



Promoting Renewable Energy Services for Social Development in Sierra Leone

Baseline Data and Energy Sector Research

Final Report

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INTRODUCTION

This report details baseline and energy sector data for the project Promoting Renewable Energy Services for Social Development in Sierra Leone (PRESSD-SL), which is funded by the European Union (EU) and implemented by Welthungerhilfe (WHH) in partnership with Energy for Opportunity (ENFO), IBIS and COOPI. It draws on data collected in late 2014 and early 2015. The first objective of the research is to contribute to the broader discourse and understanding of rural energy in Sierra Leone. The existing literature on rural energy is either out-dated (e.g., Davidson, 1985; Kamara, 1986), or focused on energy needs for cooking (i.e., charcoal, firewood) (e.g., Munro & van der Horst, 2012). The data in this report is therefore critical to ensuring that broader project and policy interventions in the rural energy sector are well designed and effective. The second two objects of the research project, involve informing the project. This includes 1) providing a critical understanding of the social and economic characteristics of the project's target communities, and 2) providing baseline data to help measure future project impacts.

The following section outlines the research methodology of the project. This is followed by a series of sections which outline research findings thus far. Finally, a discussion is developed on how the data is relevant for the evaluation of the project, including specific links to the project's log frame.

RESEARCH METHODOLOGY

The research for this project involves data collection from household surveys, private sector surveys, charging station surveys, interviews with school staff, and interviews with health centre staff. Collectively, this data provides a detailed snapshot of energy use in household and community settings in rural Sierra Leone. Data collection took place in six districts in the north of the country: Port Loko, Kambia and Bombali; and three in the East: Kono, Kenema and Kailahun. District capital towns were excluded from data collection to maintain focus on rural areas. In total, 139 towns or villages were visited, in which 4,500 households were surveyed (60 households per Chiefdom headquarter town). 198 charging stations, 184 health facilities and 267 private sector businesses (e.g., shops, restaurants) were interviewed and 64 schools were visited.

A number of methodological challenges have been encountered in the project; the most serious of which being the Ebola virus disease (EVD) outbreak that has disrupted every sector in Sierra Leone since mid-2014. Due to travel restrictions, many Districts and Chiefdoms, which were a central part of the research project, became inaccessible. Schools across the country were closed for eight months, therefore making interviews with teachers and student surveys impossible. Education data has therefore been restricted to interviews with teachers in the Eastern District.

Figures 1-7 provide maps of the target districts and chiefdoms for the project, which are elaborated on throughout this report.

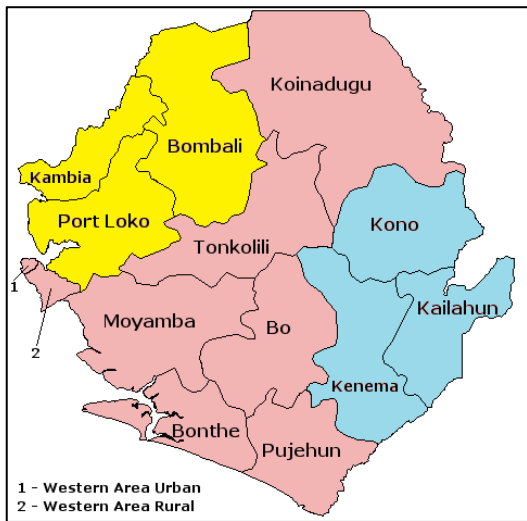


Figure 1 - Map of Districts targeted for the research. Yellow indicates districts surveyed in the northern region, blue indicates districts surveyed in the eastern region.

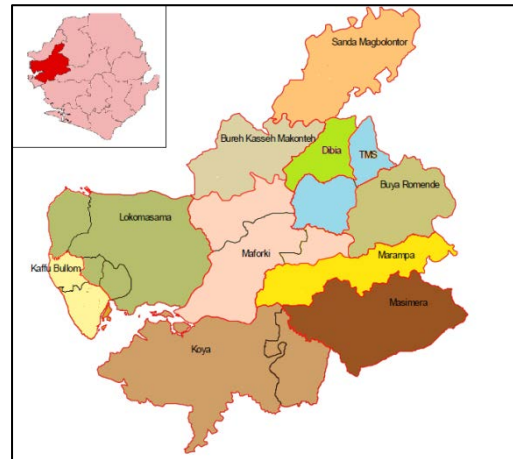


Figure 2 - Map of Port Loko Chiefdoms



Figure 3 - Map of Bombali Chiefdoms

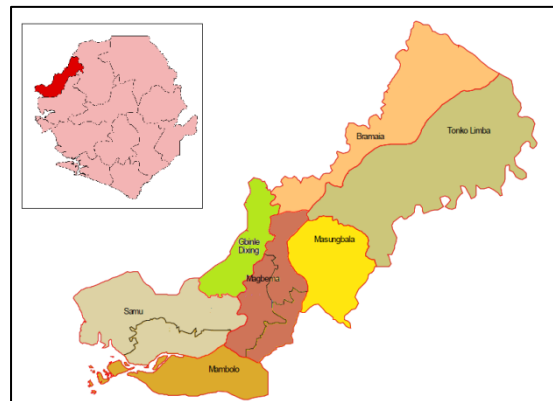


Figure 4 - Map of Kambia Chiefdoms



Figure 5 - Map of Kailahun District

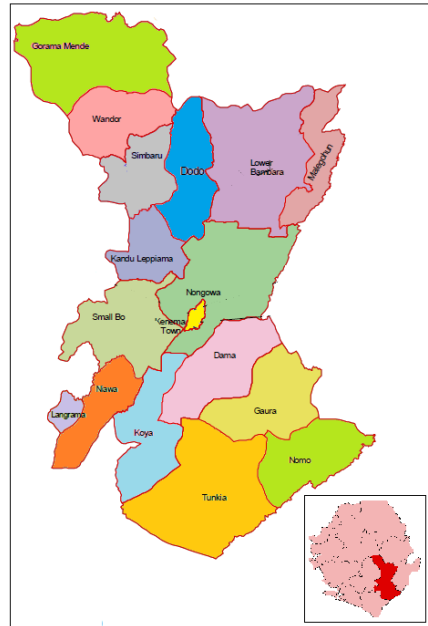


Figure 6 - Map of Kenema District



Figure 7 - Map of Kono District

THE 'AVERAGE' HOUSEHOLD

A vignette is presented here of what an average household – based on the 4500 households surveyed – looks like. It is important to emphasize that this is the average of the aggregate data, and therefore it is a statistical average, rather than an indication of what is 'normal'. There is, as the full report illustrates, great heterogeneity across and within villages. Nevertheless, this introduction helps to provide some insights in terms of what a beneficiary household might look like.

Approximately eleven people are likely to be resident in the average house – five of which are children – who collectively shared between them 5 bedrooms and 2 additional rooms. The walls of this house are made from mud (though some neighbours might have cement walls), while the roof is made from zinc. The main source of income and subsistence for the household is derived from farming, although it is highly likely that some of its members partake in forms of petty trading or other informal employment to supplement this base income. The household occupants would likely be growing cassava and rice and potentially groundnuts, yams and potatoes as well.

The main source of lighting for the house is battery powered torches. The house owns around five of these, and spends about 13% of its income buying batteries for the torches. A decade earlier, however, the main source of lighting in the house would have been kerosene lamps. The house also owns about three mobile phones, equating to approximately one mobile phone for every two adults, and spends roughly 7% of its income paying for the phones to be recharged at the local charging station. The only other (operating) electrical item in the household is a radio. No one in the household has ever used a computer or accessed the internet.

Water for the household is most likely to have been sourced by a village hand pump, although wells and taps might also be common in the village. The household, on rare occasions, might sometimes buy purified packets of water. Firewood is the main source of fuel for cooking, although a minority of neighbours might be starting to use charcoal as a cooking fuel.

HOUSEHOLD DATA – ECONOMIC ACTIVITY

Table 1 - Overview Household Data for the Districts

District:		Port Loko	Bombali	Kambia	Kenema	Kailahun	Kono
Main Economic Activity	shop	9%	4%	5%	3%	6%	1%
	office job	8%	2%	1%	0%	0%	0%
	farming	45%	72%	78%	93%	85%	94%
	teacher	6%	6%	3%	1%	3%	0%
	petty trade	25%	10%	12%	3%	3%	3%
	Other	7%	6%	1%	1%	3%	1%
Income Earners per Household		3.1	2.9	3.4	2.3	2.2	2.2
Percentage of Household Earning an Income		26%	23%	22%	24%	20%	24%
Recieves Remittances		34%	18%	29%	14%	25%	11%
Has Bank Account		28%	14%	17%	7%	35%	13%

Table 1 represents data from household surveys across the six districts. This data provides a broad proxy indicator for understanding how the district economies are structured.

It suggests that the districts in the east (Kenema, Kailahun, Kono) has much more agrarian economies than districts in the north. Port Loko District, however, is the most distinct in that it is the only district where a much smaller proportion of households site farming as the main source of income. This is almost certainly due to Port Loko District’s proximity to Western Area (where Freetown, the capital city, is located) which, by virtue of geography, offers opportunities for more diversified economic activities.

The last four indicators in Table 1 portray household economic vulnerability. These relate to household ‘fallback’ mechanisms to absorb economic ‘shocks’ that could include drought, crop failure, or the loss of a job. For example, a household with a higher percentage of income generating individuals is less vulnerable to economic shock if one person loses a job, compared to a household with a lower percentage of income generating individuals.

Remittances, and savings in the form of bank accounts, also represent financial capital that households can draw upon in times of hardship. This data is important, as the desirable impacts of promoting modern forms of energy in villages and chiefdoms should not solely seek to increase household incomes as an overall aggregate, but should also diversify village and chiefdom economies to ensure that they become more resilient against (natural and economic) disasters.

Port Loko

Table 2 - General Household Economic Data from Port Loko District

Town	Lunsar	Mange	Foredugu	Gbinti	Masiaka	Petifu	Rogbera	Mahera	Masimera	Sendugu	Malekuray	OVERALL	
Chiefdom	Marampa	Bureh Kaseh	Buya Romende	Debia	Koya	Loko Massama	Maforiki	Kaffu Bullom	Masimera	Sanda M.	TM Safroko		
Main Economic Activity	shop	20.0%	16.7%	18.3%	5.0%	11.7%	6.7%	8.3%	5.0%	2.1%	2.0%	0.0%	8.71%
	office job	25.0%	0.0%	8.3%	0.0%	18.3%	0.0%	26.7%	3.3%	4.3%	2.0%	0.0%	7.99%
	farming	8.3%	53.3%	30.0%	63.3%	20.0%	46.7%	15.0%	41.7%	85.1%	54.0%	81.7%	45.37%
	teacher	11.7%	11.7%	0.0%	5.0%	1.7%	8.3%	1.7%	5.0%	2.1%	10.0%	5.0%	5.65%
	petty trade	25.0%	15.0%	40.0%	16.7%	40.0%	26.7%	41.7%	33.3%	6.4%	24.0%	11.7%	25.49%
Other	10.0%	3.3%	3.3%	10.0%	8.3%	11.7%	6.7%	11.7%	0.0%	8.0%	1.7%	6.79%	
Income Earners per household	2.8	3.1	3.8	2.6	3.1	2.9	3.4	2.5	2.6	3.7	3.7	3.1	
Percentage of household earning an income	22%	23%	29%	22%	27%	26%	29%	23%	24%	29%	27%	26%	
Productive Bricolage	85%	65%	79%	78%	83%	82%	83%	83%	70%	100%	100%	83%	
Receives Remittances	25%	15%	15%	20%	22%	63%	18%	3%	23%	84%	83%	34%	
Has Bank Account	70%	5%	17%	8%	73%	38%	25%	2%	9%	56%	7%	28%	

As Table 2 indicates, there is great variation between the different towns in Port Loko district in terms of their economic activities. Chiefdom headquarter towns close to Western Area or along the main highway: Lunsar, Masiaka and Rogbera, have relatively small agrarian sectors with more diversified economies, while more remote towns: Gbinti, Masimera, Malekuray, Sendugu and Mange, are more reliant on agriculture. Mahera and Mange show high levels of household vulnerability, due to their relatively low percentage of household income generators, lack of remittances and low percentage of bank account use.

Bombali

Table 3 - General Household Economic Data from Bombali District

Town	Manonko	Kamabai	Gbanti	Gbendembu	Batkanu	Kagberak	Masongbo	Mapaki	Binkolo	Kamakwie	Kamalo	Mateboi	Fintonia	OVERALL	
Chiefdom	Bombali Shebora	Biriwa	Gbanti Kamaranka	Gbendembu Ngawahun	Libeisayghan	Magbaimba Ndowahun	Makari Gbanti	Paki Massabong	Safroko Limba	Sella Limba	Sanda Loko	Sanda Tenraren	Tambakha		
Main Economic Activity	shop	0.0%	5.0%	5.0%	3.3%	10.0%	0.0%	3.3%	0.0%	1.7%	16.7%	3.3%	0.0%	0.0%	3.72%
	office job	0.0%	0.0%	3.3%	3.3%	0.0%	0.0%	3.3%	1.7%	6.7%	9.0%	0.0%	0.0%	1.7%	2.23%
	farming	96.7%	56.7%	66.7%	58.3%	76.7%	93.3%	53.3%	61.7%	60.0%	46.7%	90.0%	91.7%	88.3%	72.31%
	teacher	1.7%	8.3%	6.7%	3.3%	3.3%	0.0%	16.7%	8.3%	11.7%	11.7%	3.3%	1.7%	1.7%	6.03%
	petty trade	1.7%	23.3%	13.3%	25.0%	8.3%	5.0%	16.7%	11.7%	3.3%	8.3%	3.3%	3.3%	3.3%	9.74%
Other	0.0%	6.7%	5.0%	6.7%	1.7%	1.7%	6.7%	16.7%	15.0%	5.0%	0.0%	3.3%	3.3%	5.52%	
Income Earners per household	3.7	2.6	2.9	2.6	2.5	2.2	3.8	3.3	2.8	2.8	2.9	2.6	3.2	2.9	
Percentage of household earning an income	28%	20%	26%	25%	25%	20%	21%	22%	21%	24%	22%	29%	21%	0.2	
Productive Bricolage	100%	70%	75%	98%	87%	75%	98%	95%	87%	83%	85%	92%	62%	85%	
Receives Remittances	0%	18%	8%	52%	15%	2%	25%	13%	20%	35%	10%	28%	2%	18%	
Has Bank Account	0%	25%	10%	20%	3%	3%	27%	10%	37%	35%	12%	2%	0%	14%	

Table 3 shows that, although less acute than in Port Loko, there is considerable variation between towns in Bombali District in terms of village level economies. Kamakwie, the largest city outside of the district capital Makeni, has the lowest economic reliance on agriculture, while some of the smaller chiefdom headquarter towns, such as Manonko and Kagberak, have a stronger reliance of agriculture for subsistence. Although in Manonko, all households maintain some form of an income outside of the agriculture sector (i.e., productive bricolage), with a high number of income earners per household. This is an important factor, considering the overall lack of remittances coming into the community. Overall, remittances and bank account use varied greatly across the different headquarter towns.

Kambia

Table 4 - General Household Economic Data from Bombali District

Town		Kawula	Kakuna	Kychom	Madina	Mambolo	Rokupr	Tawuya	OVERALL
Chiefdom		Masungbala	Briama	Samu	Tonko Limba	Mambolo	Magbema	Gbinle Dixing	
Main Economic Activity	shop	1.7%	8.3%	1.7%	13.3%	0%	10%	0%	5.0%
	office job	1.7%	0%	0%	0%	0%	5%	0%	1.0%
	farming	85%	66.7%	96.7%	71.7%	90%	51.7%	83.3%	77.9%
	teacher	1.7%	3.3%	0%	8.3%	0%	1.7%	6.7%	3.1%
	petty trade	6.7%	18.3%	1.7%	6.7%	10%	30%	10%	11.9%
	Other	3.3%	3.3%	0%	0%	0%	1.7%	0%	1.2%
Income Earners per household		3.2	4.0	2.8	3.1	3.7	3.7	3.1	3.4
Percentage of household earning an income		21%	22%	22%	25%	20%	22%	24%	22%
Productive Bricolage		91.7%	96.7%	91.7%	93.3%	98.3%	90%	65%	90%
Receives Remittances		18%	62%	37%	30%	13%	12%	32%	29%
Has Bank Account		10%	10%	10%	62%	8%	13%	7%	17%

Kambia is relatively homogenous in terms of village-level economies, with agriculture being the dominant economic activity in all villages. Larger towns, however, such as Rokupr, Madina and Kakuna, have reasonable diversification into other sectors. In terms of vulnerability, the villages are similar on most indicators, with the exception of Madina, which has high bank account ownership. This is likely a result of a project being established and the promotion of a community bank in early 2014 (see MAFF Press Unit, 2014). There is significant disparity between villages on the remittances received.

Kenema

Table 5 - General Household Economic Data from Kenema District

Town		Baoma	Blama	Boajibu	Dodo	Faala	Faama	Glema	Gorahun	Joru	Gbado	Hanga	Panguma	Sembehun	Sundume	Tungie	Ya Baiima	OVERALL
Chiefdom		Koya	Small Bo	Simbaru	Dodo	Wandor	Nomo	Dama	Tunkia	Gaura	Kandu Leppiam	Nongowa	Lower Bambara	Malegohun	Niawa	Gorama Mende	Langurama	
Main Economic Activity	shop	2%	2%	8%	4%	2%	0%	2%	0%	2%	5%	12%	2%	0%	0%	3%	2%	3%
	office job	0%	0%	0%	2%	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0%	0%
	farming	93%	90%	83%	86%	92%	98%	97%	100%	98%	93%	85%	83%	98%	100%	92%	98%	93%
	teacher	2%	0%	0%	2%	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	5%	0%	1%
	petty trade	3%	8%	3%	4%	7%	2%	2%	0%	0%	2%	3%	8%	0%	0%	0%	0%	3%
	Other	0%	0%	5%	2%	0%	0%	0%	0%	0%	0%	0%	3%	2%	0%	0%	0%	1%
Income earners per household		2.1	2.4	2.1	1.9	3.3	1.7	2.4	2.5	1.9	2.6	2.4	2.6	2.1	2.2	2.3	2.1	2.3
Percentage of household earning income		22%	19%	24%	23%	42%	23%	22%	22%	19%	27%	21%	19%	24%	26%	29%	33%	25%
Receives Remittances		3%	5%	10%	36%	0%	3%	5%	50%	2%	12%	33%	33%	10%	14%	2%	12%	14%
Has Bank Account		0%	3%	13%	16%	0%	0%	0%	28%	0%	2%	2%	22%	0%	18%	7%	3%	7%

As Table 5 shows, agriculture is a dominant industry across all villages in Kenema. Villages close to the district capital, however, such as Lower Bambara, Dodo, Nongowa and Small Bo, tend to have slightly more diversified economies. In terms of vulnerability, there was great dynamics between the villages. In Dodo, although none of the households reported receiving remittances or having bank accounts, there was a high percentage of household members earning an income (42%). In contrast, Panguma had a small proportion of income earners (19%) but a high percentage of households (33%) received remittances.

Kailahun

Table 6 - General Household Economic Data from Kailahun District

Town	Baiwala	Bandajuma	Bueda	Bunumba	Daru	Dea	Jojoima	Kangama	Manowa	Mobai	N'geihun	Pendembu	Sandaru	Segbwema	OVERALL	
Chiefdom	Dea	Yawei	Kissi Tongi	Peje West	Jawe	Kissi Kama	Malema	Kissi Teng	Peje Bongre	Mandu	Luawa	Upper Bambara	Penguia	Jaluhun		
Main Economic Activity	shop	3.33%	1.67%	3.33%	3.33%	3.33%	8.33%	5.00%	13%	11.67%	5.00%	6.67%	0.00%	11.67%	5.71%	
	office job	0.00%	0%	0%	2%	0%	0%	0.00%	0%	1.67%	0.00%	0.00%	0%	1.67%	0.36%	
	farming	88.33%	90.00%	90.00%	78.33%	93.33%	83.33%	91.67%	92%	78.33%	87%	92%	90%	100.00%	39%	85.16%
	teacher	3.33%	1.67%	6.67%	10.00%	0.00%	6.67%	0.00%	0	0%	0.00%	1.67%	0.00%	0.00%	16.67%	3.33%
	petty trade	1.67%	0.00%	0.00%	0.00%	0.00%	6.67%	0.00%	3%	5.00%	0%	2%	3%	0.00%	23.33%	3.21%
	Other	3.34%	6.67%	6.67%	6.68%	3.34%	0.00%	0.00%	0.00%	1.67%	0.00%	0.00%	0.00%	0.00%	6.67%	2.50%
Income earners per household	1.9	1.8	1.7	2.7	2.1	2.6	3.1	2.1	2.4	2.3	1.9	2.1	2.1	2.4	2.2	
Percentage of household earning income	15%	23%	11%	26%	17%	37%	23%	23%	25%	15%	21%	17%	21%	17%	21%	
Receives Remittances	12%	0%	2%	47%	33%	65%	13%	42%	35%	15%	7%	15%	0%	60%	25%	
Has Bank Account	15%	52%	22%	37%	27%	52%	18%	47%	52%	35%	8%	32%	12%	80%	35%	

As Table 6 shows, agriculture is a dominant industry across all villages in Kailahun. The notable exception is Segbwema, which has a high number of households (23.33%) involved in petty trading as their main source of income. This is likely a result of Segbwema being a relatively large trading town (~16,000 people); it also should be noted, although most households did not list agriculture as their *main* source of income, all households in Segbwema stated that they were involved in subsistence agriculture. In terms of vulnerability, Bueda in the chiefdom of Kissi Tongi, appears to be most concerning, with a low number of incomes earners per household (1.7) and a low level of remittances (2% of households). In contrast Dea, in Kissia Kama Chiefdom, had 2.6 people per household bringing in an income, and over 65% of households received remittances.

Kono

Table 7 - General Household Economic Data from Kono District

Town	Baima	Ngandorhun	Jaiama	Kainkorda	Kamiendor	Kangama	Kayima	Koakor	Koardu	Kondewokor	Njagbwema	Njaiama	Siam	Tumbudu	OVERALL	
Chiefdom	Tankoro	Gbane	Nimiyama	Soa	Mafidor	Gorama Komo	Sandor	Gbense	Gbane Kandor	Toli	Fiama	Nimikoro	Lei	Kamara		
Main Economic Activity	shop	0.00%	0.00%	1.67%	0.00%	0.00%	8.33%	0%	1.67%	0%	0%	7%	0%	0	1.31%	
	office job	0.00%	0%	0.00%	0.00%	0.00%	0	0.00%	0.00%	0.00%	0.00%	2%	2%	1.67%	0.36%	
	farming	100.00%	96.67%	86.67%	95.00%	100%	96.67%	88%	100.00%	96.67%	100.00%	100.00%	80%	88%	86.67%	93.93%
	teacher	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0%	0.00%	0%	0%	0%	2%	2%	0.24%
	petty trade	0.00%	3.33%	11.67%	3.33%	0%	1.67%	3.33%	0.00%	1.67%	0.00%	0.00%	8%	7%	8.33%	3.45%
	Other	0.00%	0.00%	0.00%	1.67%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	3.33%	1.67%	1.67%	0.60%
Income earners per household	2.3	2.4	2.4	2.2	2.2	2.4	2.4	2.1	2.4	2.1	1.9	2.5	2.1	2.1	2.2	
Percentage of household earning income	24%	26%	18%	25%	25%	24%	28%	22%	29%	29%	19%	23%	27%	22%	24%	
Receives Remittances	0%	5%	5%	2%	0%	5%	7%	37%	2%	0%	0%	53%	5%	27%	11%	
Has Bank Account	25%	3%	23%	0%	0%	12%	0%	22%	5%	3%	3%	53%	2%	25%	13%	

Agriculture is also a dominant industry across Kono District, with the chiefdoms close to the Guinea border in particular, being heavily reliant on farming as a main source of income. Nimikoro has the most diverse economy, perhaps as a result of its close proximity to the district capital. In terms of household vulnerability, Njagbwema and Jaiama appear to be the worst off, with low levels of employed members per household, and low levels of remittances received.

HOUSEHOLD DATA – AGRARIAN ACTIVITY

Table 8 - Farming sector comparisons across the six districts

District:	Port Loko	Bombali	Kambia	Kenema	Kailahun	Kono	
Practices Subsistence Farming	86%	97%	92%	94%	99%	98%	
Main Crops	cassava	64%	46%	39%	73%	67%	65%
	yam	3%	3%	2%	52%	49%	62%
	Potato	36%	29%	31%	46%	41%	41%
	Maize	24%	8%	2%	15%	6%	19%
	Pepper	13%	21%	24%	13%	9%	16%
	Vegetables	4%	4%	12%	29%	31%	23%
	Groundnut	42%	75%	32%	36%	36%	22%
	Rice	59%	66%	80%	49%	52%	67%
	Other*	19%	14%	21%	18%	26%	17%
*Includes millet, beans, okra among others							

Table 8 provides a comparison of the main agricultural crops across the three districts. Subsistence farming is important in all three districts, even in Port Loko despite a slightly more diversified economy. There is some variation in the crops produced, with maize being more prominent in Port Loko, rice in Kambia and in Bombali; while cassava and yam are much more prominent in the eastern districts. The village breakdowns displayed in the Tables below provide further insight into these variations.

Port Loko

Table 9 - Breakdown of the farming sector in Port Loko

Town	Lunsar	Mange	Foredugu	Gbinti	Masiaka	Petifu	Rogbera	Mahera	Masimera	Sendugu	Malekuray	OVERALL
Chiefdom	Marampa	Bureh Kaseh	Buya Romende	Debia	Koya	Loko Massama	Maforki	Kaffu Bullom	Masimera	Sanda M.	TM Safroko	
Subsistence Farming	43.0%	92.0%	83.0%	78.0%	82.0%	90.0%	88.0%	98.0%	100.0%	98.0%	95.0%	86%
What Crops	cassava	65.2%	67.0%	76.0%	68.0%	67.3%	45.3%	85.0%	60.0%	40.8%	70.2%	64%
	Potato	30.4%	49.0%	61.0%	32.0%	20.4%	16.7%	60.4%	68.0%	14.9%	12.2%	36%
	Maize	30.4%	18.0%	6.0%	2.0%	79.6%	22.2%	49.1%	29.0%	19.2%	4.1%	24%
	Pepper	4.3%	11.0%	8.0%	0.0%	0.0%	22.2%	17.0%	0.0%	40.4%	22.5%	13%
	Groundnut	30.4%	24.0%	35.0%	21.0%	75.5%	57.4%	67.9%	15.0%	54.8%	51.0%	42%
	Rice	69.6%	33.0%	80.0%	79.0%	20.4%	46.3%	41.5%	24.0%	81.0%	91.8%	59%
	Other	13.0%	42.0%	20.0%	33.0%	10.2%	33.0%	9.4%	70.0%	7.1%	32.6%	26%

Subsistence farming is prominent in all the villages of Port Loko, with the exception of Lunsar, where only 43% of households reported subsistence farming. This is lower than all other villages surveyed and indicates the diversification of its economy into other sectors. While all villages reported growing a wide variety of crops, there were regional variations. Chiefdoms in the east of Port Loko (i.e., Sanda Magbolontor; Debia; TM Safroko; Buya Romende; Marampa and Masimera) grow more rice; while Chiefdoms in the west grow more groundnut. The northern chiefdom of Bureh Kaseh is the anomaly, growing more yam (11% of farmers) and millet (16% of farmers), a crop that is rare in the rest of the District. The latter could be due to close proximity to Kambia (see Table 8) which also grows millet, indicating that this is likely a millet producing region in Sierra Leone.

Bombali

Table 10 - Breakdown of the farming sector in Bombali

Town	Manonko	Kamabai	Gbanti	Gbendembu	Batkanu	Kagberak	Masongbo	Mapaki	Binkolo	Kamakwie	Kamalo	Mateboi	Fintonia	OVERALL	
Chiefdom	Bombali Shebora	Biriwa	Gbanti Kamaranka	Gbendembu Ngowahun	Libeisaygahun	Magbajamba Ndownahun	Makari Gbanti	Paki Massabong	Safroko Limba	Sella Limba	Sanda Loko	Sanda Tenraren	Tambakha		
Subsistence Farming	100%	90%	95%	100%	100%	100%	93%	98%	93%	97%	100%	100%	100%	97%	
What Crops	Cassava	90%	30%	17%	32%	31.67%	38%	68.33%	82%	45%	42%	22%	62%	33%	46%
	Potato	68%	32%	0%	15%	26.67%	15%	78.33%	45%	32%	20%	7%	25%	8%	29%
	Maize	7%	10%	0%	5%	11.67%	8%	0.00%	10%	7%	20%	5%	13%	8%	8%
	Pepper	7%	10%	43%	22%	30.00%	12%	10.00%	7%	7%	8%	42%	25%	45%	21%
	Groundnut	50%	73%	88%	83%	75.00%	87%	65.00%	58%	77%	70%	95%	68%	90%	75%
	Rice	80%	40%	53%	58%	63.33%	80%	56.67%	72%	60%	45%	82%	80%	88%	66%
	Other	29%	22%	25%	28%	25%	15%	10%	15%	15%	25%	17%	25%	25%	21%

The production of crops is relatively diverse in Bombali, with potato being more common in the southern chiefdoms. Batkanu was also a major producer of okra, while Mateboi produced large amounts of eggplant.

Kambia

Table 11 - Breakdown of the farming sector in Kambia

Town	Kawula	Kakuna	Kychom	Madina	Mambolo	Rokupr	Tawuya	OVERALL	
Chiefdom	Masungbala	Briama	Samu	Tonko Limba	Mambolo	Magbema	Gbinle Dixing		
Subsistence Farming	93%	92%	98%	93%	95%	80%	95%	92%	
What Crop	cassava	72%	17%	10%	33%	41.67%	33.33%	68.33%	39%
	Potato	58%	3%	20%	20%	35.00%	28.33%	53.33%	31%
	Maize	5%	0%	0%	7%	0.00%	5.00%	0.00%	2%
	Pepper	18%	65%	38%	15%	6.67%	8.33%	15.00%	24%
	Groundnut	22%	83%	2%	68%	20.00%	1.67%	28.33%	32%
	Rice	70%	87%	98%	63%	88.33%	61.67%	90.00%	80%
	Millet	15%	23%	0%	28%	0.00%	0.00%	18.33%	12%
Other	35%	7%	18%	23%	25%	30%	25%	23%	

Table 11 indicates that in Kambia there is some crop variation. Millet is grown exclusively in the northern chiefdoms of the district. Rice production tends to be more prominent in the southern chiefdoms.

Kenema

Table 12 - Breakdown of the farming sector in Kenema

Town	Baoma	Blama	Boajibu	Dodo	Faala	Faama	Giema	Gorahun	Joru	Gbado	Hanga	Panguma	Sembehun	Sundumei	Tungie	Ya Baiima	OVERALL	
Chiefdom	Koya	Small Bo	Simbaru	Dodo	Wandor	Nomo	Dama	Tunkia	Gaura	Kandu Leppiam	Nongowa	Lower Bambara	Malegohun	Niawa	Gorama Mende	Langurama		
Practices Subsistence Farming	93%	98%	85%	88%	97%	100%	98%	100%	100%	97%	88%	90%	98%	100%	95%	78%	94%	
Main Crops	cassava	43%	73%	62%	74%	80%	60%	78%	92%	93%	68%	68%	70%	73%	65%	72%	95%	73%
	yam	30%	33%	45%	46%	73%	40%	62%	70%	52%	48%	43%	42%	67%	63%	42%	75%	52%
	Potato	20%	53%	38%	36%	43%	43%	50%	43%	65%	53%	52%	57%	68%	43%	12%	63%	46%
	Maize	22%	27%	20%	10%	22%	30%	17%	10%	23%	18%	7%	3%	10%	12%	0%	3%	15%
	Pepper	13%	18%	5%	0%	35%	27%	20%	17%	20%	12%	17%	3%	0%	3%	18%	2%	13%
	Vegetables	27%	32%	35%	22%	30%	52%	38%	20%	40%	45%	40%	15%	17%	18%	5%	27%	29%
	Groundnut	55%	38%	35%	12%	42%	38%	48%	45%	55%	45%	23%	28%	17%	20%	33%	45%	36%
	Rice	70%	40%	57%	34%	53%	70%	73%	23%	50%	42%	38%	47%	33%	52%	72%	37%	49%
Other	45%	30%	18%	14%	27%	28%	28%	17%	17%	7%	10%	5%	5%	8%	18%	13%	18%	

Cassava is the dominant crop grown in the Kenema district, especially in the south of the district; however, yam, maize and rice are also prominent.

Kailahun

Table 13 - Breakdown of the farming sector in Kailahun

Town	Baiwala	Bandajuma	Bueda	Bunumba	Daru	Dea	Jojoima	Kangama	Manowa	Mobai	N'geihun	Pendembu	Sandaru	Segbwema	OVERALL	
Chiefdom	Dea	Yawei	Kissi Tongi	Peje West	Jawe	Kissi Kama	Malema	Kissi Teng	Peje Bongre	Mandu	Luawa	Upper Bambara	Penguia	Jalauhun		
Practices Subsistence Farming	100%	100%	97%	98%	100%	100%	100%	93%	100%	98%	100%	98%	100%	100%	99%	
Main Crops	cassava	87%	50%	73%	68%	88%	73%	85%	37%	68%	77%	83%	75%	35%	40%	67%
	yam	67%	85%	57%	57%	20%	28%	53%	12%	62%	73%	55%	50%	62%	12%	49%
	Potato	50%	25%	65%	45%	0%	30%	47%	33%	33%	57%	52%	48%	48%	45%	41%
	Maize	0%	0%	7%	13%	5%	3%	2%	7%	2%	5%	2%	7%	12%	15%	6%
	Pepper	0%	0%	7%	2%	0%	22%	3%	27%	8%	7%	5%	3%	43%	0%	9%
	Vegetables	2%	28%	13%	55%	70%	20%	38%	27%	40%	23%	37%	20%	0%	67%	31%
	Groundnut	40%	18%	43%	25%	85%	55%	18%	60%	28%	35%	35%	25%	7%	23%	36%
	Rice	90%	72%	27%	32%	15%	85%	60%	27%	55%	57%	53%	53%	93%	5%	52%
	Other	3%	55%	30%	10%	25%	55%	5%	47%	13%	15%	20%	10%	77%	0%	26%

Almost all households surveyed across Kailahun are involved in subsistence farming. No single crop dominates farming; however, cassava, yam, potato and rice are common throughout the district. Groundnut farming is most common in the north of the district, while rice farming tended to be more common in districts bordering Guinea.

Kono

Table 14 - Breakdown of the farming sector in Kono

Town	Baima	Ngandorhun	Jaiama	Kainkorda	Kamiendor	Kangama	Kayima	Koakor	Koardu	Kondewokor	Njagbwema	Njaiama	Sama	Tumbudu	OVERALL	
Chiefdom	Tankoro	Gbane	Nimiyama	Soa	Mafidor	Gorama Komo	Sandor	Gbense	Gbane Kandor	Toi	Fama	Nimikoro	Lei	Kamara		
Practices Subsistence Farming	100%	98%	97%	95%	100%	98%	95%	98%	97%	100%	100%	93%	97%	98%	98%	
Main Crops	cassava	68%	75%	80%	70%	48.33%	82%	61.67%	75%	57%	48%	22%	77%	67%	73%	65%
	yam	65%	82%	63%	68%	73.33%	75%	58.33%	45%	52%	43%	78%	58%	60%	48%	62%
	Potato	42%	75%	27%	67%	35.00%	57%	43.33%	38%	48%	22%	17%	33%	38%	38%	41%
	Maize	17%	38%	3%	18%	23.33%	37%	30.00%	8%	32%	7%	7%	2%	18%	22%	19%
	Pepper	18%	17%	2%	7%	20.00%	20%	21.67%	10%	10%	7%	58%	23%	12%	2%	16%
	Vegetables	5%	22%	27%	28%	35.00%	25%	21.67%	18%	12%	8%	68%	10%	27%	22%	23%
	Groundnut	17%	30%	7%	33%	41.67%	22%	30.00%	15%	40%	18%	5%	3%	37%	8%	22%
	Rice	78%	60%	53%	87%	85.00%	55%	86.67%	77%	77%	62%	33%	67%	82%	32%	67%
	Other	20%	15%	12%	8%	8%	15%	17%	47%	22%	7%	18%	12%	32%	12%	17%

Cassava, yam, and rice were the most prominent crops in Kono District. Gorama Komo and Mafidor Chiefdoms in particular, had great diversity in terms of the crops produced at household level.

HOUSEHOLD DATA – LIGHTING USE

Table 15 - Household lighting use across the six districts

District	Port Loko	Bombali	Kambia	Kenema	Kailahun	Kono	Overall
Main source of lighting	Kerosene Lamp	0.7%	0.3%	0.5%	0.0%	0.2%	1.6%
	Candles	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Battery Powered Light	93.5%	97.8%	99.3%	99.2%	98.8%	96.8%
	solar home lighting system	0.3%	0.5%	0.0%	0.0%	0.0%	0.1%
	generator and lights	5.5%	1.4%	0.2%	0.8%	1.0%	1.5%
Secondary source of lighting	Kerosene Lamp	2.8%	0.5%	1.4%	0.0%	0.0%	2.9%
	Candles	0.0%	0.1%	0.0%	0.0%	0.1%	0.1%
	Battery Powered Light	85.0%	94.1%	91.9%	98.3%	93.0%	93.4%
	solar home lighting system	0.0%	0.4%	0.0%	0.0%	0.0%	0.1%
	generator and lights	12.2%	4.6%	6.7%	1.7%	6.9%	5.6%
Lighting cost as a % of income	14.9%	12.0%	10.0%	10.5%	16.9%	11.4%	12.7%

Household lighting was used consistently across almost all of the villages, with battery powered lights being the dominant source of lighting in at least 90% of households in each of the villages surveyed. The only exception was Lunsar, where there was a remarkably high use of generators (48%). Interestingly, generators (when owned by households) were more commonly a secondary source of lighting, rather than a primary source. This is likely due to their high running costs, as well as their propensity for breaking down. Solar power, overall, has very little penetration in terms of being a household energy source. The cost of lighting, on average, occupied between 10-15% of household incomes. Households using generators were found to spend a greater proportion of their income (upward of 20%) on lighting.

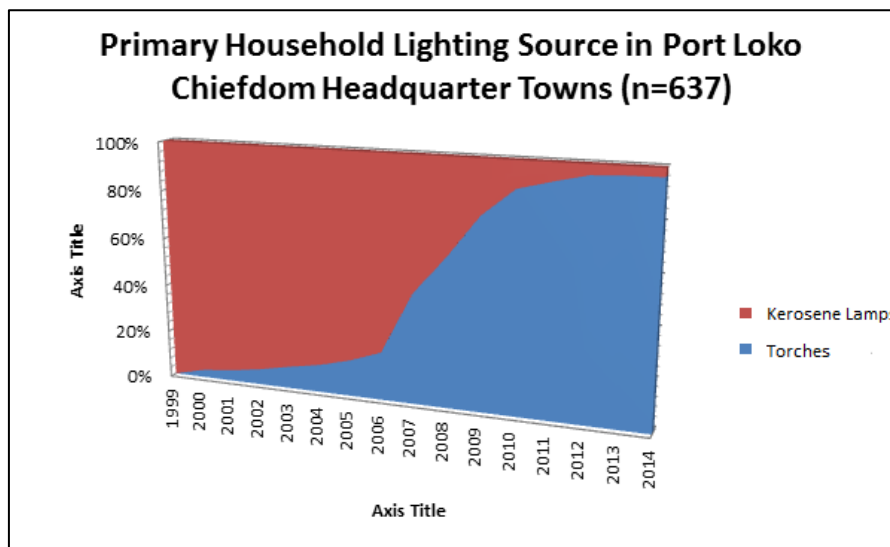


Figure 8 - Transition from Kerosene Lamps to Battery Power Torches in Port Loko District

The most remarkable aspect of the rural lighting market is the dominance of battery powered lights (see Figure 9). This was not always the case; in the 1990s kerosene lamps, which are now almost non-existent as a lighting source, were the dominant lighting source at household level. The transition has occurred due to increasing availability of torches and batteries in rural markets, as well as fluctuating availability of kerosene. Battery torches also provide better light than kerosene lamps and are therefore seen as a more advanced technology. Figure 8 draws on project data, and shows the gradual transition to battery torches in Port Loko, from 1999 to 2014. This transition is relevant for the project's work with disseminating LED lamps, as it indicates that people like the lamp/torch design; but also that they are open to energy transitions. The torches are both commercially made and homemade, and usually operate with D-sized batteries, which cost between SLL1,500 and SLL2,000 (up to SLL4,000 in some remote communities).



Figure 9 - Rural Lighting - Torch

HOUSEHOLD DATA – ICT USE

Table 16 - ICT use comparison across the six districts

District	Port Loko	Bombali	Kambia	Kenema	Kailahun	Kono	Overall
Mobile phones per adult	0.64	0.56	0.57	0.46	0.54	0.42	0.52
Phone Charging as a % of income	7.73%	5.54%	10.14%	6%	9%	6%	0.066667
Mobile Charging and Lighting as a % of income	22.64%	17.54%	20.14%	16.88%	25.57%	17.29%	0.193733
Used a computer	12.60%	9.90%	10.10%	3.00%	10.47%	3.83%	7.73%
Used Internet	12.50%	7.50%	8.60%	8.31%	9.70%	3.45%	8.21%

Table 16 provides an overview of Internet and communication technology (ICT) use across the six districts. Mobile phone ownership is relatively high across the districts – ownership being slightly higher in the northern Districts in comparison to the more remote Eastern Districts. On average, at least one in two adults own and use a mobile phone. This explains why mobile phone charging absorbs a substantial proportion of household incomes (between 5% and 10%). Combined, the cost of mobile phone charging and household lighting, amounts to approximately one fifth of overall household income (varying considerably between villages, see below) and represents a sizeable potential market for solar enterprise to enter. Computer and Internet use was relatively low across all districts, with Port Loko being slightly higher, due to its more diversified economy. This percentage difference is mainly due to a couple of towns (see Table 17). It should be noted that computer use is not a prerequisite for accessing the Internet, as increasingly people are accessing internet through mobile phones. In Africa, especially, it is increasingly likely that people will first encounter the internet on a mobile phone rather than a computer (Bornman, 2012).

Port Loko

Table 17 - ICT use in Port Loko District

Town	Lunsar	Mange	Foredugu	Gbinti	Masiaka	Petifu	Rogbera	Mahera	Masimera	Sendugu	Malekuray	OVERALL
Chiefdom	Marampa	Bureh Kaseh	Buya Romende	Debia	Koya	Loko Massama	Maforki	Kaffu Bullom	Masimera	Sanda M.	TM Safroko	
Used computer	57%	2%	5%	5%	43%	0%	15%	0%	6%	6%	0%	13%
Used internet	47%	2%	2%	12%	45%	2%	5%	0%	4%	8%	10%	12%
Mobile phones per adult	1.01	0.49	0.72	0.74	0.93	0.47	0.77	0.54	0.46	0.46	0.44	0.64
Recharge Mobile at home	22%	0%	2%	0%	12%	0%	1.67%	0%	0%	0%	0%	3%
Phone charging as a % of income	6%	8%	6%	13%	5%	6%	7%	10%	5%	9%	10%	8%
Phone and Lighting as a % of income	23%	20%	18%	34%	14%	20%	20%	21%	17%	28%	34%	23%

In Port Loko District, larger, more economically diversified, towns of Lunsar and Masiaka have considerably higher usage rates of computers, Internet and mobile phones. Furthermore, due to the higher presence of generators in these towns, a relatively high proportion of the population is able to recharge their mobile phones at home or work, rather than using a charging station. Gbinti, Sendugu and Malekuray spend approximately one third of their overall household income on mobile

phone charging and household lighting. This presents potentially lucrative sites for selling micro-solar products such as LED lamps and solar home systems.

Bombali

Table 18 - ICT use in Bombali District

Town	Manonko	Kamabai	Gbanti	Gbendembu	Batkanu	Kagberak	Masongbo	Mapaki	Binkolo	Kamakwie	Kamalo	Mateboi	Fintonia	OVERALL
Chiefdom	Bombali Shebora	Biriwa	Gbanti Kamaranka	Gbendembu Ngowahun	Libeisyagahun	Magbaimba Ndowahun	Makari Gbanti	Paki Massabong	Safroko Limba	Sella Limba	Sanda Loko	Sanda Tenraren	Tambakha	
Used computer	0%	13%	12%	7%	5%	0%	7%	25%	23%	28%	2%	3%	3%	10%
Used internet	0%	8%	8%	10%	5%	0%	5%	7%	23%	23%	2%	5%	2%	7%
Mobile phones per adult	0.34	0.71	0.44	0.66	0.68	0.37	0.49	0.68	0.66	0.77	0.51	0.51	0.48	0.56
Recharge Mobile at home	0%	2%	0%	0%	3%	1.67%	3.20%	1.67%	3%	2%	0%	0%	0%	1%
Phone charging as a % of income	3%	11%	4%	5%	5%	5%	6%	5%	7%	6%	6%	4%	5%	6%
Phone and Lighting as a % of income	15%	28%	15%	15%	15%	17%	20%	15%	20%	17%	17%	15%	19%	18%

The larger towns of Binkolo and Kamakwie have relatively high access or use of computers, internet and mobile phones. In Mononko and Kagberak computer and Internet use and access was non-existent among those surveyed, and mobile phone ownership was relatively low. This explains why mobile phone recharging accounted for a comparatively small percentage of most household incomes in these two villages. Overall mobile phone ownership is lower in Bombali than Port Loko, therefore resulting in a lower percentage of household income spent on mobile phone recharging. The combined expenditure on phone recharging and lighting is still considerable, with Kamabai presenting a lucrative market (which perhaps helps to explain the high success of the community charging station that was installed there as few years ago (see Kemeny et al., 2014)).

Kambia

Table 19 - ICT use in Kambia District

Town	Kawula	Kakuna	Kychom	Madina	Mambolo	Rokupr	Tawuya	OVERALL
Chiefdom	Masungbala	Briama	Samu	Tonko Limba	Mambolo	Magbema	Gbinle Dixing	
Used computer	2%	13%	7%	12%	12%	22%	3%	10%
Used internet	3%	2%	7%	8%	12%	25%	3%	9%
Mobile phones per adult	0.38	0.50	0.55	0.79	0.54	0.71	0.49	0.57
Recharge Mobile at home	0%	0%	5%	0%	0%	0%	0%	1%
Phone charging as a % of income	3%	5%	5%	5%	6%	7%	5%	5%
Phone and Lighting as a % of income	13%	15%	13%	14%	19%	16%	16%	15%

Kambia has a low variation of ICT access at the village level. The main exceptions being that Kawula and Tawuya have relatively low access to computers, Internet and mobile phones, while the larger town of Rokupr has relatively high access. The percentage of income spent on lighting and mobile phone recharging is the lowest amongst the districts, but nevertheless it is still considerable, especially in the town of Mambolo.

Kenema

Table 20 - ICT use in Kenema District

Town	Baoma	Blama	Boajibu	Dodo	Faala	Faama	Giema	Gorahun	Joru	Gbado	Hanga	Panguma	Sembahun	Sundumei	Tungie	Ya Baiima	OVERALL
Chiefdom	Koya	Small Bo	Simbaru	Dodo	Wandor	Nomo	Dama	Tunkia	Gaura	Kandu Leppiam	Nongowa	Lower Bambara	Malegohun	Niawa	Gorama Mende	Langurama	
Used computer	3%	2%	3%	12%	0%	0%	0%	3%	3%	2%	3%	7%	2%	0%	5%	3%	3%
Used internet	12%	7%	15%	12%	7%	3%	5%	7%	12%	13%	12%	15%	7%	0%	3%	3%	8%
Mobile phones per adult	0.47	0.48	0.66	0.51	0.40	0.12	0.36	0.43	0.35	0.65	0.63	0.47	0.47	0.43	0.42	0.58	0.46
Recharge mobile at home	0%	2%	0%	0%	0%	0%	0%	0%	0%	3%	2%	2%	0%	0%	0%	0%	1%
Phone charging as % of income	6%	9%	7%	6%	5%	5%	6%	7%	6%	5%	8%	9%	7%	6%	5%	5%	6%
Phone charging + lightinh as % of income	17%	23%	17%	14%	14%	15%	19%	22%	15%	15%	17%	21%	17%	16%	16%	12%	17%

Figures for ICT access in Chiefdoms across Kenema were fairly consistent, with overall low levels of computer and/or Internet access, with approximately 0.46 mobile phones per adult. Faama village was a notable outlier with just 0.12 mobile phones per adult, perhaps a result of its remote location near the Liberia border, where there is little mobile phone connection.

Table 21 - ICT use in Kailahun District

Town	Baiwala	Bandajuma	Bueda	Bunumba	Daru	Dea	Jojoima	Kangama	Manowa	Mobai	N'geihun	Pendembu	Sandaru	Segbwema	OVERALL
Chiefdom	Dea	Yawei	Kissi Tongi	Peje West	Jawe	Kissi Kama	Malema	Kissi Teng	Peje Bongre	Mandu	Luawa	Upper Bambara	Penguia	Jaluhun	
Used computer	5%	5%	3%	28%	5%	3%	5%	7%	10%	13%	2%	10%	0%	50%	10%
Used internet	0%	7%	3%	18%	4%	8%	5%	5%	17%	12%	2%	5%	0%	48%	10%
Mobile phones per adult	0.26	0.53	0.42	0.76	0.32	0.88	0.45	0.57	0.56	0.45	0.58	0.64	0.49	0.68	0.54
Recharge mobile at home	0%	0%	0%	0%	0%	0%	0%	15%	0%	0%	0%	0%	0	0.00%	1%
Phone charging as % of income	7%	7%	10%	12%	9%	5%	8%	6%	9%	10%	9%	10%	12%	8%	9%
Phone charging + lightinh as % of income	26%	20%	30%	31%	24%	21%	24%	24%	23%	25%	27%	27%	33%	23%	26%

Kailahun District had some notable variation between chiefdoms in terms of ICT access. Segbwema had relatively high levels of computer and Internet access probably due to its role as a trading centre. Mobile phone ownership varied greatly between chiefdoms. For example, mobile phone ownership was high in the remote chiefdom of Kissi Kama, whereas it was relatively low in Dea Chiefdom. On average, the cost of recharging mobile phones – as a percentage of income – was quite high in Kailahun compared to other districts. Prices for recharging mobiles at charging stations in Kailahun are similar to other districts, so this higher percentage is likely due to a lower overall household income in the District.

Table 22 - ICT use in Kono District

Town	Baima	Ngandorhun	Jaiama	Kainkorda	Kamiendor	Kangama	Kayima	Koakor	Koardu	Kondewokor	Njagbwema	Njaiama	Siam	Tumbudu	OVERALL
Chiefdom	Tankoro	Gbane	Nimiyama	Soa	Mafidor	Gorama Komo	Sandor	Gbense	Gbane Kandor	Toli	Fiama	Nimikoro	Lei	Kamara	
Used computer	3%	0%	17%	2%	0%	2%	0%	2%	0%	0%	7%	18%	0%	3%	4%
Used internet	3%	0%	7%	2%	2%	5%	0%	0%	3%	0%	5%	15%	3%	3%	3%
Mobile phones per adult	0.39	0.46	0.55	0.44	0.18	0.38	0.62	0.52	0.20	0.15	0.32	0.72	0.30	0.62	0.42
Recharge mobile at home	2%	2%	3%	0%	0%	0%	3%	0%	0%	0%	0%	0%	0%	0%	1%
Phone charging as % of income	8%	5%	6%	6%	5%	6%	5%	8%	10%	3%	4%	7%	4%	6%	6%
Phone charging + lightinh as % of income	21%	14%	18%	15%	17%	17%	17%	25%	21%	13%	13%	19%	15%	17%	17%

ICT access and use was relatively low across the Kono, except for Njaiama and Jaiama towns, which reported measurably higher percentages of household members having previous used a computer or accessed the internet. Mobile phone ownership varied considerably, from 0.72 mobile phones per adult in Njaiama to just 0.15 mobile phones per adult in the remote chiefdom of Toli near the Guinean border.

PRIVATE SECTOR

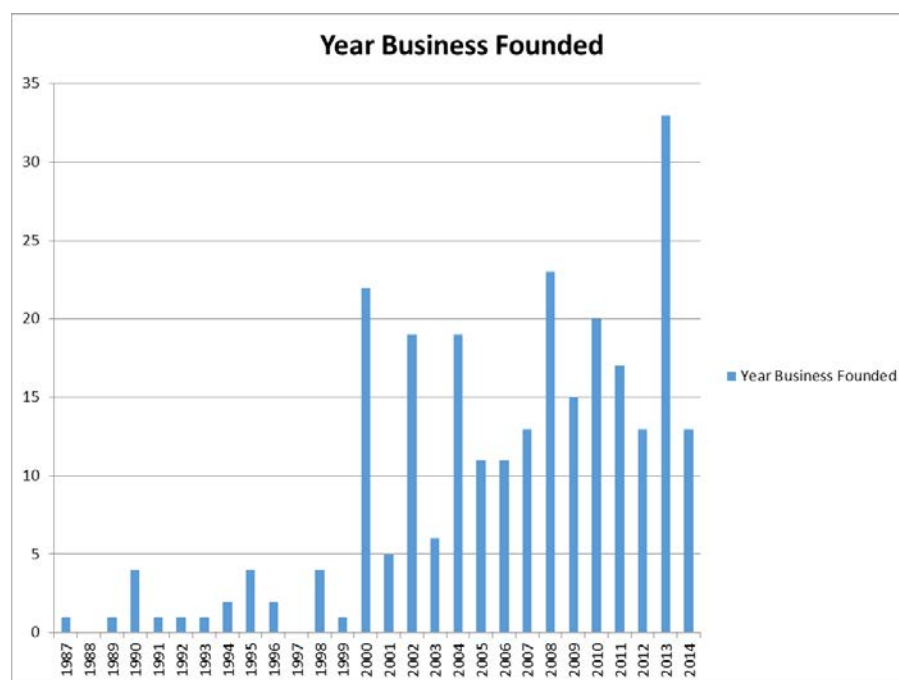


Figure 10- Founding year of private sector business surveyed (n=263).

Figure 10 presents the founding years of the businesses surveyed. Most are relatively nascent, having been founded in the last five to ten years (and perhaps attributable to post-civil war economic growth). The high number of businesses founded in 2013 is potentially not a case of 2013 being an exceptional year, but rather an indication of the volatile nature of Sierra Leone's private sector. It is highly likely that many businesses close within their first twelve months of operation and therefore would not have been counted in this survey. Future surveys for the project should shed more light on this theory.

Table 23 - Private Sector Energy use across the six districts

District	Port Loko	Bombali	Kambia	Kailahun	Kenema	Kono
Generator	34%	41%	65%	51%	31%	26%
Battery powered light	49%	46%	26%	39%	65%	74%
Solar lights	6%	8%	0%	2%	4%	0%
Candle	2%	0%	0%	0%	0%	0%
Kerosene	4%	0%	0%	0%	0%	0%
None	6%	5%	9%	8%	0%	0%

As Table 23 indicates, battery-powered torches and generators were the most common sources of lighting for the private sector. However, it is important to note that many use multiple sources of lighting, often using battery power lighting as a backup for generators and solar lighting. A common theme to emerge in interviews with business owners was that the high cost of lighting has a heavy restriction on trading, forcing many businesses to close earlier at night than desired. In particular, survey respondents highlighted the high cost of generator fuel and maintenance as well as generators being deemed unreliable as a major issues. Survey respondents also reported the propensity of generators to damage electrical items as a barrier to their use. Beyond its obvious use as a source of lighting, having electricity was also seen as a strategic form of advertising – having a business light on at night with music was seen as a key strategy for attracting customers. Light was also reported as providing security against theft. Solar power currently has very little penetration into the private sector across the six districts, with only Bombali District recording a significant percentage of solar power users, even then it was dwarfed by generator and battery powered torches. Nevertheless, is is interesting to note that the knowledge of solar power presence within a town, had an impact on the private sector of that vicinity, with many operators stating that they had a longer term plan to switch to solar as soon as it was deemed feasible. There could well be a substantial market for solar products within the private sector once their dissemination reaches a critical mass.

For private sector businesses using battery powered lights as their main source, lights were use used exclusively at night (on average 4.5 hours per business). These businesses spent on average around 4.2% of their income on lighting (i.e., purchasing batteries), although it was as high as 20% for some businesses. For the one private sector business that used candles as their main source, they used it for six hours a night and spent only 0.4% of their revenue on lighting needs. For private sector businesses using generators as their main source, 38% of these businesses operated their generators during the day (5.7 hours on average), while almost all operated at night (4.6 hours on average). These businesses spent on average around 11.67% of their income on fuel for lighting, although it was as high as 50% for some businesses. For the two businesses using kerosene lamps, they both operated these for 4 hours each night, spending around 1.25% of their revenue on their lighting needs. The businesses using solar used lighting on average for 5.2 hours each night and spent no money on lighting per night (although two businesses reported occasionally supplemented their solar lighting with battery powered torches).

Table 24 - Business lighting source across the three districts.

	Generator	Candle	Battery powered Light	Solar	Kerosene Lamp	None
Mechanic	44%	0%	22%	11%	0%	22%
General Store	35%	0%	56%	3%	1%	4%
Building Materials	40%	0%	40%	0%	0%	20%
Clothes	33%	0%	67%	0%	0%	0%
Print House	100%	0%	0%	0%	0%	0%
Restaurant/Bar	77%	8%	15%	0%	0%	0%
Drug Store	35%	0%	59%	6%	0%	0%

Table 24 provides a breakdown of energy sources by business type. These results are unsurprising, with businesses that require larger amounts of energy (printers for print houses; fridges for

restaurants) having a higher reliance of generators; while businesses that are open predominantly during the day often having no source of lighting (e.g., building materials shops, mechanics). Important to note, however, is that “general store” is by far the largest category (n=206) as most private sector business in Sierra Leone sell an eclectic range of goods, thus defying neat categorisation.

CHARGING STATIONS

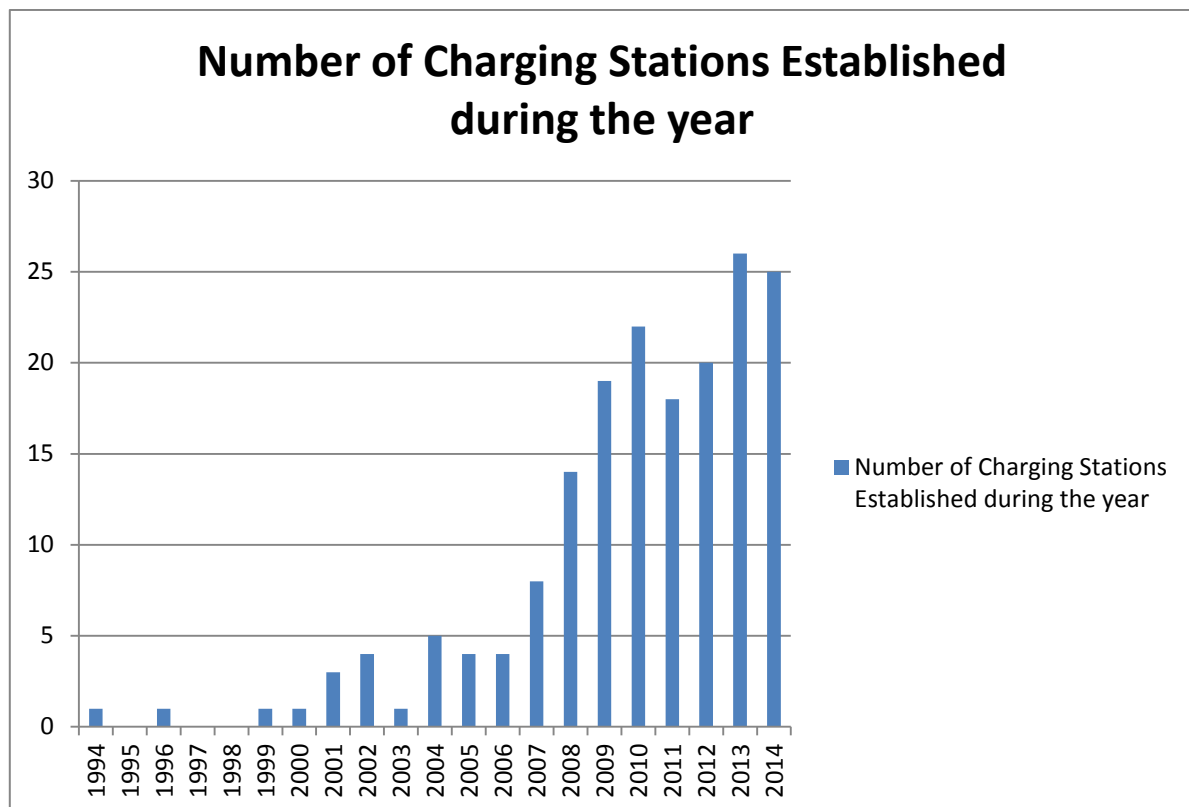


Figure 11 - Charging stations established each year across the six districts.

Figure 11 provides an overview of the years in which the different charging stations in the six districts were established. The last five to seven years, in particular, has seen a proliferation of charging stations and this likely parallels the increase in mobile phone ownership (and hence demand for energy to recharging mobile phones) that has occurred in Sierra Leone. The vast majority of charging stations used generators (96%), with only eight (4%) used solar power. Four of these solar power installations were the result of previous EFO installations (see Kemeny et al., 2014; Willans et al., 2011), while the other four were established independently by the charging station. For charging stations using generators, the cost of fuel accounted for an average of 55% of operational costs. On average, charging stations operated for 12 hours per day, charging 58 mobiles during this period (around 5.18 phones per hour). The cost of charging mobile phones was usually in the range of SLL1000 to SLL1500. Some stations also charge DVD players, radios and computers for approximately SLL2000.

As in the private sector, most charging stations complained about the cost and unreliability of generators, with generator breakdowns often forcing charging stations to close down (see Figure 12). Shortages of fuel were also deemed a major issue. Similar to the private sector business owners, many charging station owners expressed an interest in switching to solar power in the long term.



Figure 12 - (An empty) Charging station in Port Loko that had been shut down for three months due to generator failure

HEALTH SECTOR

This survey encompassed a large range of health facilities: hospitals, private run clinics, community health centres, primary health units and primary health posts. This research was conducted during the Ebola outbreak, with most facilities reporting a reduction of up to 75% of patients due in large to fears that health clinics were potential sites for Ebola transmission. Opening hours varied among health facilities, some operating fully for 24 hours, while others just accommodating emergencies through the night.

Table 25- Energy source at clinics across the six districts

Energy Source	Northern Districts	Eastern Districts
Battery Powered Torches	84%	91%
Solar Power	73%	69%
Grid Electricity	4%	4%
Generator	16%	34%
Candles	1%	1%

Table 25 provides a breakdown of the light use across health facilities in the six surveyed districts. Most health clinics rely on multiple sources for their energy, usually in the form of a combination of solar power and torches; solar power and generators; or generators and torches. The health sector had the highest use of solar out of all the sectors due to the high prevalence of solar vaccine fridges (at 65% of the sites in the Northern Districts; and 67% of sites in the Eastern Districts) and the UNFPA solar suitcases (two lights and a battery system). The vast majority of the vaccine fridges were not functioning, while most clinics indicated that the solar suitcases were insufficient for their needs. Unfortunately, despite its high prominence, solar power has not been utilised effectively in the health sector. Generators, as in the private sector, presented major problems in terms of their running costs and maintenance. Many clinics owned generators that had broken down sometime in the last five years and had remained in a state of disrepair due to a lack of funds to pay for maintenance costs. Although there was great variance between the sites, on average SLL53,000 was reportedly spent per site on lighting (i.e., batteries or fuel).



Figure 13 - Joru Community Health Clinic

EDUCATION

Sixty schools were surveyed across Kono, Kenema and Kailahun Districts. Seven schools used battery power torches for night lighting, spending on average SLL28,000 to pay for batteries. Twenty schools owned generators, spending around SLL104,000 per month to pay for operating costs. A small number of schools owned generators that were in need of repair. Two schools in Kenema Town were connected to the grid network and paid around SLL 37,700 in electricity bills per month. One school used solar power, while the remaining 36 schools had no lighting source. If night classes were available, students were required to bring their own lighting source. 16% of all schools surveyed opened for night classes; the majority of these did so during exam periods.

Out of the schools surveyed, 44% owned computers – many which had been donated by NGOs; however, only 63% of these schools used the computers as a part of their education programme; 26% reported that they did not have an electricity source to power computers; 7% said generator running costs were too high; and finally, 7% reported only using computers for administrative purposes.

Table 26 - Schools Surveyed

School Name	Village Name	Chiefdom Name	District	Number Classrooms	Number of Students	Number of Staff	Open at Night	Lighting Source	Does your school have computers?
Government Sec Sch - Dia	Dia Village	Kissi Kama Chiefdom	Kallahun District	6	379	8	No	Generator	Yes
Kissi Bendu Sec Sch	Koindu Town	Kissi Tere Chiefdom	Kallahun District	20	1355	21	No	None	Yes
Kissi Tongi High School (Both JSS and SSS)	Buedu Village	Kissi Tongi Chiefdom	Kallahun District	12	651	20	No	Solar Lanterns / Generator	Yes
Eastern Islamic Sec Sch	Buedu Village	Kissi Tongi Chiefdom	Kallahun District	10	340	19	Yes	Battery powered lights	No
National Sec Sch	Kallahun Town	Luawa Chiefdom	Kallahun District	11	855	22	No	None	No
Luawa Islamic Secondary school	Kallahun Town	Luawa Chiefdom	Kallahun District	6	460	11	No	None	No
Tahir Ahmadiyya Muslim Secondary School	Kallahun Town	Luawa Chiefdom	Kallahun District	9	500	17	No	None	No
SLMB Secondary School	Pendembu Town	Upper Bambara Chiefdom	Kallahun District	7	300	10	No	Candles / Battery powered lights	No
Ahmadiyya Muslim Sec Sch	Pendembu Town	Upper Bambara Chiefdom	Kallahun District	7	322	11	No	None	No
Pendembu Vocational & Technical Secondary School	Pendembu Town	Upper Bambara Chiefdom	Kallahun District	13	720	26	No	Generator	Yes
St. Michaels Secondary school	Baaima Village	Mandu Chiefdom	Kallahun District	3	152	7	No	None	no
Peace Memorial Government Sec Sch (JSS)	Baiwalla Village	Dea Chiefdom	Kallahun District	6	250	12	No	None	No
Provincial Islamic Secondary School (JSS)	Jojoima Village	Malama Chiefdom	Kallahun District	6	175	11	No	None	No
Wallace Sec Sch (JSS)	Daru Town	Jawi Chiefdom	Kallahun District	6	450	16	No	None	No
Provincial Islamic JSS	Daru	Jawei Chiefdom	Kallahun District	6	572	23	No	Generator	Yes
Jawei Ahmadiyya Muslim Secondary school (JSS & SSS)	Daru Town	Jawei Chiefdom	Kallahun District	21	1195	46	No	None	yes
Methodist JSS	Sandaru Village	Pengula Chiefdom	Kallahun District	6	253	8	No	None	No
Methodist Agricultural Sec Sch	Bunumbu Town	Peje West Chiefdom	Kallahun District	10	379	18	No	None	No
Holy Ghost Sec Sch JSS & SSS	Segbwema Town	N'jalahun Chiefdom	Kallahun District	23	1129	36	Yes	Battery powered lights (students bring them)	No computers
N'jalahun Methodist Sec Sch (JSS & SS)	Segbwema Town	N'jalahun Chiefdom	Kallahun District	8	740	25	No	None	No
Wesleyan Sec Sch	Segbwema Town	N'jalahun Chiefdom	Kallahun District	20	950	32	No	Generator	Yes
Tunkia JSS	Gorahun	Tunkia Chiefdom	Kenema District	9	200	15	No	None	No
Baoma JSS	Baoma Koya Village	Koya Chiefdom	Kenema District	8	153	8	No	None	no
St. Patricks JSS	Jene Village	Kandu Lepplama	Kenema District	5	286	2	Yes	Battery powered lights	Yes. 1 computer
Government secondary school	Gbonboma Village	Kandu Lepplama	Kenema District	5	229	8	No	None	No
Vocational Sec Sch - JSS & SSS	Boajibu Town	Simbaru Chiefdom	Kenema District	12	467	15	No	None	No
Ahmadiyya Sec Sch (JSS & SSS)	Boajibu Town	Simbaru Chiefdom	Kenema District	11	497	13	No	None	No
Gorama Mende Agric & Vocational JSS	Mondema Village	Gorama Mende	Kenema District	9	226	16	Yes	Battery powered lights.	No
United Islamic JSS	Mondema Village	Gorama Mende	Kenema District	4	197	11	No	None	No
Wandor Islamic Agric SEC SCH - (JSS)	Baama Village	Wandor Chiefdom	Kenema District	8	390	12	Yes	Battery powered lights.	Yes
Government JSS	Sembehun 1	Malegohun Chiefdom	Kenema District	6	325	13	Yes	Battery powered lights	No
St. Joseph Agric & Vocational Sec Sch. JSS & SSS)	Blama Town	Small Bo Chiefdom	Kenema District	18	1078	25	Yes	NPA / Generator	Yes
Ahmadiyya Muslim Sec Sch JSS	Blama Town	Small Bo Chiefdom	Kenema District	10	303	12	No	NPA / Generator	No
Lower Bambara Sec Sch (JSS & SSS)	Panguma Town	Lower Bambara	Kenema District	12	732	20	No	Generator	Yes
Government Sec Sch DODO	Dodo Village	Dodo Chiefdom	Kenema District	4	257	8	Yes	Generator	yes
Tongo Agric Sec Sch (JSS)	Tongo Town	Lower Bambara	Kenema District	8	642	20	No	None	No
Jaiama JSS & SSS	Jaiama	Nimikor Chiefdom	Kono District	35	486	26	No	None	Yes
Donovan Francis Foamansa Memorial Academy JSS	N'jala Village	Nimikor Chiefdom	Kono District	4	100	8	No	None	No
Yengema JSS and SSS	Yengema Town	Nimikor Chiefdom	Kono District	26	761	35	No	None	Yes
Ansarul Islamic JSS & SSS	Yengema Town	Nimikor Chiefdom	Kono District	15	647	13	No	None	YES
Supreme Islamic Council JSS & SSS	Bumpah Town	Nimikor Chiefdom	Kono District	10	330	15	Yes	Candles / Battery Powered Lights.	Yes
Bumpah Agric JSS	Bumpah Town	Nimikor Chiefdom	Kono District	9	200	7	No	None	No
Gbane Agric Sec Sch.	Gandorhun	Gbane Chiefdom	Kono District	12	453	14	No	None	No
Gorama Agric JSS	Kangama Village	Gorama Kono	Kono District	5	221	11	No	None	Yes
Yormandu High School	Yormandu Village	Sandor Chiefdom	Kono District	8	237	12	No	None	No
God's Mission JSS	Waidala Village	Sandor Chiefdom	Kono District	3	281	9	No	None	no
Tefeya JSS	Tefeya Village	Sandor Chiefdom	Kono District	4	250	9	No	None	No
Fasuluku Memorial & Vocational Sec Sch. (JSS)	Kayima	Sandor Chiefdom	Kono District	7	451	13	No	None	Yes
St. Edwards JSS	Mmanjama Village	Soa Chiefdom	Kono District	9	159	6	No	None	No
Sewafe JSS and SSS	Sewafe	Nimiyama Chiefdom	Kono District	22	630	33	No	None	Yes
Municipal JSS	Koidu Town	Tankoro Chiefdom	Kono District	11	365	12	No	None	No
Bethkonoid JSS	Koidu Town	Tankoro Chiefdom	Kono District	8	125	9	No	Battery powered lights (students bring them).	Yes
Ansarul Dawa Islamic Secondary School (JSS)	Koakoyima Town	Tankoro Chiefdom	Kono District	12	536	15	Yes	Generator	Yes
AL-HARRKAN JSS & SSS	Sewafe Town	Nimiyama Chiefdom	Kono District	9	814	5	Yes	Generator	Yes
Ansarul Islamic Girls JSS & SSS	Koidu Town	Tankoro Chiefdom	Kono District	17	798	32	No	None	No
Islamic sec Sch Kiudu	Koidu Town	Gbense Chiefdom	Kono District	29	2804	42	No	None	Yes
God is our light JSS & SSS	Koidu Town	Gbense Chiefdom	Kono District	18	1375	30	No	None	Yes
Gbense High School JSS & SSS	Koidu Town	Gbense Chiefdom	Kono District	16	1023	40	No	Generator	Yes
Koidu Girls Sec Sch JSS & SSS	Koidu Town	Gbense Chiefdom	Kono District	14	800	23	No	None	Yes
Koidu Sec Sch. SSS	Koidu Town	Gbense Chiefdom	Kono District	13	934	27	No	Solar / Generator	Yes
Ahmadiyya Nurat Jahan JSS	Tombodu Village	Kamara Chiefdom	Kono District	8	360	17	No	Solar	Yes
Songu N'riwa JSS	Tombodu Village	Flama Chiefdom	Kono District	7	128	8	No	None	No

KEY INDICATORS FOR EVALUATION

This section provides a brief overview of the different data sets that can be used to evaluate long-term impacts. Where relevant, it is stipulated if the indicator relates to the project's log frame (which has been included in Appendix A).

Household

Reduction household in phone and lighting charging costs

This first indicator provides a good proxy for evaluating increases in household disposable income. Currently, households spend between 15% and 30% of household income on phone recharging and lighting needs. When the improved lighting market reaches a critical mass, this should result in an overall drop in these percentages, subsequently freeing up household incomes for other items. This indicator is directly relevant for the project's Overall Objective (OO); Specific Objective (SO); Result One (R1) as outlined in the project's logframe.

Increased productive bricolage

The indicator provides a good proxy in terms of indicating if the renewable energy penetration has helped to create a more diversified village level economy (i.e., household members working in a range of different industries). It is relevant for areas of the log frame as this e previous indicator. This indicator is directly relevant for the project's OO; SO; R1 as outlined in the project's logframe.

Number of income earners

This indicator provides a good proxy in terms of indicating if the renewable energy penetration has helped to increase overall employment in the target community. It is relevant for the OO and R1 of the logframe.

Increased use of solar products for lighting

This is a direct indicator to measure the uptake of improved lighting products. It is relevant for the SO, R1 and Result Two (R2) in the logframe.

Increased ICT access

This indicator provides a good proxy for understanding if there has been an increase in access to services. It is relevant for the SO and Result Two (R2) in the logframe.

Wealth Analysis

As noted earlier, calculating household incomes accurately can be highly problematic in rural areas, thus this indicator will provide a good proxy for understanding if increased energy access at the village level has helped to generate more wealth.

Private Sector

Conversion to solar

This is an indicator to measure solar powers penetration beyond the direct confines of the project (i.e., its ability to establish a market in solar). It has some relevance for Result 3 (R3) in the logframe.

Increased business opening hours

This is related to the previous indicator (i.e., solar power allowing businesses to open earlier due to reduced transaction costs). This is relevant for R2 of the logframe.

Health

Increase opening hours

The provision of lights will allow for clinics to open for longer hours and therefore providing a more extensive service. This is relevant for R2 of the logframe.

Increased patients per day

This is a similar proxy to the previous one, and adds an extra dimension for evaluation. However, some care is needed with this indicator, as clinics experienced a major drop in patient numbers due to the EVD outbreak and the rebuilding of trust the country's health system is likely to be an ongoing issue. It is also relevant for R2 of the logframe.

Increased child births

This provides a good proxy indicator for child mortality rates (increased facility based deliveries are likely to reduce infant mortality rates). It is also relevant for R2 of the logframe.

Education

Increasing night classes.

The provision of solar power will remove a cost barrier in terms of opening up schools at night time. This relates to R2 of the logframe

Increased computer used

The provision of solar power will allow schools to make use of their computer equipment. This relates to R2 of the logframe

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APPENDIX A – PROJECT LOGFRAME

LOGICAL FRAMEWORK FOR THE PROJECT				
	Intervention logic	Objectively verifiable indicators of achievement	Sources and means of verification	Assumptions
Overall objectives	Contribute to poverty alleviation through renewable energy services while promoting low-carbon development	50% of households with access to renewable energy systems attain additional revenue or increase productivity or reduce home lighting cost through electricity-related activities by 30%	<ul style="list-style-type: none"> - <i>baseline study (economic statistics, beneficiaries' survey)</i> - <i>official UNFCCC data and reports of GoSL</i> - <i>impact surveys</i> 	<p><i>Sierra Leone will remain politically and socially stable</i></p> <p><i>Overall economic growth in Sierra Leone is sustained and decentralization process is not hampered</i></p>
Specific objective	Improve and increase access to renewable, affordable and sustainable energy services for rural poor in Sierra Leone focusing on energy efficiency measures and scale-up effects	A minimum of 16,000 households are either directly connected to a renewable energy grid or possess home solar systems thereby reducing energy costs for light by 30% 850,000 people have access and benefit from renewable energy electrification (productive or social infrastructure)	<ul style="list-style-type: none"> - <i>baseline study</i> - <i>list of electricity users and payers</i> - <i>project documentation</i> - <i>impact surveys</i> - <i>Ministry of Energy statistics</i> - <i>solicitation (application form) formally signed by village authorities</i> 	<i>Government of Sierra Leone continues its efforts to achieve good governance and decentralisation and supports the renewable energy sector, allowing private sector involvement</i>
Results	R1 – Improved living conditions and increased economic revenues for rural poor due to access to electric energy	<p>Rural electrification has created revenue or productivity increase by 30% for at least 10,000 households compared to baseline 100 solar charging stations with at least 200 direct jobs created</p> <p>22 energy hubs are operational (e.g. agriculture processing, tree nurseries, water purification, small irrigation) and used by min. 50,000 smallholders</p> <p>Minimum of 15,000 households have access to off-grid home lighting</p>	<ul style="list-style-type: none"> - <i>Registration of companies (village records)</i> - <i>baseline study (including income questionnaire)</i> - <i>impact survey (household interviews)</i> 	<p><i>The business environment in Sierra Leone remains positive</i></p> <p><i>Mobile phone industry and GoSL favours rural development strategy</i></p> <p><i>Agriculture crop prices conducive to invest into irrigation (especially cocoa and coffee)</i></p>
	R2 - The quality of public services is enhanced by electrification of public infrastructure	<p>Minimum of 600kW of production capacity installed, producing a minimum of 900 kW-hr / year</p> <p>Minimum of 6 Senior or Junior Secondary Schools supplied with a minimum of 3000kW-hr/year; Minimum of 6 Senior or Junior Secondary Schools supplied with a minimum of 6000Kw-hr/year</p> <p>Minimum of two hospitals</p>	<ul style="list-style-type: none"> - <i>Surveys, governmental sector review, project documentation</i> - <i>Pictures, reports, Ministry of health, Ministry of education and Ministry of agriculture</i> - <i>Impact surveys</i> 	<p><i>Targeted institutions are interested in electricity services</i></p> <p><i>Corruption and irregular private use of installations can be minimized</i></p> <p><i>Governmental policy supports establishment of rural energy companies</i></p>

	<p>connected to localised grid structures</p> <p>Minimum of three hospitals supplied with a minimum of 30,000Kw-hr/year</p> <p>Minimum of 9 Community Health Post/Centres supplied with a minimum of 2000kW-hr / year</p> <p>Minimum of 12 Community Health Centres supplied with a minimum of 4000kW-hr/year</p>		
<p>R3 - Awareness and capacity in respect to renewable energy systems (including climate change education) in the private and governmental sectors exist and is sufficient to sustain/ scale up the renewable energy sector in Sierra Leone</p>	<p>Minimum of 20 lecturers and 200 students have completed at least two course of renewable energy training</p> <p>A total of 250 beneficiaries from the target group are applying their knowledge at the energy hub/solar charging stations</p> <p>A sector study that provides information on energy and lighting patterns at the household level</p> <p>Learning platform with private sector and government agents – link to A4D working groups are functioning</p> <p>Three training labs in vocational training institutes are established offering four energy technologies (solar, hydro, biomass, wind)</p>	<ul style="list-style-type: none"> - <i>Policy papers (district development plans)</i> - <i>UNFCCC communication</i> - <i>Working group reports</i> - <i>Training curriculum of vocational centres</i> - <i>Statistics of vocational training centres</i> - <i>Project Surveys: Student Interviews, Craftsmen Interviews, market surveys</i> - <i>Impact surveys</i> 	<p><i>Ministry of Energy and institutions on district level remain collaborative</i></p> <p><i>Ministry of Education remains interested in the renewable energy curriculum</i></p> <p><i>Decentralized supply solutions based on renewable energy is a major strategy (on district level)</i></p>