



Village Infrastructure

Making Energy
Affordable

Why focus on solar agroprocessing?

UN Target: "Access to Energy" for all by 2030

- Lighting + phone charging ≠ "access"
Need more than 2-10W solar lamps/kits

Possible "Access to Energy" package:

- Residential, mostly night-time needs:
Lighting, phone charging, radio, fan and/or TV
 - Community/business, mostly day-time needs:
Refrigeration (especially for clinics), communications for market access, productive power for processing crops, carpentry, others?
- = "Tier 2+" service package
= 75-150 kWh/year/house, or 25-50W/house

Tiers of Energy Service

Supply side: Tiers based on attributes of electricity supply

ATTRIBUTES	Tier-0	Tier-1	Tier-2	Tier-3	Tier-4	Tier-5
Peak Available Capacity (Weq)	-	>1	>50	>500	>2000	>2000
Duration (Hrs)	-	≥4	≥4	≥8	≥16	≥22
Evening Supply (Hrs)	-	≥2	≥2	≥2	≥4	≥4
Affordability	-	-	√	√	√	√
Formality (Legality)	-	-	-	√	√	√
Quality (Voltage)	-	-	-	√	√	√
Global Tracking for SE4All	No	Basic	Advanced			

Service side: Tiers based on regular use of appliances

Tier-0	Tier-1	Tier-2	Tier-3	Tier-4	Tier-5
-	Task Lighting AND Phone Charging	General Lighting AND Television AND Fan	Tier-2 AND any low-power appliances	Tier-3 AND any medium-power appliances	Tier-4 AND any high-power appliances

Current view of "access to energy" is still uncertain, and current thinking is based on tiers of services.

However, very focused on consumers / households

Does not account for

- clinic needs for health
- community mills
- school equipment, comms
- solar water pumping

and similar mostly community-scale needs.

Hence, "Tier 2+" suggested which includes these needs.

Opportunity of Productivity

Saving 1 hour per day for 250 million women globally that lack electricity

= 100 billion hours/year of productivity

= 50 million peoples' worth of 8-hour days

= entire workforce of the UK or France

by reducing time spent processing crops, fetching water and collecting firewood

Benefits of solar agro-processing

Staple crops

- Mechanized agro-processing reduces time spent on basic labour
- Saved time leads to more time spent in the fields increasing food security
- Saved time leads to non-agricultural income-generating opportunities
- Saved time can also increase parents' contribution to childrens' education
- Reduced expenditure on diesel, which dominate offgrid milling now

Cash crops

- Processing cash crops at the village level can earn more value for households
(eg. coconut oil vs copra, edible rice vs unhulled)
- Saved time leads to more time in fields growing/harvesting, increasing income

Agro-processing is commonly part of microhydro, grid and diesel rural electrification projects, but rarely part of solar electrification projects.

Crops of the poorest 1 billion

Over 1 billion people lack electricity

15 crops make up 90% of all food consumed on the planet

3 crop groups make up 50-60% of all food consumed

- Rice
- Maize
- Wheat and other cereals (sorghum, millet, barley, rye, etc)

Other major crops are roots (cassava, yams, potato, taro) and in the Pacific, coconut

Meat is a larger food group for the rich than the poor.

Chicken and pork dominate the rural meat markets of poor countries.

Staple Crops of the World

Rank	Crop	World production	Average world yield	Processing required
		2008 (metric tons)	2010 (tons per hectare)	
1	Maize/Corn	823 million	5.1	thresh, grind, winnow
2	Wheat	690 million	3.1	thresh, grind, winnow
3	Rice	685 million	4.3	thresh, hull, winnow, (polish for white rice)
4	Potatoes	314 million	17.2	wash, peel
5	Cassava	233 million	12.5	peel, grate or slice
6	Soybeans	231 million	2.4	thresh, dry, clean, press
7	Sweet potatoes	110 million	13.5	peel, sometimes slice
8	Sorghum	66 million	1.5	thresh, grind, winnow
9	Yams	52 million	10.5	peel, sometimes grate
10	Plantain	34 million	6.3	peel

Source: Staple food - Wikipedia, the free encyclopedia.htm



threshing maize



pounding = grinding
corn/cassava or hulling rice



winnowing



grating cassava / yams



grinding flour



grating coconut

Transport: the hidden cost

Diesel mills are rarely found in small villages of <50 households

Many villagers travel 1-10 km to access a mill outside their village

This can cost \$0.20-\$1.00 for the return trip, with a 25-50 kg bag

The cost of milling is typically \$0.02-0.05/kg or \$0.50-2.00 per bag

Thus, **travel can increase agro-processing costs for small villages by 50-100%** and so they tend to not use mills even if they could afford it the basic milling cost.

Small solar mills can reach these markets that diesel mills do not.

Case Study - Corn Shelling



Case Study - Flour Grinding



Case Study - Rice hulling



Case Study - Coconut Grating

