Emerging
COOKING
SOLUTIONS

Advanced Biomass Cooking for a Billion People

– With Massive Climate Impact

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About us

Emerging COOKING SOLUTIONS

- Selling gasification stoves in Zambia and soon also in Malawi and Mozambique;
- Running a 2.5 t/hr pellet factory in Zambia;
- Hi-tech: mobile money, PAYGO, carbon credits, Tier-5 stove;
- Most experienced and "largest" company in Africa working with gasifying stoves and pellets;

2009: an Idea is Born

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Produce pellets from waste biomass as fuel for cooking stoves and sell it cheaper than charcoal

2013: First Serious Production

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2014-15: Business model trials

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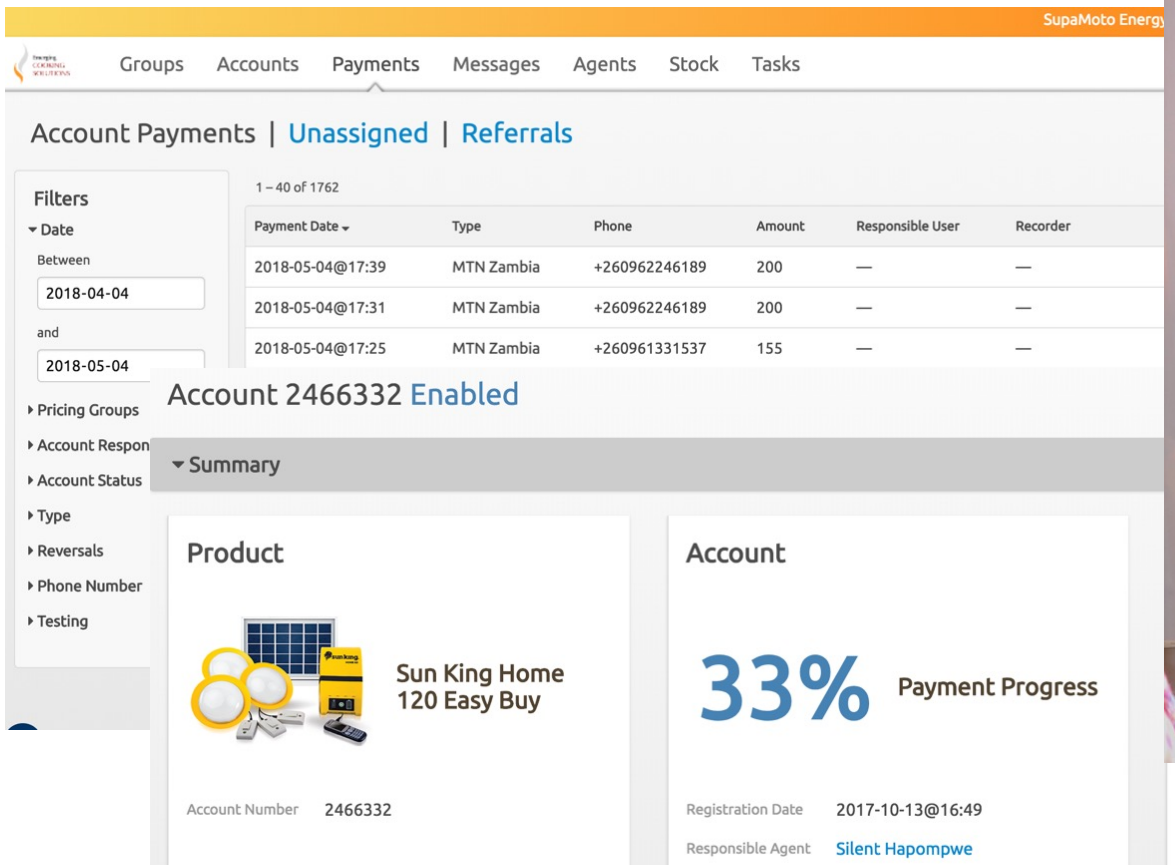
2015: The Fire

2017: Building up Capacities

- Introducing fin-tech (PAYGO and Mobile Money)
- Grew revenue by 3x
- Proof of concept



The Problem of Unclean Cooking

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- Social and environmental cost is in the **trillions of dollars** annually.
- Global **climate foot print is greater than that of entire airline industry**.
- **2.5M premature deaths** from Indoor Air Pollution (more than TB, Malaria and HIV/Aids combined).
- Women and girls spend **1-3 excessive hours** per day.
- Tens of millions of households in peri-urban Africa spend **5-10% of total income** on cooking fuel, about 20-40 billion per year on charcoal alone.

Which is the “Best Value for Money” Fuel?

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Fuel Comparisons – Typical Efficiencies [29]

Fuel	LPG	Charcoal (in efficient stove)	Charcoal (in traditional stove)	Firewood (in efficient stove; 15% moisture)	Firewood (in traditional stove; 15% moisture)
Energy Content (Megajoules (MJ) per kg)	45.5	30.0	30.0	16.0	16.0
Conversion Efficiency (%)	60	30	20	25	15
Useful Energy at Final Consumption Stage of Cooking (MJ per kg)	27.3	9.0	6.0	4.0	2.4
Quantity Necessary to Provide 5 Gigajoules of Useful Energy for Cooking Estimate (kg)	180	550	830	1250	2000



Fuel	Kg/year	Price/kg (USD)	Total (USD)
Pellets	500	0.3	$150
Charcoal	830	0.3	$240
LPG	180	1.7	$306
Ethanol	400	1.1	$440

1st-4th Generation Biomass Stoves

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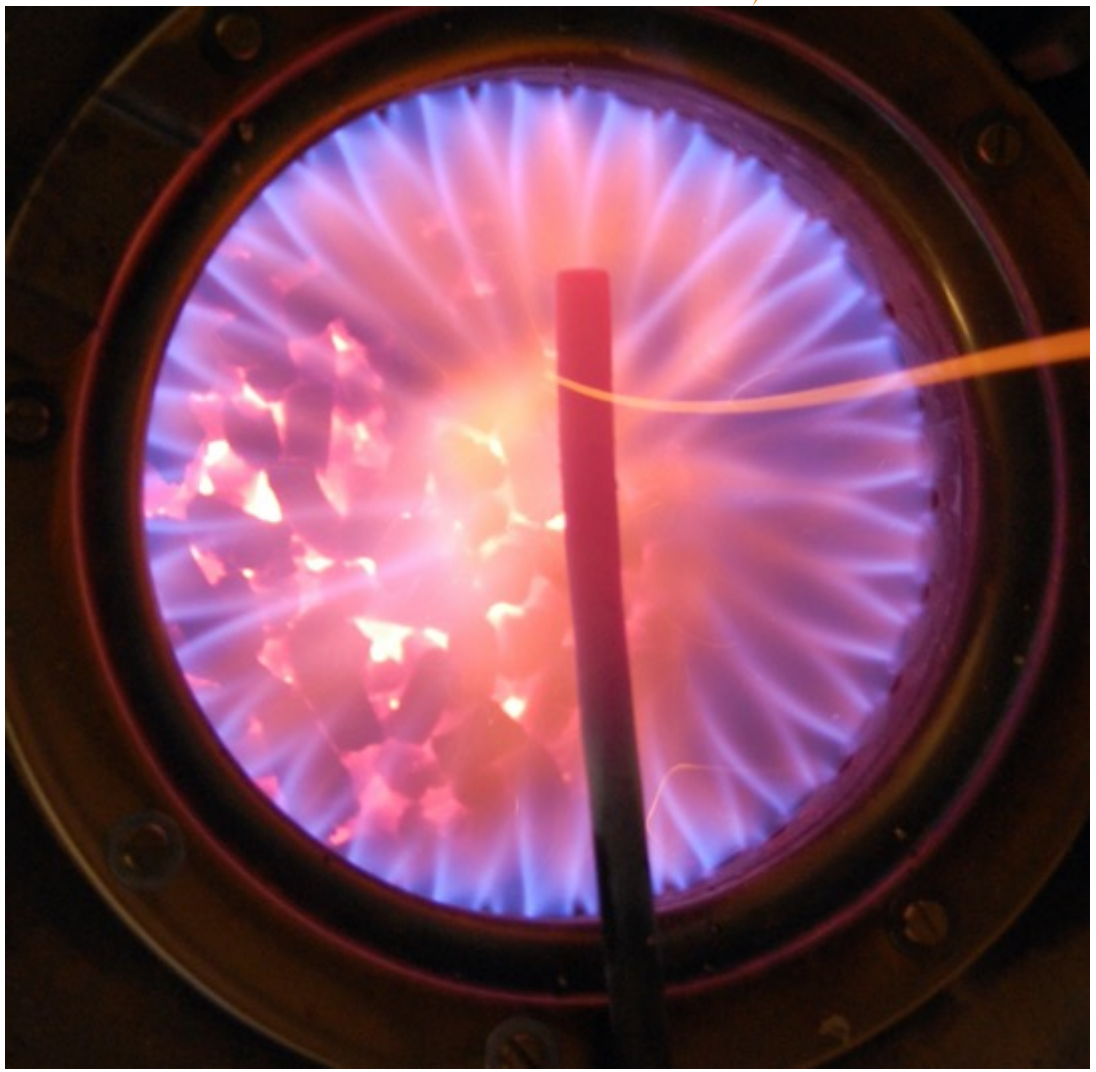
- **First generation:** Basic improved stove from simple materials such as clay.
- **Second generation:** Natural draft gasification (TLUD) and Rocket stoves
- **Third generation:** Forced air gasification
- **Fourth generation:** Advanced airflow

  Advanced (low-cost), ceramic materials

  Connected (PAYGO and usage data)

  Dramatically improved performance (duration, heat-range, emissions)



Modern Cooking

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- World Bank's has developed a multi-tier framework for access to cooking;
- "Modern cooking" is defined as Tier 4 or 5;
- In some contexts, LPG is not "modern" due to the affordability aspect;
- Almost all biomass solutions are below "modern" (i.e. "transitionary"), including some pellet solutions;
- Our new stove scores 5 in all aspects*;
- Very few "modern cooking" carbon credits have been generated, but they should attract a large premium price;

**Solid Tier-5 on Efficiency. On emissions, 3 of 4 were solid Tier-5 and the last was just below the tier-5 threshold, but can be improved through software updates*

BOX ES.1 Key Definitions for Measuring Access

Modern Energy Cooking Services (MECS)—Refers to a household context that has met the standards of Tier 4 or higher across all six measurement attributes of the Multi-Tier Framework (MTF) (figure BES.1.1):

Exposure Personal exposure to pollutants, which depends on both stove emissions and ventilation (higher tiers indicate lower exposure)

Efficiency Combination of combustion and heat-transfer efficiency

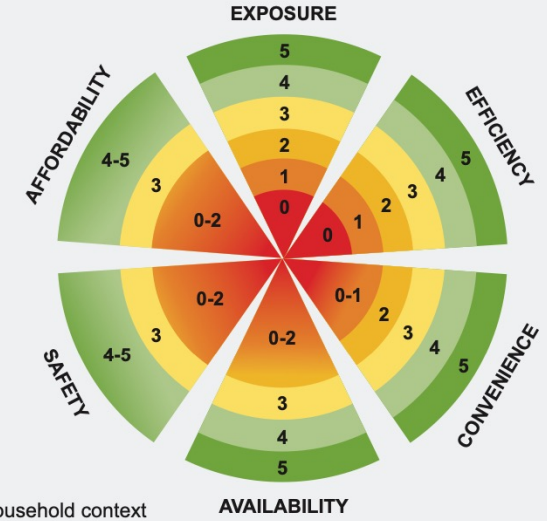
Convenience Time spent collecting/purchasing fuel and preparing the stove

Safety Severity of injuries caused by the stove over the past year

Affordability Share of household budget spent on fuel (higher tiers indicate lower share of spending)

Availability Readiness of the fuel when needed by the user

FIGURE BES.1.1 MTF Attributes, Showing Tiered Progress toward MECS Access



Improved Cooking Services Refers to a household context that has met at least the Tier 2 standards of the MTF across all six measurement attributes but not all for Tier 4 or higher (figure BES.1.1). Household contexts with a status of MTF Tier 2 or Tier 3 are considered in **Transition.**

Source: World Bank.

Note: Each attribute is scored across six tiers (0–5), and the tiers are measured using one or more indicators, each spanning a lower and upper threshold.

Doing nothing?

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This neither can nor will happen, because:

- Everybody needs to cook.
- Climate footprint of 2% of global emissions, and increasing if no action taken.
- Carbon credits can become a major driver for the sector.
- Charcoal prices are soaring all over Africa (supply squeeze); urbanisation and populationgroups put pressure on demand.

Biomass pellets is the best value for money clean fuel

- Production infrastructure needs to be developed.

The Solution (Mass Adoption Version)

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1. Introduce aspirational, high-quality, gasifying stoves;

2. Fuel:
   - **Pellets** for urban/peri-urban areas (existing purchasing power);
   - **Semi-processed/unprocessed biomass** for rural areas (biochar potential);

3. "Utility model" for the stoves, financed largely by carbon credits;

	Urban	Rural
Pellets (100M HH @ 0.4t/yr)	40M tonnes	
Biomass (100M HH @ 0.6t/yr)		60M tonnes
tCO2 (pellets x10; biomass x4)	0.4 Gt	0.24 Gt

Stove specifications

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- Specs: 1.2 – 4.5 kW power; 1.1 kg pellets capacity and 2.5 hr sustained boiling of 5 litres water.
- 2-plate standard version – second burner can be added to PAYGO contract later on.
- Connected to internet through 2G GSM.
- Savings of pellets of approx 20-30% compared with market leader.
- Designed for refurbishment/easy local assembly and repairs.
- Exo-skeleton (collapsible) and removable burning chambers.

Partnerships

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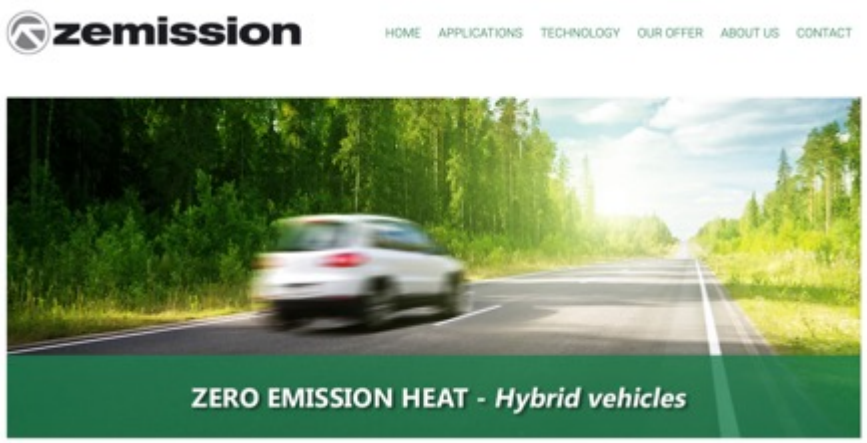
Development partners:



SIGMA

LILJENBERG

Financing:

NCF
Nordic Climate Facility
Initiative by NDF

Sida

EEP Africa

CLEAN COOKING ALLIANCE

UNITED NATIONS FOUNDATION

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Test report

The Supa Moto was tested by Aprovecho staff at the Aprovecho laboratory, Oregon, USA in December of 2021. Aprovecho conducted standard laboratory testing [WBT 4.2.3, LEMS] to determine performance metrics related to the stove's fuel use and emissions. Extended simmer tests were also conducted to determine the amount of time the stove could maintain the simmer temperature.

Excerpt:

The thermal efficiency was above 50% during high and low power which would place it in ISO Tier 5 ***[note: Tier 5 is the highest/best level]***. A three stone fire is between 10 and 20% for the same size pot depending on the height of the stones.
The temperature corrected time to boil the 5L of water was fast, about 18 minutes.

The PM2.5 emissions factor during low power was in ISO Tier 5, ***likely a first for a biomass burning stove*** *[note: ECS emphasis]*. At high power it was very close to the high ventilation ISO Tier 5 (7.9 mg/MJd vs. the 7.0 mg/MJd cutoff). When the high and low power test results are averaged together the PM2.5 emissions factor is in the high ventilation ISO Tier 5 (6.2 mg/MJd). The CO emissions factors put the stove well into ISO Tier 5.

The average total run time including high and low power during the extended simmer tests was 179 minutes, or almost 3 hours. The average pellet burn rate during the extended simmer was 4.67 g/min (Figure 7). The water temperature was maintained between 3 and 6 degrees below boiling. A plot of typical CO2 and water temperature results is shown in Figure 8. The transition to the charcoal burning phase can be seen in the plot at about 155 minutes elapsed when the water temperature and CO2 emissions increase. The water temperature drops below the simmering threshold at about 180 minutes elapsed because the thermocouple was no longer submerged in the water.

Stove type/model		supamoto12.1 0.21b	supamoto12.1 3.21a	supamoto12.1 4.21a	supamoto12.1 6.21a	supamoto12.1 7.21a	supamoto12.1 0.21b		
Location							Average	High Tier Estimate	Low Tier Estimate
Basic Operation									
COLD START									
Temp-Corrected Time to Boil	min	17.1	20.1	18.2	17.5	16.4	17.9	16.1	19.6
Burning rate	g/min	10.35	9.71	10.32	10.54	11.35	10.45	9.72	11.19
Thermal efficiency	--	56%	55%	55%	55%	56%	55%	55%	56%
Specific fuel consumption	g/liter	42.15	46.76	45.00	43.70	44.94	44.51	42.39	46.63
Firepower	watts	3,240	3,038	3,230	3,298	3,552	3,272	3,042	3,501
Average Cooking Power	kW	2.105	1.910	2.040	2.082	2.298	2.087	1.913	2.261
HOT START									
Temp-Corrected Time to Boil	min	15.4	17.5	16.6	15.6	14.8	16.0	14.6	17.3
Burning rate	g/min	12.71	11.65	11.97	12.22	12.98	12.31	11.64	12.98
Thermal efficiency	--	53%	51%	54%	53%	53%	53%	52%	54%
Specific fuel consumption	g/liter	46.27	48.54	47.64	45.59	45.72	46.75	45.15	48.35
Firepower	watts	3,979	3,647	3,747	3,826	4,063	3,852	3,642	4,062
Average Cooking Power	kW	2.404	2.136	2.317	2.368	2.462	2.337	2.183	2.492
SIMMER									
Burning rate	g/min	5.74	5.05	5.75	5.92	5.88	5.67	5.23	6.11
Thermal efficiency	--	55%	53%	52%	52%	51%	53%	51%	55%
Specific fuel consumption 45 m	g/liter	71.8	60.6	71.4	73.3	72.1	69.8	63.3	76.3
Firepower	watts	1,798	1,579	1,799	1,852	1,841	1,774	1,636	1,912
Turn down ratio	--	2.01	2.12	1.94	1.92	2.07	2.01	1.91	2.11
Average Cooking Power	kW	0.994	0.836	0.932	0.964	0.948	0.935	0.861	1.009

Next steps

- Secure premium carbon financing for the advanced biomass sector.
- Work with manufacturers and distributors.
- Grow the pellet industry in Africa.