

Solar Lantern Consumer Investments

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Key Assumptions

- ▶ Unsubsidized private enterprise is necessary for improved lighting access
- ▶ Scaling best achieved when solar lighting expenditures do not exceed current fuel-based lighting expenditures

Outline

- ▶ Lantern purchase as investment
- ▶ Rates of return
- ▶ Available financing

Monthly Fuel-Based Lighting 1–6 USD per month

Location	Kerosene	Candles	Total	Monthly
Bonasso	18.5	51.3	69.9	5.8
Ikaram	1.9	48.8	50.7	4.2
Mayange	1.6	11.6	13.3	1.1
Mbola	0.3	33.1	33.4	2.7
Mwandama	7.3	12.0	19.3	1.6
Pampaida	0.4	48.6	49.1	4.0
Ruhiira	2.4	15.1	17.5	1.4
Tiby	1.1	55.8	56.9	4.7

Table: Survey data in the Millennium Villages measuring yearly expenditures on fuel-based illumination expenses in USD.

What size lantern is needed to offset these costs?

- ▶ Small solar products cannot completely displace all kerosene use in a household.

Lighting Africa Displaced Kerosene

Lantern Cost	Displaced Kerosene
20 USD	60 ml/day
40 USD	90 ml/day
80 USD	140 ml/day

Table: Lantern cost and displaced kerosene. Data from the Lighting Africa report, “The True Cost of Kerosene in Rural Africa”.

Kerosene Costs Vary

Location	Kerosene Cost per liter
Rural	1.30 USD/liter
Urban	0.96 USD/liter

Table: Kerosene cost in rural and urban markets. Data from Lighting Africa.

Kerosene costs in unsubsidized markets can fluctuate.

Kerosene and avoided cost

Initial Cost (USD)	Avoided Kerosene (liter/day)	Avoided Cost (USD/month)	Payback Period (Months)
20	0.06	2.3	9
40	0.09	3.5	11
80	0.14	5.5	15

Table: Avoided costs from displaced kerosene from solar lanterns. Displacement rates and per liter costs are from Lighting Africa.

Available Solar Financing

- ▶ What is the basic range of solar monthly offerings?
- ▶ Loan lengths are about 1 year
- ▶ Interest rates around 30%
- ▶ Monthly payments calculated using the Capital Recovery Function (CRF)

$$CRF = \frac{i(1+i)^n}{(1+i)^n - 1}$$

M-KOPA Pay as you go



Figure: M-KOPA III Solar Home System. This device can be used for about 0.50 USD per day.

Financial Comparison

- ▶ We treat this decision using standard financial techniques
- ▶ We can compare the IRR of different decisions
- ▶ If the loan rate is higher than the IRR, it is not affordable

Solar Lantern Rate of Return

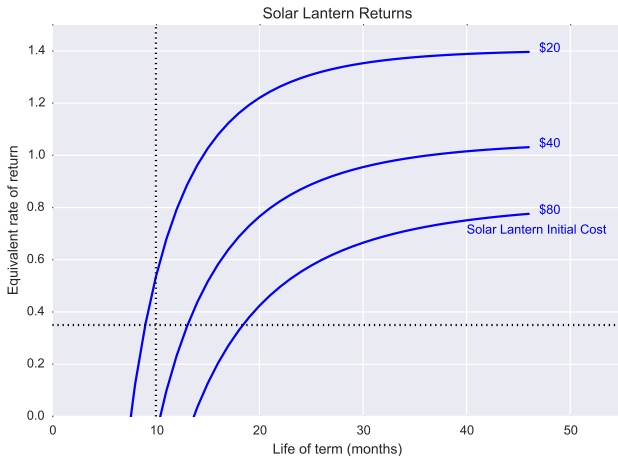


Figure: Internal rate of return for solar lanterns using Lighting Africa avoided kerosene data.

Lower interest rates and longer terms lower payments

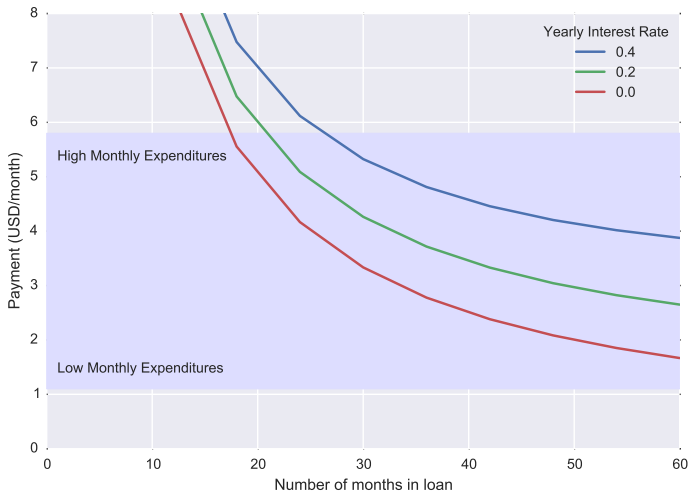


Figure: Monthly payment for a 100USD solar lantern.

Research Agenda

- ▶ Assume lowering monthly cost is the best way to make an impact
- ▶ What opportunities remain for solar and battery cost reductions?
- ▶ What opportunities remain for financial cost reductions?
- ▶ How can technical solutions support financing innovations? (PAYG, longer battery life)

Research Agenda

- ▶ What is the distribution of energy expenditures?
- ▶ Based on the distribution, what level of adoption to we expect as we lower the monthly expenditure through technology and financing?
- ▶ Are consumer willing to increase their monthly expenditures for higher quality sources?

Thank you

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