

A PRACTICAL APPROACH TO SUSTAINABLE SOLAR ELECTRIFICATION OF REMOTE RURAL COMMUNITIES IN EASTERN AFRICA: THE CASE OF TANZANIA

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The Study area

- Southern Tanzania - Lindi and Mtwara Rural District
 - Kitomanga, Chikonje and Nanyaje villages (Lindi)
 - Lilido, Chekeleni, Nitekela and Niyumba Villages (Mtwara)
- Northern Tanzania – Shinyanga , Meatu District
 - Lingeka and Nyanza Villages
- Eastern Tanzania- Morogoro rural Districts
 - Lukulunge and Dala village,

Household characteristics

- Income range TShs 160,000- 360,000 (\$106 -240) per capita. (< \$1 per day).
- Agriculture contribute 75% of the total income.
- Other activities include fishing, petty businesses and small industries



Assets owned

- A house 95% (Two to three rooms)
- Farming tools (91%),
- Bicycles (20 -50%),
- Radios (50-75%),
- Cell phones (5-20%)
- Motorcycle (3-6%)

Buildings

- Construction Materials
 - Wooden poles only (21%);
 - Wooden poles and mud (67%)
 - Concrete block or burnt bricks (12%).
- Roofing materials
 - grass thatch (78%)
- Floor materials
 - earth (94%).



Common Sources of Light

- The most common energy source of light was
 - kerosene (63%),
 - torch (39%),
 - open fire (19%) and
 - candles (7%).
- Most families owned
 - one –two locally made *tin can* lamp(s)
- Expenditure for lighting
 - about \$0.1-0.5 per day for lighting (i.e \$3 -15/month)



Cost and Quality of Light

- About 30% of HH could not afford the cost hence spend about 1-15 nights per month in the darkness especially during the rainy season.
- The poorest HH spend 10-50% of total household income on fuel for lighting.
- The light produced by traditional lamps is only 2 to 4 lumens compared to a 60 W bulb which has 900 lumens (Tanzsolar, 2010).

Cost and Quality of Light

- The light is only 0.2% of what the people in industrialized countries have for the same price.
- The light is so poor that children can only see their books if they are almost directly over the flame leading inhalation of toxic gases causing respiratory diseases.
- Kerosene lamps and improper lighting create a barrier to education and learning.

If they had a choice ...

- About 93% of the respondents dissatisfied with the fuel type and amount of light they are getting.
- Reasons advanced for the discontent include:
 - (i) Poor quality of light
 - (ii) High cost of fuel
 - (iii) the fuel cause air pollution leading diseases;



Attitude towards solar lighting

- 70-80% were willing to acquire solar lighting systems.
- Awareness on other forms of feasible renewable technologies such as biogas and wind power was very limited.



Willingness and ability to pay for SHLK

- The HH were willing to pay monthly instalments (almost equivalent to cost of fuel they use for lighting)
 - 30% of the respondents could afford about TAS 8,000 (\$5.3)
 - 60% were willing to pay TAS 5000 (\$3.3) and
 - 10% could afford 3000 (\$2.0).

Willingness and ability to pay for SHLK

- Collective decision was to pay TAS 5000 (\$3.3) until the costs of the kit is recovered.
- For a \$200 SHLK the loan could be recovered in 5 years.



Challenges

- The greatest challenge of electrifying remote rural villages is therefore not the ability of the villagers to pay for the accessories (at least on small instalments)
- Other more significant barriers identified by this study were similar to those pointed out by Pode (2010) in Northern part of the country.

Major barriers to adoption of SHLK by remote rural communities

Barriers	Methodology for redress issues
<p>Inadequate business knowledge and loan management skills</p>	<p>Build business management skill by training selected community members</p>
<p>Limited technical knowledge of sizing, installation, operation and maintenance.</p>	<p>Training selected community member to size, install and repair solar</p>
<p>High cost of solar systems, initial capital investment and operation and maintenance</p>	<p>Introduce credit scheme. Repayment of the load should correspond closely to the amount of money served from using kerosene, candles and torches</p>

Secondary barriers to adoption of SHLK by remote rural communities

Limited awareness of and experience with PV technology	Increase Understanding of solar PV technology to the larger community via media and personal networking
Lack of established dealer network	Build a network of dealer
Inadequate policy implementation	Formulate/revise policies to support solar PV (Tax on kerosene should be used as subside on Solar PVs)
Difficult access to finance for end users	Facilitate access to micro credit schemes

Community involvement in redressing the Barriers

- Approaches used in many solar electrification projects exclude the poor from contribution financially thus disowning the initiative
- Many initiatives are planned and implemented by “urban technicians” leaving the communities ill prepared to run the projects.
- These approaches exclude the rural poor from making own decisions on how the barriers should be tackled

Community involvement....

- As an alternative we advocate a decentralized and demystified energy delivery approach
- Decentralized systems allowing the end user's direct control of acquisition, design, placement and consumption decisions.
- This is especially relevant to remote rural villages where conventional energy distribution and transmission systems are either not economical or feasible.

Community involvement....

- Demystification (exposition) of the technology to users give the poor the right to decide for themselves if they want the technology and how it should be introduced in their community.
- The approach requires a keen understanding of local needs and preferences, local cultural and economic realities.
- It gives the responsibility to choose, apply and finance the technology to rural communities.

Financing SHLKs

- The local community should select village energy committee which will be responsible for the management of the project.
- The village energy committee is then equipped with business and finance management skill.
- The committee links the community with agencies (microfinance schemes) willing to provide the initial capital and follow up repayment of the loans.

Financing SHLKs

- The committee ensures each electrified household pays to the credit scheme the agreed fee each month (payment is roughly the monthly cost of kerosene, candles and flashlight batteries).
- The approach leverages local community contribution and participation with public and private sector investment and financing.

Installing and Maintaining SHLK

- Dependency of rural communities on “urban experts” is eliminated by training semi-illiterate rural women to be competent solar technicians,
- Semi- Illiterate rural women who are not likely to relocate from the remote villages to relatively urban areas are given a six months hands-on training on installation, repair and maintenance of solar lighting kits.
- After training ,the women return to their villages as solar technicians.

SELECTED TRAINEES



SELECTION CRITERIA

6-7 years of primary Education

Grandmother

Settled in the village and not likely to migrate

Committed to community development

Health care center to be electrified by Barefoot Solar Engineers (BSEs) after training



A school to be electrified by BSEs



Hands-on training of BSEs



BSEs after graduating



Celebrating – Together we can do wonders!



Village Solar workshop

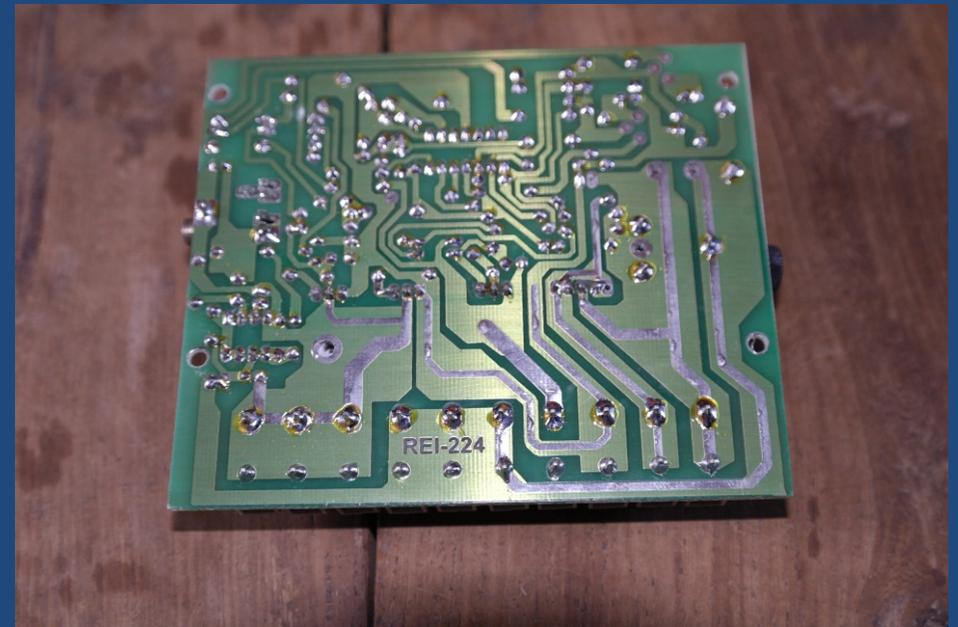
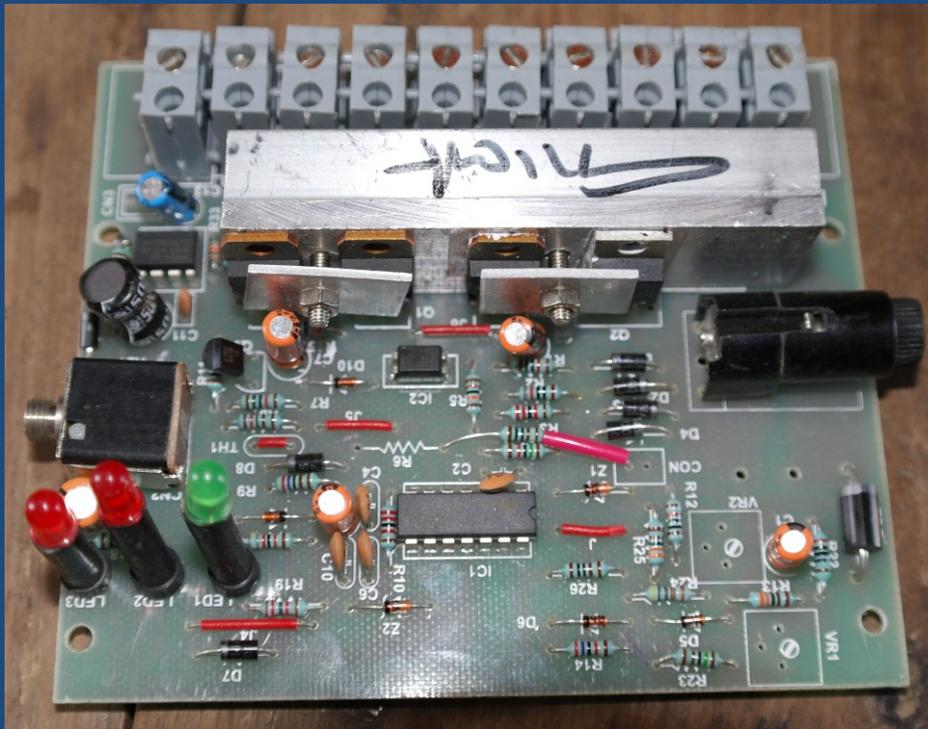


- The workshop is used for
 - Training youths
 - Repair & maintenance of solar PV component
 - Storage of electronic & other components
 - Fabrication and assembly of charger controllers, lanterns and lamps

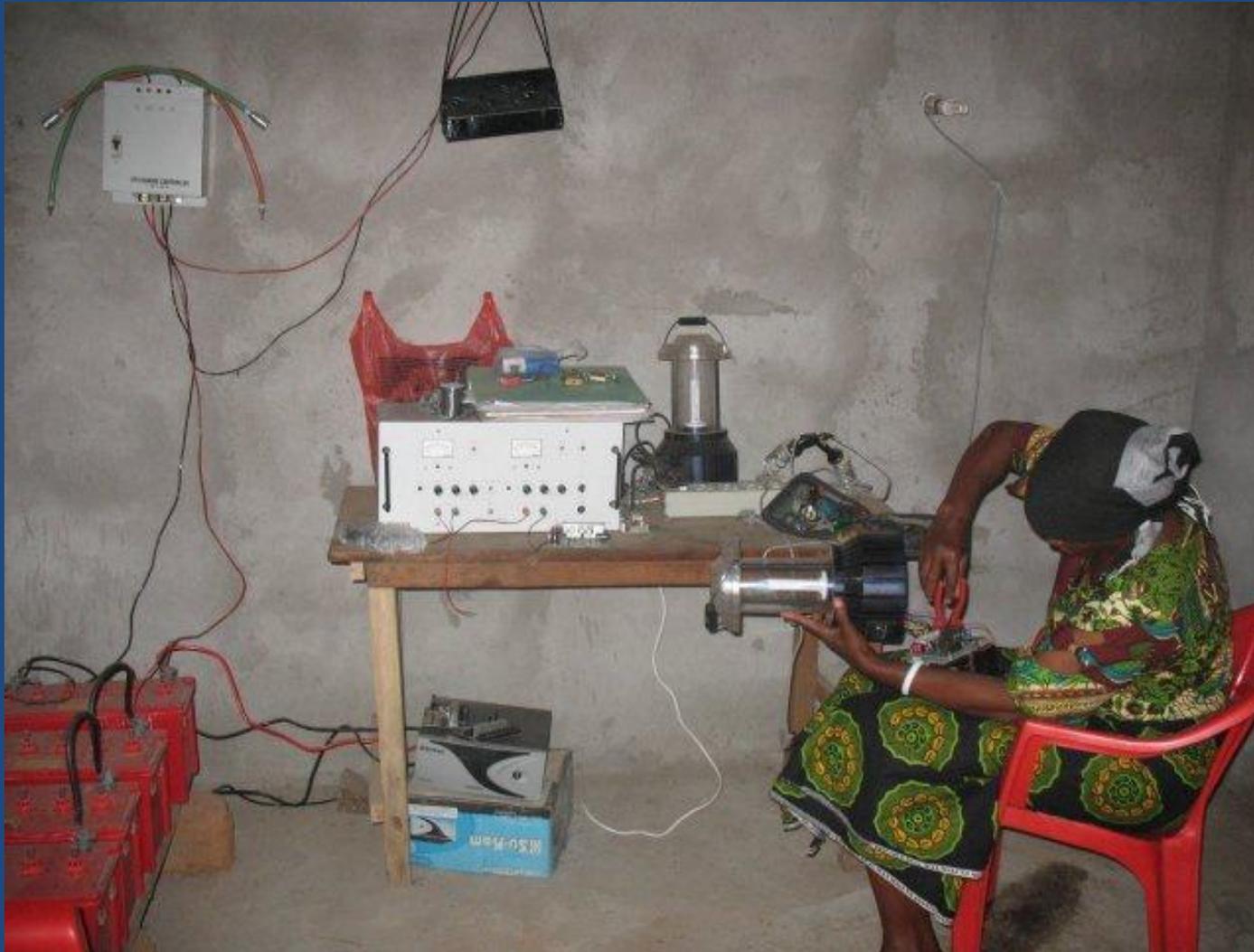
BSE making an electronic component



Assembled charger controller



Technician assembling/repairing solar lantern in Village Workshop



BSE installing PV system



Electrified House in Remote Village



Success of the approach in Tanzania

- Dena (2010) assessed two villages in Northern Tanzania which were electrified using the same approach.
- In addition to many positive findings, the author concluded that the approach provided remote communities in Northern Tanzania with solar lighting and in the process; communities gained economic, health and social benefits.
- She noted further that, by empowering women to take on technically challenging and important roles, project encouraged an increase in social equity.

Success of the approach in Tanzania

- Other benefits attributed to the approach include:
 - Decreased in environmental degradation
 - Creation of healthier indoor environments,
 - Facilitation of evening communication and social events, thus increasing community and family cohesion,
 - More time for studying, thus helping children to achieve their potential,
 - Increased entrepreneurship opportunities (ex. Poultry business, cell phone charging business, etc.).
- These benefits collectively enhance the quality of life in beneficiary rural villages.

Income generation opportunity- Poultry Project



Income Generation opportunity – Barbering



Income generation Opportunity Phone Charging



Income generation opportunity Shop



Improved Communication



Better Access to Information



Creation of Employment



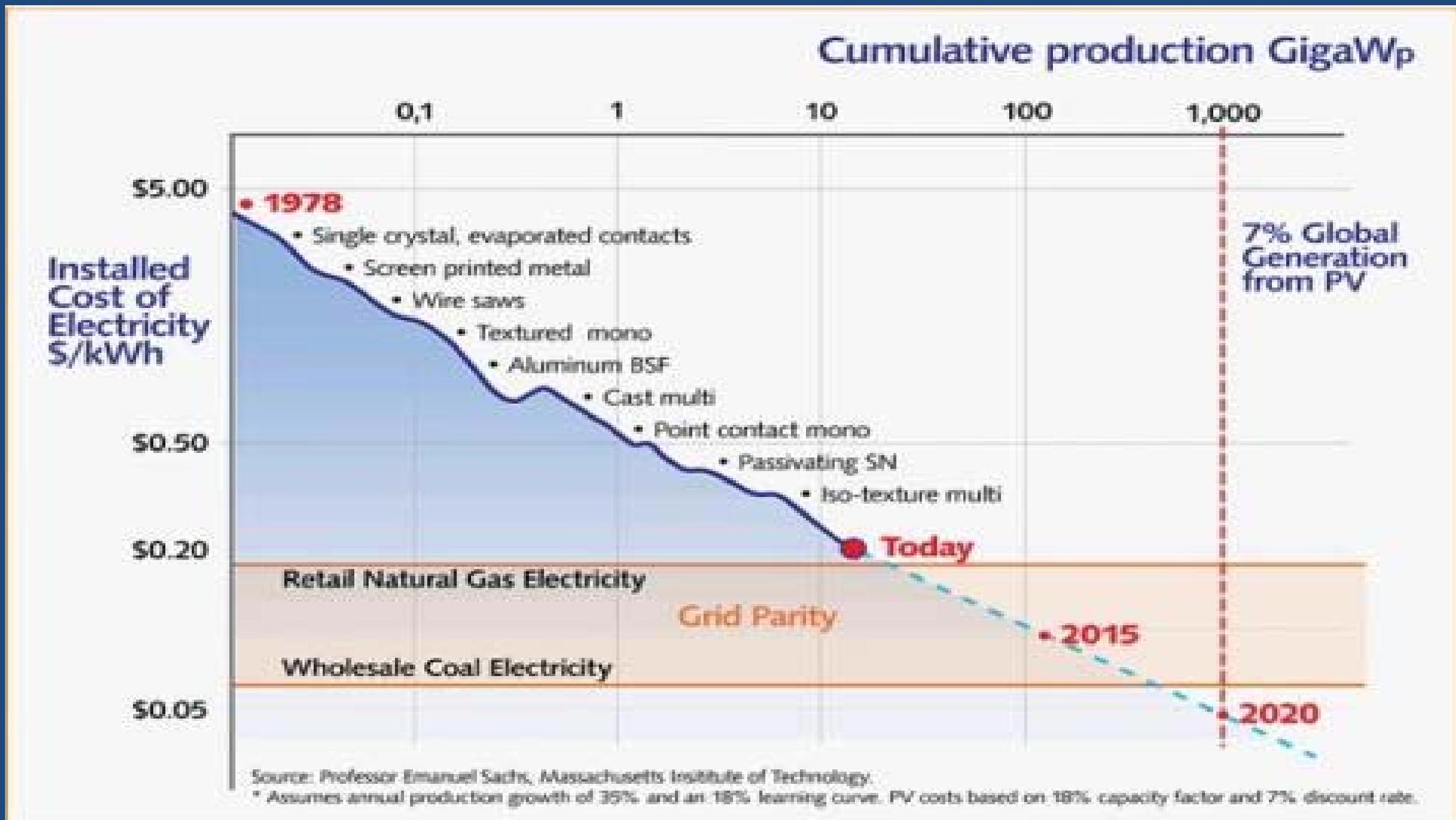
Contribution of the project to reduction of CO2 emissions

	Country	Funding scheme SHS model	SHS model (Wp)	Emission reduction (kg CO2/yr)
Chaurey and Kandpal (2005)	Argentina	Global environment facility	50-400	504
	Honduras	Activities implemented jointly	30-60	246
	India	Commercial carbon offset funding	20-53	373
	Indoncsia	World Bank/GEF	50	448
	Nepal	Government of Nepal	35	79
	Kenya	Commercial cash sales	12 to 50	205
	S. Africa	Shell/Eskom fee for service project	50	230
	Swaziland	IVAM/ECN triodos scheme	50	125
	Average CO2 emissions avoided per SHS			276
800 SHS x 276 (kg CO₂) per year			220 Tonnes per year	
In 20 years			4,416 Tonnes	

Conclusion and recommendations

- Solar electrification is a feasible solution to rural lighting.
- By providing clean, adequate indoor lighting, the general living standard of people living in deep poverty can be greatly improved.
- Trend in design of solar lighting systems suggests they will be more efficient and cost effective in the near future and hence more affordable for the poor

Trend of Installed cost of Solar Electricity and Cumulative production



Conclusion and recommendations

- Training of local people reduce reduce/eliminate aftersales problems
- Special 'hands on' training approach for repair/maintenance and spear part procurement is necessary as most rural dwellers are semi- illiterate.
- The approach has proved to be a workable solution for redressing barriers limiting adoption of SLHK in remote rural villages

Thank you for listening

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