resulting from each new job are estimated using Gross National Income (GNI) per capita as a starting point, from World Bank data<sup>23</sup>, which is assumed to grow in line with GDP projections from the IMF's World Economic Outlook<sup>24</sup>.</p> <p>Because the GNI data is per capita, the assumption is scaled up to take into account the % of the population who are economically active, taken from the CSO's Living Conditions Monitoring Survey<sup>1</sup>.</p> <p>It is assumed that this calculation gives an 'average' income in Zambia, but that a proportion of jobs created will be management positions with salaries at some multiple of the average. These assumptions are based on our stakeholder consultations.</p> <p>Many of the jobs created are likely to be below the income tax threshold. However, the more senior positions will may more – as outlined above – and will trigger income tax liabilities. The average income tax rate is calculated as a weighted average of the various marginal rates<sup>25</sup> that are assumed to apply.</p>	chain per 10,000 people	Upside: 100 Downside: 20
		Jobs in replaced value chains per 10,000 customers	5
		GNI per capita, 2016	\$1,360
		GDP growth	4.5% p.a.
		Economically active population	38%
		% of jobs in management	7%
		Management salary as a multiple of the average	3 x
		Average income tax on employment income	1.54%
		Final household consumptions as a % of GDP	49%
		Additional VAT from the consumption of new workers	The earnings derived above are also assumed to lead to additional personal consumption. These are estimated by multiplying earnings by the % of GDP accounted for by household consumption. This assumption is from World Bank data <sup>23</sup> . This consumption is again assumed to be spent on goods and services that are subject to VAT.
<b>Indirect fiscal impact through improved performance of microenterprises</b>			
Increase in turnover tax from enterprises benefiting from solar lighting	<p>Off-grid solar can support small enterprises, and we have assumed a % of households will use solar to the benefit of their microbusinesses, for example, extending working hours because they have light. This is a very approximate assumption but is based on Acumen's latest impact report<sup>26</sup>.</p> <p>These assumptions are then multiplied by the average income of economically active households (see assumptions above). It is assumed that this income is subject to Zambia's turnover tax for small businesses. It is recognised that in reality some of these enterprises will not be registered for any form of taxation.</p>	% of households using solar for micro-enterprises	31%
		Additional business hours	1
		Baseline business hours	8
<b>Non-fiscal benefits - education</b>			
Increase in study hours	The number of additional study hours available is calculated by multiplying increased uptake by the number of additional lighting hours for study (from the Acumen impact report <sup>26</sup> cited above) and the number of children per household (from the CSO Living Conditions Monitoring Survey <sup>1</sup> ). This additional study time is assumed to be available every weekday (i.e. five days per week)	Extra lighting hours for study	1
		Children per household	3

The assumptions used in evaluating the impact of zero-rating improved cookstoves for VAT are based on the use of improved, efficient cookstove solutions that also use a sustainable fuel (e.g. a sustainably produced biomass fuel). In reality there are a wide range of cookstove technologies and fuels that might lead to higher or lower realisation of some of the benefits that the analysis

attempts to quantify. Some improved cookstoves may also involve continued use of traditional fuels. This would lead to much more efficient use of those fuels and could lead to a significant reduction in health and deforestation issues but would not eliminate these challenges. The analysis assumes that the full benefit of using a sustainable fuel is realised.

Table 4 Assumptions for evaluating the fiscal impact of zero-rating improved cookstoves for VAT

Cost or benefit	Explanation	Assumption	Values
<b>Accelerated uptake</b>			
Increased uptake of clean cooking solutions	A single cookstove cost assumption is based upon our engagement with stakeholders, including cookstove companies operating in Zambia.	Cost of improved cookstove	\$120
	A significant reduction in cost of improved cookstoves is expected in the Zambian market over the coming years. We are aware of at least one company looking to increase assembly in Zambia and some new entrants with lower cost products may also enter the market.	Nominal cost reduction 2018-2023	60% Upside: 75% Downside: 40%
	As with the solar products, a replacement rate of existing stoves is assumed, which is the inverse of the expected lifetime of the stove. This assumption is again based on stakeholder consultations.	Replacement rate	25% p.a. Upside: 20% p.a. Downside: 33% p.a.
	Compared to the analysis of solar uptake, the assumption here is much simpler as uptake is assumed to only be a function of elasticity of demand. We received consistent feedback from stakeholders that demand for improved cookstoves was very price sensitive; significant increases in sales could be seen following relatively small reductions in price. The literature also supports this assertion. Mobarak et al. <sup>16</sup> noted significant elasticity of demand for improved cookstoves in Bangladesh, for example. The assumption for elasticity is based on evidence from stakeholder interviews, some of whom have experience of VAT exemptions being introduced in other countries.	Demand elasticity	250% Upside: 400% Downside: 100%
<b>Fiscal impact</b>			
Reduced VAT on cookstoves	Calculated by multiplying the baseline uptake of improved cookstoves by the VAT rate.		
Reduced turnover tax from the sale of traditional cooking fuels	For household purchasing charcoal in the baseline scenario, monthly household spend can be estimated based on assumptions on charcoal retail pricing and the average daily use of charcoal. These assumptions are based on a report about charcoal trade in Zambia by the Centre for International Forestry Research ("CIFOR") <sup>27</sup> .	Monthly baseline charcoal cost	\$5 per household
	As with solar, this amount can be reduced by a factor to reflect lower spend by less affluent households.		
	To estimate the reduced expenditure on charcoal as a result of the policy, assumptions on the prevalence of charcoal purchase are made based on data in the CSO's Living Conditions Monitoring Survey <sup>1</sup> . The reduced expenditure is then multiplied by the turnover tax rate, although it is acknowledged that in many cases charcoal retailers may not be registered even for turnover tax.	Urban households purchasing charcoal in baseline	85%
	Rural households purchasing charcoal in baseline	10%	

Cost or benefit	Explanation	Assumption	Values
VAT benefit as consumers have more disposable income	Based on information collected during stakeholder interviews it is expected that households switching to an improved cookstove will reduce their monthly expenditure as a result of the improved stove efficiency, even where a more sustainable fuel may be more expensive. It is assumed that this saving translates to an increase in disposable income, which is spent on goods and services that are subject to VAT.	Monthly savings for households switching to improved cookstoves	\$2.50 per household
Corporation tax on the net margin of cookstove companies	The increase in sales of cookstoves that results from the higher uptake can be multiplied by an assumed net margin assumption. The same net margin % are assumed as for solar (see Table 3). The net margin is then assumed to be subject to corporate income tax.		
<b>Indirect impact through health benefits</b>			
Average avoided disability adjusted life years (DALYs) in the working age population	The Institute for Health Metrics and Evaluation (IHME) publishes country-level analysis that estimates the DALYs attributable to household air pollution <sup>13</sup> (HAP). This data is also disaggregated by age group. The DALYs attributable to HAP in Zambia for the working-age population is estimated by subtracting DALYs for those over 70 years old from the total.	DALYs attributable to HAP in Zambia, 2016	466,265
		DALYs attributable to HAP for 70+ population in Zambia, 2016	45,471
	This is converted to an assumption for DALYs attributable to HAP per household using a traditional cookstove, by dividing the assumption derived above by the number of households using a traditional cooking method.	% of households using charcoal or firewood	83.6%
	To calculate the number of DALYs avoided this is then multiplied by the additional number of households using an improved cookstove once the policy is in place. This is estimated using data from the CSO's Living Conditions Monitoring Survey <sup>1</sup> . Depending on the stove technology and the fuel used, it might be that the number of DALYs avoided is lower than this number; the improved cookstove might only partially mitigate the health impacts of HAP.		
Fiscal benefit of income preserved	We have also attempted to estimate the indirect fiscal benefit that would arise from this reduction in DALYs. The starting point for this is to estimate the number of people benefiting from reduced health issues, or DALYs. The IHME database also has data on the number of deaths and years lost to disability (YLDs) attributable to HAP. This can then be used to calculate the number of people affected by HAP, and hence the number of DALYs per affected person.	Premature deaths in Zambia attributable to HAP, 2016	10,675
		YLDs attributable to HAP in Zambia, 2016	6,483
		DALYs per affected person	24.5
	The avoided lost earnings attributable to the reduction in DALYs can then be calculated as the present value of the GNI per capita (see Table 3) over the number of DALYs per affected person. The discount rate used for this calculation (and for calculating the net benefit of the policy) is the long-term Government bond rate in Zambia. Because the modelling has been performed in \$ we have adjusted the ~17% interest rate on 15-year Kwacha bonds to account for expected evolution in the Kwacha/USD exchange rate.	Nominal discount rate	10.7%
It is assumed that a portion of the avoided lost earnings also translates to avoided lost tax revenues through a range of different taxes (e.g. VAT, income tax, etc.). This is estimated using data on the % of taxation as a share of GDP from the World Bank's open data website <sup>23</sup> .	Tax take as a % of GDP	16%	

Cost or benefit	Explanation	Assumption	Values
<i>Indirect impact through forestry benefits</i>			
Miombo deforestation prevented	The first step in calculating avoided deforestation is to back-calculate the number of household using improved cookstoves in urban and rural areas, and the split between households previously using firewood and those previously using charcoal.	% urban households using firewood	6.0%
		% urban households using charcoal	59.1%
	This is required because the amount of biomass required in each case is different. The assumptions are again from the CSO Living Conditions Monitoring Survey <sup>1</sup> .	% rural households using firewood	84.5%
		% rural households using charcoal	13.2%
	The amount of biomass consumption avoided can then be calculated. Assumptions on daily charcoal consumption and the efficiency of wood use in charcoal production are found in the CIFOR paper on charcoal trade in Zambia cited earlier <sup>27</sup> .	Daily charcoal consumption	1.6 kg/day
		Daily firewood consumption	3.4 kg/day
	For households using firewood, daily consumption is estimated using data on the relative heat content of firewood and charcoal. This assumption is from analysis by the Food and Agriculture Organisation of the UN (FAO) <sup>28</sup> , which states that charcoal has a heat content of 32.6 GJ/tonne and firewood has a heat content of 15.5 GJ/tonne.	Efficiency of wood utilisation in charcoal production	12%
		The biomass quantity that results from this calculation can then be converted to the area of forest saved by using an assumption on the amount of biomass per hectare of <i>miombo</i> forest in Zambia. This assumption is derived using data on forest clearance for fuel production in a paper on cooking fuel choice in Zambia by the Indaba Agricultural Policy Research Institute <sup>29</sup> .	Biomass per hectare of forest
Carbon savings	The assumption used for the carbon content of <i>miombo</i> forest is taken from a paper by UNEP on the benefits of forest ecosystems in Zambia <sup>30</sup> . The derived carbon content is then scaled to account for the difference in atomic mass between carbon and carbon dioxide.	Carbon content of forest	42 tC/ha
		Atomic mass of carbon	12
		Atomic mass of carbon dioxide	44
Fiscal benefit of forest protected	As with the health benefits analysed above, we have attempted to assign a fiscal value to the avoided deforestation. This is estimated using an analysis of the value of forestry resources in Zambia, which is presented in the UNEP report <sup>30</sup> cited above.  This value is then multiplied by the same assumption on tax take as a % of GDP as is used for valuing the health benefits of using improved cookstoves.	Value of forestry resource in Zambia	25 \$/ha

# 4. Outputs from evaluation of the impact assessment

## 4.1. Product uptake and meeting policy objectives

Figure 5 illustrates the impact that the policy interventions proposed in this report could have on the uptake of solar and improved cookstoves. For each intervention the baseline uptake is shown with a blue line, and the improved uptake with the policy in place is shown with an orange line. In both cases there is a step-up in uptake over the next few years (even in the baseline scenario) as a result of expected cost reductions.

As noted in Section 3.2, there is significant uncertainty around some of the assumptions used in the analysis, for example the lifetime of off-grid energy products, or the price elasticity of demand. This naturally leads to uncertainty over the level of uptake likely. The dashed orange lines show the impact of the policy under the ‘upside’ and ‘downside’ assumptions presented in the tables in Section 3.2. This uncertainty also affects the modelling of the baseline; the blue shading shows the baseline range under ‘upside’ and ‘downside’ assumptions.

Figure 5 Increase in uptake of solar products (left) and improved cookstoves (right)

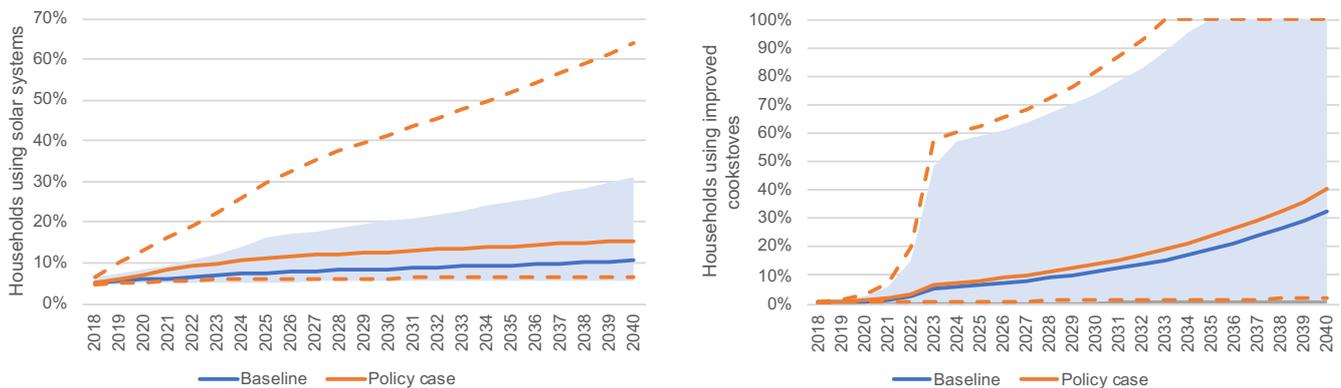
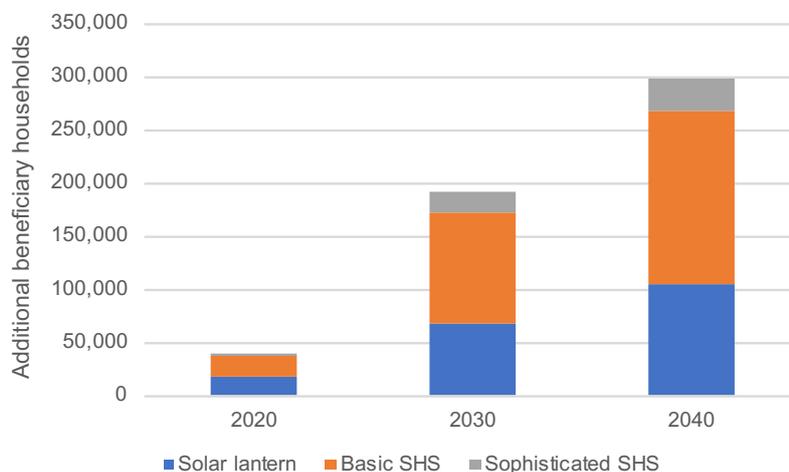


Figure 6 Breakdown of additional solar households by system type



While there is significant uncertainty over the precise numbers, the analysis shows that the proposed policy interventions could have a significant impact on the uptake of off-grid technologies. Under Base Case assumptions, improved implementation of exemptions for solar products could lead to ~191,000 additional households benefiting from solar by 2030, with this increasing to ~297,000 households by 2040. Figure 6 shows what types of system these households benefit from. The largest number of household benefit from a basic multi-room SHS (e.g. high Tier 1 access), with other household either benefiting from more basic solar lighting products, or a more sophisticated (e.g. Tier 2) SHS. Introducing zero-rating on VAT for improved cookstoves could increase uptake by ~121,000 households by 2030, increasing to 457,000 households by 2040.

Note that under Base Case assumptions this amounts to significant progress but is not by itself sufficient to meet Zambia's targets under SDG7. To meet SDG7 Zambia will need additional policy interventions beyond those covered in this report.

Under the 'upside' assumptions (i.e. if elasticity of demand is higher than in our Base Case assumption) it is possible that Zambia could meet SDG7. Using these more aggressive assumptions uptake of SHS could exceed 40% of households by 2030, which may be consistent with achieving SDG7, depending on the progress made in also extending access to the grid and promoting mini-grids. Improved cookstoves could reach >80% of households. About 16% of households in Zambia already use electricity as their main source of energy for cooking<sup>1</sup> so this would likely be sufficient to meet SDG7.

Note that our modelling has not considered the interaction of the markets for solar systems and improved cookstoves with adjacent markets for alternative products.

## 4.2. Quantitative cost-benefit analysis of proposed fiscal policy interventions

Figure 7 and Figure 8 illustrate the projected fiscal impact of improving the implementation of exemptions for solar products. Figure 7 shows the breakdown between more direct fiscal impact and the indirect impact resulting from higher employment and increased activity from micro-enterprises that benefit from using solar. This shows that under Base Case assumptions the policy would be expected to have positive impact of >\$6m p.a. by 2030. Even as early as 2020 the policy could have a net positive impact of >\$700k p.a. Over the period to 2040, the Net Present Value ("NPV") of the net fiscal benefit is \$35.3m.

The figure also shows that the policy could yield significant revenues from both increasing employment and from micro-enterprises that are able to increase their productivity, for example through extended hours, and hence contribute more in taxes. The analysis assumes that the additional business income is subject to Zambia's turnover taxes, which applies to smaller businesses. As already noted in Section 3.2, it is acknowledged that this benefit might be lower if enterprises are not registered for any tax. The analysis implicitly assumes that an increased share of the economy becomes formalised over the period analysed.

The fiscal benefit of higher employment shown in Figure 7 is mostly driven by the tax revenues earned as a result of the increased disposable income that results from the new jobs. The estimated revenues from income tax are only ~\$350k in 2030 and ~\$1.0m in 2040. This is largely a result of the high personal income tax thresholds in Zambia. A reduction in these thresholds to broaden the tax base would also increase the benefit of policies that increase employment, such as the policy intervention proposed here.

Figure 7 Impact of improved implementation of solar tariff exemptions

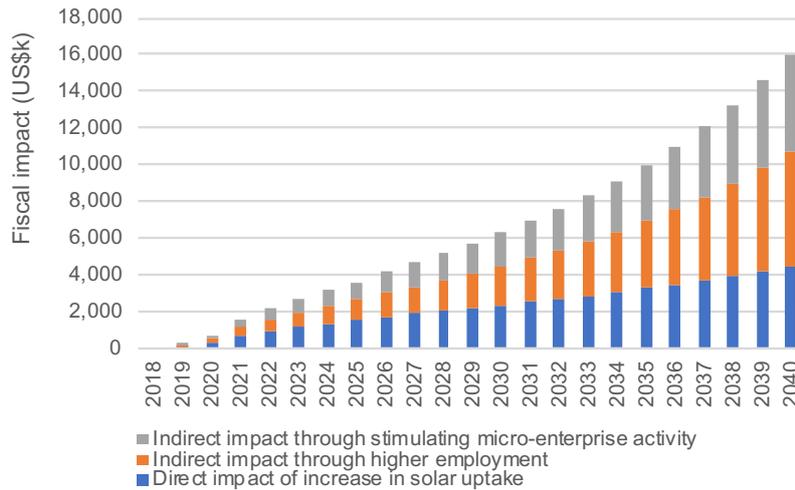


Figure 8 shows a more detailed breakdown of the more direct fiscal impact of improving implementation of solar import tariff exemptions. The solid black line in the figure shows the net positive fiscal impact and the dashed lines show the impact of using the ‘upside’ and ‘downside’ assumptions. This again illustrates the high degree of uncertainty over some of the assumptions. However, note that the fiscal impact is net positive in all cases.

The figure shows the negative impact of lost taxes as well as the positive impact, which more than offsets these costs. In terms of lost revenues, the impact of reduced import duties is very small because in the case of most shipments the exemption is already correctly applied. Most of the fiscal loss is actually from reduced turnover tax receipts from enterprises selling candles, dry cell batteries, and mobile charging services. Note that the same caveat applies to these numbers as was made above: this loss may be over-estimated where enterprises are not registered to pay any tax. The greatest fiscal benefit is seen through higher VAT revenues that result from the increased disposable income that consumers have as they switch to off-grid solar.

As noted earlier in Section 2.1 it is possible that the tax take from import duties could increase if exemptions do not apply to all appliances for solar systems. We have not attempted to quantify this potential benefit in the analysis.

Figure 8 Detailed breakdown of direct fiscal impact of improved implementation of solar tariff exemptions

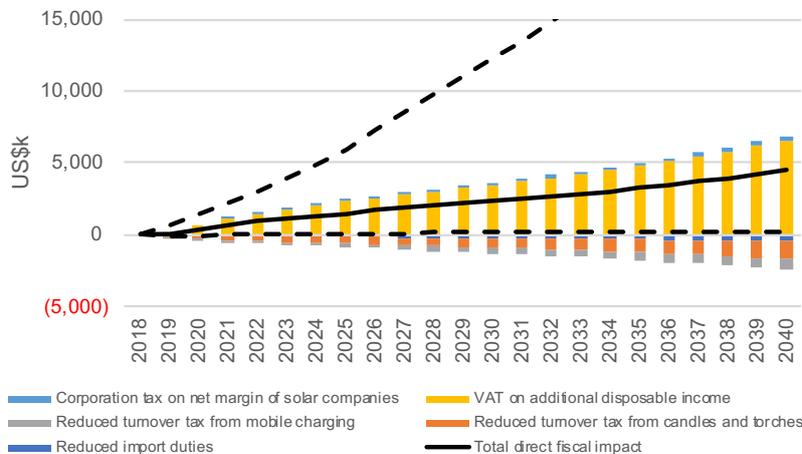


Figure 9 and Figure 10 illustrate the estimated fiscal impact of introducing zero-rating from VAT for improved cookstoves. The figures show analysis under the Base Case assumptions and, as has

been illustrated previously, there is significant uncertainty around some of the assumptions. Under the Base Case assumptions, Figure 9 shows that for this policy intervention the immediate fiscal impact is negative. For example, the VAT raised on additional disposable income does not offset the lost VAT from cookstove sales (see Figure 10). However, the potential health benefits are significant and, as argued previously in Table 4, this can translate into a fiscal benefit as well. If this benefit is included, then the net fiscal benefit is ~\$2.4m p.a. by 2030. Note that the indirect fiscal benefits from reduced deforestation are estimated to be very small (~\$30k p.a. in 2030). The NPV of the net fiscal benefit over the period to 2040 is \$16.8m.

There are two further points to highlight from analysis of the intervention to remove VAT for cookstoves:

- It takes longer to realise positive fiscal results, when compared to the solar intervention. During the first few years the fiscal cost of the policy outstrips any benefits. This peaks at a net cost of \$137k in 2021. The policy has a positive fiscal impact from 2023 onwards, and already yield >\$600k p.a. in 2024.
- Whereas the solar intervention has a positive impact even in the ‘downside’ scenario, the cookstove intervention shows a negative impact under those assumptions, although the analysis does show an annual benefit by the end of the 2030s in this scenario. This is mostly a result of lower uptake (resulting in lower benefits). The fiscal cost is ~\$80k p.a. at the start of the modelled period and the first annual fiscal gain in the ‘downside’ scenario is not until 2038.

Figure 9 Impact of zero-rating improved cookstoves for VAT

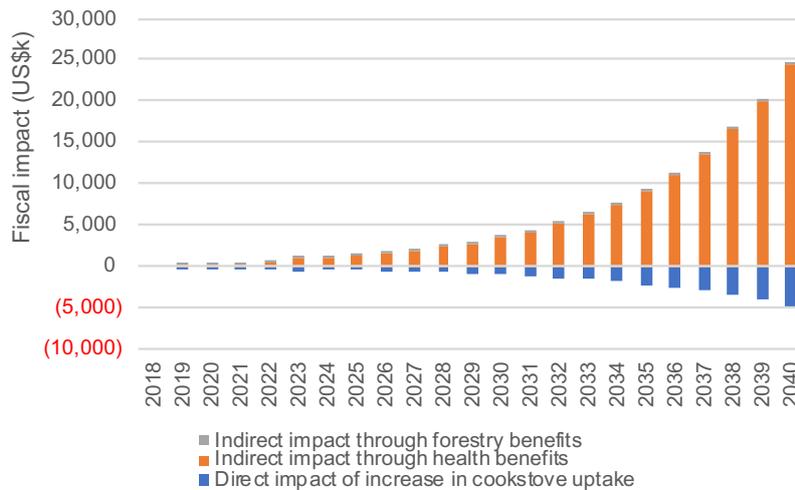
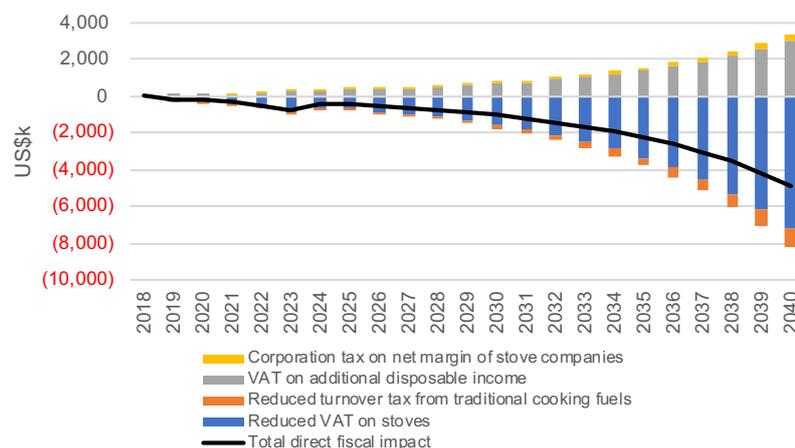


Figure 10 Detailed breakdown of direct fiscal impact of zero-rating improved cookstoves for VAT



Note that while the above analysis has focused on the fiscal impact of the proposed policies (i.e. the impact that Government sees), the primary impact is on the households and communities that benefit from increased uptake of off-grid solar products and improved cookstoves. The community and household-level benefits are aligned with GRZ policies:

- Increased energy access will help to drive rural economic development.
- As discussed further in Section 4.3 the interventions could help to increase employment opportunities.
- Many of the benefits are likely to accrue disproportionately to women and girls.

In the case of solar, the two primary fiscal benefits relate to increased VAT revenues on disposable income and increased turnover tax take resulting from the improved productivity of micro-enterprises:

- Increased VAT revenues reach ~\$3.5m p.a. by 2030, but this is the result of Zambian consumers having ~\$25m p.a. of additional disposable income as they switch from using candles and dry cell batteries for lighting.
- Similarly, the turnover tax benefit reaches ~\$1.8m p.a. by 2030, but this results from about ~\$60m p.a. in additional business income.

These very significant benefits accrue to Zambians that currently have no access to electricity. The policy is therefore progressive as well as having a significant impact on the wellbeing of the population. As we have already noted, the poorest households may still be unable to afford a system. The intervention proposed here does not explicitly tackle that issues, so further interventions may be required to ensure that the benefits highlighted in this analysis also reach the poorest rural households.

A similar point can be made about the cookstove intervention being progressive. The fiscal business case for the policy is largely driven by ~\$3.4m p.a. of fiscal benefits that are assumed from the reduced health impact of household air pollution. However, this is in turn the result of an assumed ~20,000 DALYs impacting ~800 people each year by 2030. This equates to ~500 avoided premature deaths each year. Again, these benefits are likely to accrue disproportionately to poorer households (although, again, potentially not the very poorest who cannot afford the improved stove). The benefits are also likely to disproportionately accrue to women and girls, who are more likely to be exposed to pollution from cooking.

### **4.3. Other considerations in evaluating the interventions**

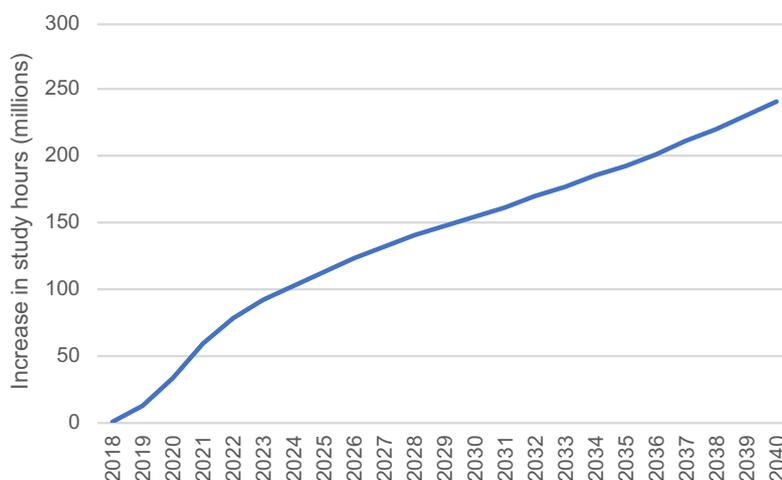
In addition to the fiscal benefits analysed in Section 4.2, there are significant additional benefits that should be considered alongside the fiscal business case. A summary of the key policy indicators for the proposed interventions is presented in Table 5.

Table 5 Key policy indicators

		2020	2030
<b>Off-grid solar: consistent application of tariff exemptions</b>			
Fiscal benefit from solar	\$k p.a.	736	6,291
New connections	Cumulative	39,855	191,098
Increase in household consumption	\$k p.a.	5,627	36,314
Increase in jobs	Cumulative	508	2,436
Rural enterprises benefiting from increased productivity	Cumulative	1,744	11,257
Increase in study hours	hours p.a.	32,211,533	154,447,876
<b>Improved cookstoves: zero-rating for VAT</b>			
Fiscal benefit from improved cookstoves	\$k p.a.	(128)	2,394
Households benefiting	Cumulative	8,415	120,463
Increase in household consumption	\$k p.a.	266	4,636
Potential reduction in working age DALYs	p.a.	1,367	19,563
Potential reduction in deforestation	ha p.a.	533	7,741
Potential reduction in CO <sub>2</sub> emissions	ktCO <sub>2</sub> p.a.	22	325

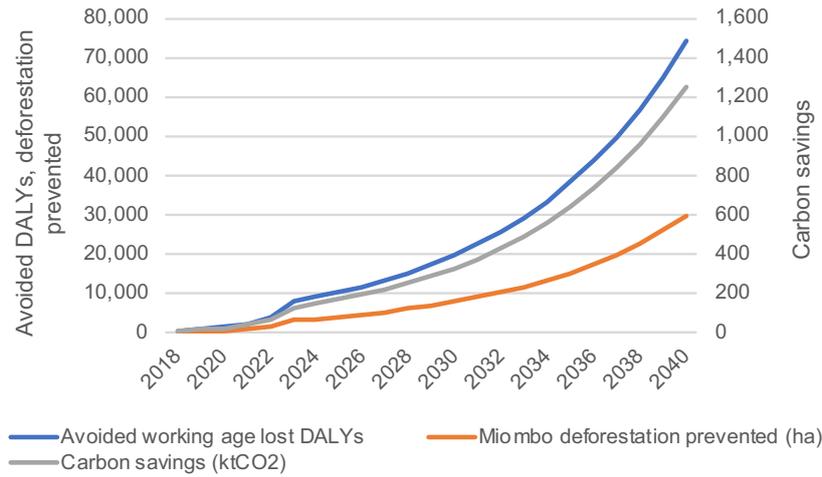
Specifically, in the case of increasing the uptake of off-grid solar, the number of additional study hours has been estimated. Under Base Case assumptions it is estimated that children in Zambia would benefit from >150m additional study hours every year by 2030 (see Figure 11).

Figure 11 Increased study hours resulting from increased uptake of off-grid solar



The health benefits of using VAT exemptions to increase the uptake of improved cookstoves have already been mentioned in Section 4.2. These benefits are shown in Figure 12, along with the benefits of reduced deforestation that result. It is estimated that the deforestation of *miombo* forest could decline by nearly 8,000 ha p.a. by 2030, and nearly 30,000 ha p.a. by 2040. This could reduce Zambia’s annual rate of deforestation by ~10%. The figure also shows that CO<sub>2</sub> emissions would fall by >300 ktCO<sub>2</sub> p.a. by 2030 and over 1,200 ktCO<sub>2</sub> p.a. by 2040. This would make a major contribution to the emissions reductions of 20,000-38,000 ktCO<sub>2</sub> proposed by Zambia’s INDC<sup>15</sup>. Given the pressing challenge of deforestation in Zambia, these are notable benefits, even where the knock-on fiscal benefit is expected to be small.

Figure 12 Additional benefits from increased uptake of improved cookstoves



Employment opportunities are another potentially significant benefit highlighted by the analysis. It is estimated that almost 2,500 additional jobs could be created in the solar sector by 2030 if the intervention is implemented. This could increase to >3,500 jobs by 2040.

In the cookstove sector the debate about employment is more complex. A paper analysing deforestation in Zambia prepared by US AID<sup>31</sup> suggests that as many as 500 people are employed in the charcoal value chain for every 10,000 households that rely on charcoal for cooking. However, another paper by IAPRI<sup>32</sup> suggests that these are mostly low-paying jobs, which pay ~60% of average earnings. By contrast, we estimate from stakeholder consultations that ~200-250 jobs would be created in the cookstove value chain for each 10,000 households. These jobs, on average, are likely to be higher paid jobs. This does not include jobs in the fuel value chains. For households using an improved cookstove to burn traditional fuels, some jobs might remain in the charcoal value chain. New jobs could also be created in farming communities producing sustainable biomass fuels.

The exact impact of improved cookstove uptake on jobs is complex, and highly dependent on the technologies deployed. It is possible that some jobs are lost as a result of higher uptake. However, the shift towards higher value jobs should help to offset any negative impacts. Total employment income across the population should remain at a similar level before the positive secondary impacts of additional disposable income from higher paid jobs take effect.

# 5. Recommendations and action plan

The analysis presented in this report has evaluated the fiscal impact of policies to accelerate the uptake of off-grid technologies in Zambia.

In the case of improved implementation of existing import duty exemptions for solar systems, the analysis suggests that there are clear arguments for taking action. The net benefit to GRZ's budget over the next 20 years would be \$35.3m using our Base Case assumptions. The fiscal cost of this intervention is small as duties are normally not charged anyway, but the benefits of increased uptake as confidence in the industry improves could be significant. As has also been noted in this report, the net fiscal impact of an updated set of exemptions is likely to be positive.

The business case for exempting improved cookstoves from VAT is more nuanced. If the secondary fiscal benefits associated with reduced health issues are considered, the policy could yield a net benefit of \$16.8m over the next 20 years. However, there is significant uncertainty over the exact quantum of the benefit, and if the uptake of cookstoves is much lower than expected it is possible that the policy results in a net cost to GRZ in the short to medium-term.

Under Base Case assumptions, it is expected that the new exemptions would prevent ~500 premature deaths per annum by 2030. Even in the 'downside' case the policy could prevent ~20 premature deaths per annum by 2030. The policy also aligns well with other GRZ policies as it would help improve economic development and many of the benefits (both the economic benefits and health benefits) could fall disproportionately to women and girls. When considered alongside the likely fiscal benefit it is recommended that GRZ also implement this VAT exemption. The success of the policy should be closely monitored so that if the policy does not lead to the expected acceleration in cookstove uptake (noting this may take a number of years to take place) the policy can be reconsidered.

While we have not performed a detailed quantitative analysis of charcoal levies, it is also recommended that GRZ consider undertaking a detailed review of levies and incentives on cooking fuels, including charcoal. As discussed in Section 2.2 of this report, such a review could consider whether charcoal levies are set at an appropriate level, and also whether allocating responsibility to ZRA might improve enforcement of the levies. The review might also consider whether incentives are appropriate for fuels that are more sustainable.

Table 6 summarises some of the key actions required to implement the recommendations made in this report.

Table 6 Actions required to implement the recommended interventions

Action	Responsible party
<p>Update of the tariff exemptions for solar power through the 2019 budget process. Discussion on the scope of good that should be covered by the re-drafted exemption is presented in Section 2.1. A starting point for re-drafting the exemption is attached in Appendix B.</p> <p>We understand that the key milestones in the budget process are as follows:</p> <ul style="list-style-type: none"> <li>• A call for proposals is likely to be issued by MOF during May 2018, which will allow MOF to collect ideas and evidence for policy changes to be made through the budget process. The evidence in this report will need to be presented in response to that call. It is possible that the call for proposals requires evidence to be presented in a specific format.</li> <li>• In parallel, MOF will be consulting with key industries to collect evidence on where changes in fiscal policy might be required.</li> <li>• The proposals will then be considered by a Tax Policy Review Committee during June and July. This process is run by MOF but is likely to consult DOE and ERB. Those proposing policy changes can be called to give evidence during this period.</li> <li>• After the Committee stage, a recommendation is made to cabinet. Cabinet will make a final decision in August or early September. Again, further evidence could be sought during this period.</li> <li>• Finally, the full budget package enters parliament, with a final vote expected in November. Parliament will vote on the package as a whole, so it seems less likely (but is not impossible) that further evidence on a detailed line item in the budget is requested at this stage.</li> </ul>	<p>MOF, with support from DOE and ZRA</p> <p>Donors could support with advice on the drafting</p>
<p>Expedite ongoing work to transition customs administration to electronic systems. Combined with an unambiguous coding to apply to imported goods, this should mitigate the risk that similar or identical imported shipment are treated differently, for example if they are inspected by different customs officials.</p> <p>Establishing a “Green Lane” for approved products and/or companies could also help to speed up the processing of imports.</p>	<p>ZRA</p>
<p>Preparation of a VAT exemption for improved cookstoves. Discussion on how such an exemption should be scoped is presented in Section 2.2.</p>	<p>MOF, with support from DOE and ZRA</p> <p>Donors could support with advice on drafting</p>
<p>The impact of the solar and cookstove interventions should be monitored where possible to evaluate whether the policy is yielding the expected returns for GRZ. In particular, GRZ might re-consider the VAT exemption for improved cookstoves if the increase in uptake is less than expected, although sufficient time needs to be allowed for this to occur.</p>	<p>DOE</p> <p>Donors could support DOE in establishing the monitoring capabilities to perform this task</p>
<p>GRZ should perform a comprehensive review of charcoal levies, with the aim of establishing levies that are much better enforced than is the case today. This might include responsibility for these levies being allocated to ZRA, rather than local councils as is currently the case. The review should analyse the opportunity for interventions through the full charcoal value chain and should consider whether incentives might be appropriate for alternative, more sustainable fuels.</p>	<p>MOF, DOE, ZRA, local councils</p> <p>Donors could support this analysis</p>

The interventions recommended by this report could help Zambia to take a significant step towards meeting SDG7. However, as has already been noted in Section 4.1 these interventions by themselves are unlikely to be sufficient to meet SDG7. Further policy interventions will also be required.

In particular, it has been noted that while the exemptions discussed here will have an impact on the affordability of off-grid technologies at the margin, these technologies will remain out of reach for the poorest households and for households in the most remote rural areas. To meet SDG7 these remaining affordability gaps will also need to be addressed. This could be achieved, for example,

through adoptive a concession-type approach in more remote regions, or through implementing progressive cross-subsidies, analogous to the lifeline tariff used for grid-connected households. Fiscal policies that specifically tackle the ability to pay of the poorest rural households should be consider further as such policies could radically mitigate demand side constraints on the size of the market for off-grid energy solutions.

# Appendix A: Stakeholder list

The following stakeholders have been consulted in the preparation of this report:

<b>Organisation</b>	<b>Individuals consulted</b>
<b>Government stakeholders</b>	
Department of Energy	Mafayo Ziba – Energy Officer, Renewables Arnold Simwaba – Director of Electricity Winford Simwanza – Power Development Officer Brian Siakweenda – Energy Officer Agnelli Kafuwe – Energy Economist Misheck Mubuyaeta – Electrification Officer Allan Chivunda – Energy Officer Ilitongo Kaywala – Senior Energy Officer Elijah Chibwe – Power Development Officer Masialeli Wakambo – Electrification Officer Isaac Soko – Energy Economist
Ministry of Finance	Margaret Moonga – Head of Tax Policy, Budget Office Remmy Kampamba – Economic Policy Kayula Chimfwembe – Chief Budget Analyst Bonaventure Chinombwe – Economist, Tax Policy Jeff Chanda – Senior Economist Penelope Simidili Kambita – Economist, Tax Policy Chabu Kapamdwe – Economist Dingiswayo Banda – Assistant Director Kalunga Muripe – Economist, Tax Policy
Energy Regulation Board	Nelson Banda – Manager, Renewables
Zambia Revenue Authority	Reuben Kunda – Deputy Commissioner, Customs Mukuka Sichula – Customs Beatrice Kachinda – Customs Sifuniso Sifuniso – Customs Moses Shuko – Commissioner, Domestic taxes Peter Phiri – Director, Design and Monitoring
<b>Donors and organisations implementing donor programmes</b>	
McKinsey (implementing SAEP)	Laurence de Lascaille Lilay Berhane Jessica Standish-White Roukaya El Houda
SIDA / Beyond the Grid	Sabera Khan
European Commission	Adam Grodzicki – Head of Infrastructure, EU delegation Davide Bixio
A wide range of donors were consulted through presenting at an energy sector cooperating partners meeting	

<b>Organisation</b>	<b>Individuals consulted</b>
<i>Government stakeholders</i>	
<i>Private sector actors</i>	
Vitalite	John Fay – Managing Director
M-KOPA	Pauline Githugu – Director for External Affairs
Azuri Technologies	Alexander Brummeler – Head of Finance Innovation Neil Halliday – Zambia Sales Operations Manager
Emerging Cooking Solutions	Mattias Ohlson – CEO
Ecozoom	Oli Raison – CEO
Radian Stores / Thunderbolt	Amrat Patel
Timbuktu Holdings	Nicole Marais
Fenix International	John Foye
A wide range of other local solar stakeholders through the Solar Association	
<i>Other stakeholders</i>	
Global Off-Grid Lighting Association (GOGLA)	Patrick Tonui – East Africa Regional Representative
International Growth Centre (IGC)	Miljan Sladoje – Country Economist, Zambia
International Institute for Sustainable Development (IISD)	Richard Bridle – Senior Policy Advisor

# Appendix B: Proposed wording for VAT and duties exemption

## VAT and import duty exemptions for off-grid solar

It is recommended that the following products are exempt from import duties and zero-rated for VAT. These substantive tax changes should be made as part of the process for approving the 2019 budget.

Note that where new codes are listed these are only suggested codes. We have identified what appears to be the most appropriate code in ZRA's January 2018 "Harmonised Commodity Description and Coding System Guide" which uses international HS codes as its basis. However, an alternative code could be used if deemed appropriate by Ministry of Finance and/or ZRA.

The "current status" column indicates the prevailing substantive tax rates and does not reflect temporary exemptions enacted by Statutory Instruments.

HS code	Existing code	New code	Product description	Current status
8513.10.10		✓	Solar lantern: a lamp with an inbuilt solar panel for charging an inbuilt battery	Code does not exist
8541.40.10		✓	Integrated solar-powered home systems <200 W, including all integrated solar panels, batteries for electricity storage, charge controller, LED lighting, and associated casing and cabling. <i>[Note this proposed code does not include any more sophisticated DC appliances contained in the box. Such appliances should be listed separately on customs invoices, whether or not an exemption applies. See below for suggested codes.]</i>	Code does not exist
8539.50.00	✓		LED lamps / lights	15% duty + VAT

Note that in addition to the items listed above, it might also be necessary to process exemptions for the following items, especially to the extent that the budget changes result in the existing SI 31 and SI 32 to be withdrawn. Note that these are not new exemptions that we are recommending – these products are already exempted through the existing SIs.

HS code	Existing code	New code	Product description	Current status
8504.40.00	✓		Charge control units and inverters	VAT only
8507.20.00	✓		*Lead acid battery	VAT only
8507.50.00	✓		*Nickel metal hydride battery	VAT only
8507.60.00	✓		*Lithium ion battery	VAT only
8539.31.00	✓		Bulbs and fluorescent tubes	15% duty + VAT
8541.40.00	✓		Solar PV module	VAT only
8419.19.10		✓	Solar geysers	Code does not exist, but a VAT exemption is granted through SI 32/2008

Items identified with a (\*) in the table above are items where a code does exist, but where it might be required to create a new code to limit the scope of the exemption granted. For example, if an exemption is only to be awarded for lithium ion batteries being used in conjunction with solar PV:

- An additional code could be defined for such batteries (e.g. 8507.60.20), and
- Guidance would need to be prepared for customs officials so that these batteries can be distinguished from lithium ion batteries used for other applications.

However, it is noted that the battery HS codes already have an exemption from import duties, although VAT applies in the substantive rates. Where VAT can be reclaimed by most energy sector participants, retaining the status quo for batteries would be acceptable in most cases.

The following table indicates a further set of DC appliances that could be granted exemptions:

HS code	Existing code	New code	Product description	Current status
8528.59.10		✓	*D.C. television	Code does not exist
8527.19.10		✓	*D.C. radio	Code does not exist
8414.59.10		✓	*D.C. fan	Code does not exist
8418.61.30		✓	*D.C. fridge or D.C. freezer	Code does not exist
8413.81.10		✓	*D.C. irrigation pump	Code does not exist

All of the codes listed above are new proposed codes but are subdivisions of existing H.S. codes. The existing parent codes all currently suffer VAT and either 15% or 25% import duties. If the

above codes and exemptions are introduced, they will need to be accompanied by guidance notes, which is again indicated by the asterisk, for customs officials so that they are able to distinguish between a D.C. appliance under the new H.S. code, and a traditional A.C. equivalent appliance.

**VAT exemptions for improve cookstoves**

It is also recommended that the following product is zero-rated for VAT. These substantive tax changes should be made as part of the process for approving the 2019 budget.

HS code	Existing code	New code	Product description	Current status
7321.19.00	✓		Solid fuel stoves	Standard rate
7321.11.00	✓		Gas fuel stoves	VAT only

# Endnotes and references

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