Final Report
Public version

Validating eCooking in Planning and Operations of Solar Microgrids in Haiti

Research, Planning and Modelling to provide a detailed business plan and model for the microgrid.

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AI was used to formulate some parts of the structure of this output.

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Executive Summary

Full EarthSpark COSMO Project Executive Summary

In 2020, EarthSpark International and Enèji Pwòp partnered with the Modern Energy Cooking Services (MECS) initiative to implement an innovative research project deploying electric cooking solutions in solar microgrids in Haiti. Overall, the project clearly demonstrated that electric cooking can not only be effectively integrated into solar microgrid models for energy access, but can also help drive socio-economic development and improved quality of life for participants and improved operations for microgrid models. EarthSpark and Enèji Pwòp are now working to build off this foundation to refine the technology solutions and business model for electric cooking in Haiti.

As a first step towards this EarthSpark worked with MECS through the COSMO Phase 1 Initiative to develop a sustainable supply chain implementation plan covering a variety of aspects including the expected impact on microgrid models (financial, technical performance, demand-side management, etc.), the microgrid context and pathway to operation, customer costs, and appliances / sales / customer satisfaction / service. This plan leveraged a variety of different data sources including HOMER Pro modelling, EarthSpark's financial models, customer surveys, past cooking pilots and sector research.

This process and the ultimate plan detailed in this report highlighted several key findings for electric cooking and microgrids in Haiti including:

1. Electric cooking enhances the microgrid financial model by increasing total low-interest debt accessible by raising CAPEX and "ticket size" for large institutional investors, increasing operational revenue, reducing average tariff required for cost-recovery, and enabling better equity payments for investors while still preserving debt repayment windows
2. Electric cooking enhances technical operations by allowing for more flexibility in consumption and demand management, increasing utilization of solar energy, and reducing the overall levelized cost of electricity for the systems
3. EarthSpark needs to identify a new dispatchable load source to help meet the technical requirements of its future microgrids (e.g., regulatory requirements, targets and requirements for 100% renewable grids, etc.), and electric cooking loads are well aligned with the criteria needed for this load (e.g., significant fraction of overall demand, aligned with middle of the day solar production, available alternatives to help balance DSM needs)
4. Customers have high, consistent purchasing and utilization of baseline charcoal fuels, and while expenditures for those fuels are generally lower than electricity costs, the gap is approachable through strategies like carbon financing and EarthSpark's "Fem-Elec finance" approach for results-based financing for health and gender aspects of clean cooking
5. EarthSpark can leverage significant learnings for customer engagement, outreach, communications collateral, etc. from its past two electric cooking studies to help improve uptake, sustainability, and impact of the proposed electric cooking solutions

Overall, the benefits of adding electric cooking to the microgrid model likely outweigh the costs in the long run, and the plan to partially integrate electric cooking into EarthSpark's microgrid scale-up plan in Haiti is worth pursuing.

Critically, more up-front work is needed before the eCooking aspect of the plan can be fully evaluated. The Phase 2 COSMO grant will support the acquisition and warehousing of the appliances and associated meters and wiring, cooking-specific customer engagement, further institutional cooking research and partnership formation, monitoring and evaluation and project management. EarthSpark's approach of 'de-risking by doing' – deploying appliances and cooking services to at least 10% of customers across two microgrids – will yield highly valuable, actionable data that will inform future grid and programmatic design.

EarthSpark is planning to scale-up its microgrid operations in Haiti to serve more than 23,000 new connections in the next 4 years, and favorable eCooking findings will guide EarthSpark's planning for those and other future grids. MECS COSMO Phase 2 funding will help validate EarthSpark's strong hypothesis that electric cooking on solar-powered microgrids can significantly improve customer experience, reduce climate impacts, and boost the microgrid business model all at once.

EarthSpark has a proven track record of developing energy access business models that solve specific aspects of Sustainable Development Goal #7. Electric cooking in the energy access microgrid context is not yet ready for investment as a stand-alone business. Nevertheless, there is great potential for a viable eCooking vein to enhance the various enterprises already engaging in the microgrid development and operations in Haiti. COSMO Phase 2 funding will enable EarthSpark to apply its proven process of innovation, incubation and iteration to electric cooking in Haiti with the aim of solidifying and expanding eCooking's role at the heart of microgrid planning, financing, and operations.

EarthSpark COSMO Phase 2 Executive Summary

EarthSpark International's MECS COSMO Phase 2 initiative builds upon the foundational insights of Phase 1 by expanding the evidence base, refining the technical and financial modeling, and deepening institutional readiness for electric cooking ("eCooking") adoption in rural Haiti. Building on EarthSpark's long-standing leadership in clean energy innovation, this project strengthens the case for eCooking as both a social-impact service and a power-system optimization strategy within a portfolio of fully renewable, community-scale microgrids.

Phase 2 unfolds in the context of Haiti's evolving national energy landscape and an increasingly urgent need for solutions that improve energy access and reliability, reduce dependence on charcoal, and empower local institutions. Across technical modeling, consumer finance assessments, institutional consultations, and operational fieldwork, the project consistently reveals that eCooking is uniquely positioned to advance EarthSpark's mission of delivering clean, affordable, reliable energy. The work draws extensively from advanced microgrid modeling conducted with the University of Colorado Boulder (CU Boulder), internal financial mechanism reviews, community-level institutional engagements, and the organization's operational adaptation following the Tiburon microgrid fire.

Four themes emerged throughout the project:

1. **eCooking is central to the performance and economics of 100% solar-powered microgrids.** Technical modeling shows that coordinated eCooking adoption allows microgrids to reduce significant curtailing of PV while maintaining 100% reliability to all other loads. Daytime

cooking also reduces the amount of expensive storage required for the system. The now-validated "nine-day curtailment" finding shows that eCooking can be paused on fewer than ten days per year while still enabling high adoption and improved overall system reliability and utilization. This insight—developed through EarthSpark + CU Boulder collaboration and published in multiple ASES conference materials—provides a powerful foundation for integrating cooking loads into system planning and tariff structures.

2. **Institutional cooking is a viable and strategically important early-entry market.** Phase 2 identified schools, clinics, and community food services as highly promising first adopters. Institutions face real burdens under traditional cooking fuels: the cost and availability of charcoal, smoke exposure, and labor inefficiencies. These institutions also have predictable daytime cooking schedules that align naturally with solar availability, making them ideal load anchors and demonstration partners. The 2025 MECS COSMO memo underscores that, due to Haiti's security and logistics disruptions, institutional pilots became a near-term priority and a gateway for broader market development.

3. **Consumer finance and results-based financing (RBF) tools are essential for scaling adoption.** EarthSpark's 16-year experience with clean energy finance—including peer-to-peer credit, on-bill financing, microloans, and productive-use equipment trials—forms the backbone of its eCooking financing strategy. The Consumer Finance + RBF Assessment identifies on-bill financing as the most accessible and operationally feasible mechanism for both households and institutions, especially when paired with SparkMeter's digital infrastructure. Carbon- and gender-impact financing remain promising pathways for reducing appliance costs and supporting program delivery.

4. **Operational analysis validates substantial mid-day energy availability and confirms community readiness to engage with eCooking.**

   Even during prolonged operational challenges—including the Tiburon microgrid fire and the region-wide instability of 2024–2025—EarthSpark's DER systems demonstrated significant solar clipping and reliable mid-day availability. This means substantial unused energy already exists that could be harnessed for cooking loads. Communities expressed strong interest in electric cooking, reinforcing that technical readiness aligns with social readiness. EarthSpark's May 2025 MECS COSMO memo documents how these field conditions shaped milestone revisions and informed a more resilient, institution-led deployment strategy.

Taken together, these findings suggest that eCooking should be a key component of EarthSpark's strategy to deliver modern, clean energy services across Haiti. **eCooking strengthens microgrid economics, reduces emissions, enhances public health, empowers women, and lowers reliance on unstable charcoal markets—while improving system reliability and reducing operational risk for developers.**

One other significant development that happened during Phase 2, was that EarthSpark acquired the emerging market operations of its smart metering provider, SparkMeter, Inc. EarthSpark's stepping in to take over global operations of SparkMeter Inc.'s metering enterprise was in response to the company's going out of business and EarthSpark's reliance on the advanced features of the SparkMeter metering platform for eCooking and overall grid management for its 100% solar-powered grids. SparkMeter's situation offered both a crisis and an opportunity for EarthSpark and the minigrid sector at large. EarthSpark's intention now is not only to ensure continuity of SparkMeter operations but also to evolve the service offerings to better support eCooking integration and broader integration and management of distributed energy resources.

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1. INTRODUCTION & BACKGROUND

EarthSpark International has operated in Haiti since 2009, with a mission grounded in the delivery of clean and affordable energy services that meaningfully improve lives. Over sixteen years, EarthSpark has pioneered innovations in mini-grid development, demand-side management, productive-use equipment financing, and community energy engagement. With two microgrids already built and more than 20 sites advancing through regulatory and engineering pipelines, EarthSpark is shaping what will become Haiti's first national network of community-scale microgrids.

The MECS COSMO initiative supports this work by focusing specifically on the role of electric cooking, how it can be integrated into household and institutional energy use, how it interacts with demand patterns, and how it influences technical system design and economics. Phase 1 of the program established early foundations: validating customer interest, exploring tariff implications, and initiating technical models of how eCooking would affect solar PV and battery systems. The Phase 1 report emphasized that eCooking was one of the "most valuable and universal energy services" available to microgrid-connected communities—and one that offered the potential to transform rural cooking practices, improve public health, reduce charcoal dependence, and strengthen EarthSpark's system-wide operations.

Phase 2 builds directly on those foundations, expanding into deeper technical modeling, real-world operational investigation, refined consumer finance mechanisms, and institutional pilot engagement. Quantitative field data could not be collected during this study period due to the sourced electric cooking appliances being delayed in Haiti import customs amid ongoing socio-political unrest, preventing in-country deployment. As a result, this phase of study lacks new quantitative evidence, but the team still plans to implement and monitor results when opportunity presents itself next. To mitigate this limitation, the research team conservatively relied on the best available historical datasets, prior field studies, and secondary sources to inform analysis and contextualize findings. This report synthesizes those insights into a coherent narrative, providing a roadmap for future implementation and scale.

1.1 The Haiti Setting

Haiti's electricity sector is characterized by chronic under-supply, problematic fuel dependency, and an unreliable national grid. Rural communities mostly lack access to electricity and depend heavily on charcoal for cooking—an unhealthy, expensive, time-consuming, and environmentally damaging fuel that disproportionately burdens women and reinforces cycles of poverty. Electric cooking offers a clean and modern alternative, but only if it can be delivered affordably and reliably through strong renewable microgrid systems. EarthSpark's microgrids are designed to provide improved rural electricity access with 100% high-reliability solar-powered systems and digitally enabled demand-side management.

1.2 The Promise of eCooking

eCooking offers benefits across multiple dimensions:

- **For households and institutions:** reduced fuel costs, improved health, convenience, and safety.
- **For microgrid operators:** increased daytime load, reduced PV curtailment, improved CAPEX efficiency.
- **For the environment:** reductions in emissions, deforestation, and localized air pollution.
- **For gender equity:** reduced labor burdens on women and opportunities for new enterprises.
- **For financial sustainability:** increased kWh sales and opportunities for carbon-credit generation and RBF mechanisms.

Phase 2 reconfirmed that the alignment between eCooking loads and solar production is not just beneficial, it is transformative for renewable microgrid operation. The collaboration with CU Boulder demonstrates how predictable cooking loads allow for more efficient solar sizing, lowering system costs while maintaining reliability.

This mother in Haiti relished the time she saved when she switched from charcoal to electricity.

1.3 Phase 2 in Context

The 2024–2025 period presented unexpected challenges, including national security disruptions, fuel blockages, and logistical delays. The most significant operational setback was the Tiburon microgrid fire, which required extensive reconstruction work. Fortunately, the smaller DER system was unaffected, allowing EarthSpark to temporarily shift program emphasis toward DER-based trials. May 2025 COSMO Memo outlined these disruptions and their influence on project milestones.

Despite these challenges, institutional partnerships strengthened, modeling work advanced, and financing strategies matured.

Phase 2 therefore represents not only an expansion of technical insights, but an adaptive, resilient response to Haiti’s realities—positioning EarthSpark to implement high-impact eCooking programming in future phases.

2. COSMO PHASE 2 OBJECTIVES

Building on Phase 1 findings, COSMO Phase 2 set out to deepen the evidence base and prepare EarthSpark for implementation across multiple grid sites. The Phase 2 objectives included:

1. Strengthening technical validation of eCooking within fully renewable microgrids.

This involved advanced modeling focused on overall reliability, curtailment requirements, and optimal sizing strategies. The objective was to determine how eCooking adoption levels could be supported without compromising system performance or requiring excessive capital investment.

2. Assessing institutional cooking potential as a strategic entry market.

Schools, clinics, and community food centers were evaluated to determine their energy needs, operational capacities, and readiness for eCooking adoption. The objective was to chart a clear pathway for demonstration pilots that would be feasible despite broader national disruptions.

3. Refining consumer finance mechanisms for appliance acquisition.

The Consumer Finance Assessment reviewed EarthSpark's historic financing tools and aimed to identify models that could support large-scale dissemination of electric pressure cookers (EPCs), rice cookers, and other appliances. It also explored carbon-credit and gender-finance mechanisms (e.g., the FemElec model) to reduce end-user costs.

4. Evaluating operational readiness and field conditions for eCooking trials.

Using DER operational data, SOC patterns, and solar clipping analyses, Phase 2 sought to confirm that eCooking loads could be supported under both normal and disrupted system conditions.

5. Synthesizing cross-cutting insights to inform future implementation.

Phase 2 aimed to consolidate technical, operational, financial, and social findings into a strategic framework for future rollout.

MECS Modern Energy Cooking Services
UK International Development Partnership | Progress | Prosperity
Loughborough University

3. METHODOLOGY

COSMO Phase 2 employed a multi-layered methodological approach designed to advance the technical, financial, operational, and institutional foundations required for successful eCooking deployment across EarthSpark's expanding microgrid portfolio. This methodology built directly on EarthSpark's Phase 1 experience, integrating lessons learned into deeper research streams and adapting to Haiti's dynamic operating environment.

3.1 Institutional Cooking Engagement

A major methodological component of Phase 2 involved direct engagement with institutional partners in Les Anglais, Tiburon, and La Cahouane. This work was designed to assess:

- **cooking practices and daily schedules,**
- **fuel procurement patterns and associated burdens,**
- **organizational readiness for electric appliance integration,**
- **perceived benefits and concerns related to eCooking,**
- **existing infrastructure constraints, and**
- **willingness to participate in pilot demonstrations.**

Institutions—particularly schools—were identified as high-potential early adopters. Field conversations revealed:

- persistent challenges with charcoal sourcing,
- harmful smoke exposure to kitchen workers,
- high variability in cooking fuel costs, and
- interest in modernizing cooking practices.

The 2025 MECS COSMO Memo emphasized that, due to political and logistical disruptions, institutions emerged as the most feasible and strategically aligned participants for Phase 2 and future programming.

This method built on Phase 1's emphasis on community consultations but deepened the approach by focusing on anchoring organizations that could model behavior change and facilitate broader community uptake.

For the number and type of institutions engaged, depth of engagement and selection criteria, refer to Appendix A - Pre-Feasibility Assessment for Electric Cooking Integration for Schools in EarthSpark's Mini-grid Communities in Haiti. As part of this assessment, in total, 10 schools were surveyed (6 in Les Anglais and 4 in Tiburon) representing the majority of schools in the mini-grid footprints. These institutions represented a variety of different sizes (279 – 850 students and 15-42 staff) and types of schools (4 private schools, 3 state schools, and 3 religious schools).

3.2 Technical Modeling of Solar Microgrid Performance

A second major methodological pillar involved the advanced microgrid modeling conducted in collaboration with the University of Colorado Boulder. The modeling work—summarized in the ASES Extended Abstract and supported by Python-based scenario analysis—evaluated:

- **solar resource variability,**
- **battery SOC patterns,**
- **operational implications of differing eCooking adoption levels,**
- **PV and storage CAPEX implications,**
- **reliability thresholds based on solar-only generation, and**
- **frequency of required curtailment events.**

The methodology featured iterative simulation cycles, optimization of PV and storage capacity under multiple eCooking penetration and curtailment scenarios, sensitivity analyses, and cross-comparison with EarthSpark's real-world operating data. Unlike Phase 1, which used simplified modelling to estimate feasibility, Phase 2's methodology:

- integrated cooking load profiles into full-year data sets,
- decomposed impacts across hours, days, and seasons,
- evaluated multiple penetration levels, and
- tested demand-side management strategies.

A defining methodological breakthrough was the identification of the **"nine-day curtailment" threshold**, which found that only nine days per year would require planned eCooking curtailment to maintain 100% system reliability to all non-cooking loads without the need for any diesel backup. To accommodate 20% eCooking adoption required only a 6% increase in CAPEX while significantly increasing kWh sales. Although further analysis is required, we expect that a reduced tariff for daytime e-Cooking could make it always cheaper than charcoal and still improve the microgrid's finances.

This finding reflects a refined methodological approach that combines rigorous simulation with practical operational considerations.

3.3 Consumer Finance & RBF Mechanism Analysis

EarthSpark undertook a structured analysis of its consumer finance history and its applicability to eCooking deployment. This methodology included:

- retrospective review of 16 years of financing mechanisms,
- evaluation of repayment performance,
- assessment of administrative overhead requirements,
- review of device-specific financing risks,
- mapping of financing needs across households and institutions,
- modeling affordability against various tariff and repayment scenarios.

The "Assessment of Consumer Finance & RBF" document provided the backbone for this analysis.

This work also included an assessment of:

- carbon-credit feasibility,
- gender-impact finance models (FemElec Finance),
- donor-aligned RBF structures, and
- technology-enabled metering and verification pathways.

Lessons from 2020–2024 financing activities informed the suitability of on-bill financing for eCooking, forming a major methodological insight for Phase 2.

3.4 Operational Field Analysis

A final methodological stream involved real-world operational assessment.

Using SOC logs, solar clipping data, system downtime patterns, and DER performance monitoring, EarthSpark conducted analysis to:

- identify feasible windows for eCooking use,
- understand impacts of system downtime,
- evaluate cooking load compatibility with DER systems,
- assess voltage and load balancing considerations, and
- refine operational messaging for DSM.

Field observations—even amidst major disruptions—provided critical validation for the modeling results. The Tiburon DER site, for instance, demonstrated that eCooking could be incorporated even during partial-grid operation.

The methodological approach thus combined theoretical modeling with grounded operational assessment, increasing the robustness and real-world relevance of Phase 2 findings.

4. TECHNICAL FINDINGS

The technical findings from Phase 2 build significantly on the groundwork laid in Phase 1, moving from conceptual feasibility to validated, model-supported operational strategies. Notably, Phase 2 confirms that electric cooking is not only compatible with fully renewable microgrids—it actively improves their reliability, economics, and operational efficiency.

4.1 The Nine-Day Curtailment Breakthrough

The most important technical finding of Phase 2 emerges from the ASES Extended Abstract:

Only nine days per year of planned eCooking curtailment are required to maintain 100% reliability for all other loads in a fully renewable microgrid with no backup diesel generator. Furthermore, 20% eCooking adoption can be accommodated with only a 6% increase in CAPEX while significantly increasing kWh sales.

This has several implications:

- eCooking loads do not significantly threaten reliability. In fact, when paired with DSM they can enhance reliability for all of the other loads on the system.
- E-Cooking is feasible without diesel backup, preserving EarthSpark's 100% solar commitment.
- 20% penetration has minimal additional capital requirements, and higher penetrations are also feasible without diesel backup.
- The cooking load is inherently compatible with daytime solar abundance.
- DSM strategies need only be applied on a small number of days, minimizing user burden.

Phase 1 hypothesized this alignment, while Phase 2 confirmed it through full-year (8,760-hour) modeling. The analysis was conducted by simulating multiple scenarios in HOMER Pro. Total system cost results are presented in Table 2, while incremental costs relative to the no-eCooking case (cost additionality) are shown in Table 3.

The modeling was done by HOMER pro. Methodology and key assumptions are summarized below:

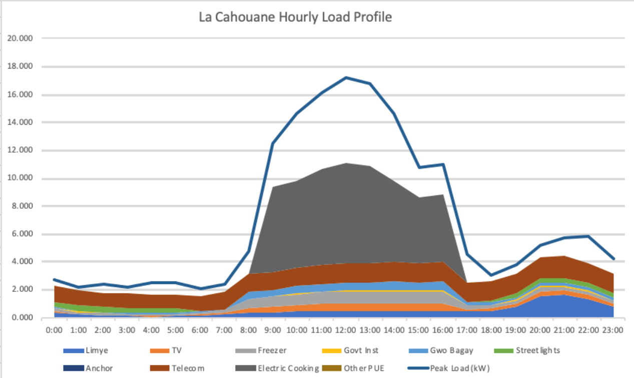
- **Scenario definition:**
  The optimization model was run for 11 distinct scenarios, each representing a different demand-side management (DSM) intensity. Scenarios range from no eCooking curtailment to increasingly aggressive curtailment levels of 5, 9, 16, 20, 29, 38, 48, 66, 87, and 118 eCooking curtailment days per year.
- **Input data preparation (8,760-hour CSV files):**
  - **Solar resource:** Hourly solar radiation data downloaded from NREL's National Solar Radiation Database.
  - **Load profiles (Table 1):**
    - **Load #1 – Baseload (excluding eCooking):** Derived from the Kwison Elektrik report (2021) and held constant across all scenarios.

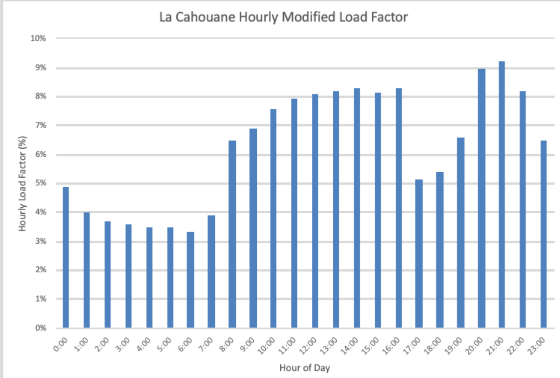
- **Load #2 – eCooking:** Generated separately for each scenario using Kwison Elektrik data and applying scenario-specific eCooking curtailment rules based on solar availability. eCooking demand is curtailed when solar radiation is insufficient.

- Homer Pro **Optimization and sensitivities:**
  Each of the 11 scenarios was modeled and evaluated under the following sensitivities:
  - eCooking penetration levels of 0%, 5%, 10%, 20%, 50%, 70%, and 100%
  - Zero capacity shortage (100% system reliability)
- **Model outputs:**
  For each scenario and sensitivity, HOMER Pro identified the least-cost system configuration. The resulting optimized system costs are reported in Table 2 and Table 3.

Table 1: The dark grey mid-day projected load for EarthSpark's next grid is eCooking.

(5) La Cahouane [Tranche 2]





238	connections	23	streetlights	0	cold storage (3-4MT) / ice machines	25	connections with electric cooking

EP Tariffs	Limye	TV	Freezer	Govt Inst	Gwo Bagay	Streetlights	Anchor	Telecom	Electric Cooki	Other PU	Sub-Total (Customer	Total
Tariff (Wp)	30	120	360	180	600	20	3000	2000	1200	1000	NA	NA
% of total conne	81.1%	11.3%	4.6%	0.8%	1.7%	NA	0.0%	0.4%	N/A	0.0%	NA	NA
Number of conne	193	27	11	2	4	23	0	1	N/A	0	238	261
Peak Load by group (kW)	5.790	3.240	3.960	0.360	2.400	0.460	0.000	2.000	30.000	0.000	48	48.210

Chart

Table 2: The EarthSpark-CU study found significant benefits at just 9 days of load curtailment.

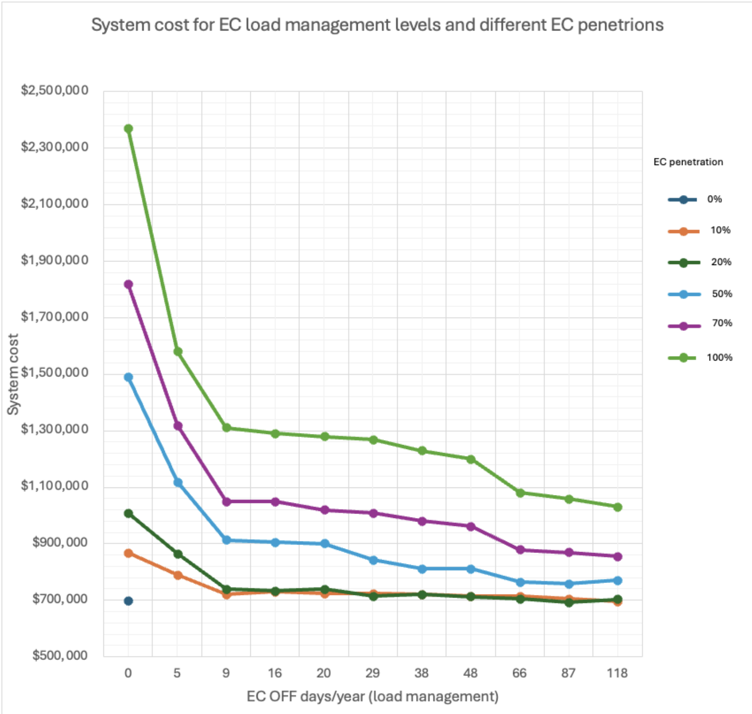


Table 3: With just nine days of load management, sizing for eCooking increases CAPEX by only 3 or 6% respectively for 10 and 20% eCooking adoption rates. Depending on eCooking tariffs, the addition of this level of eCooking has the potential to significantly increase revenue to enhance the overall financial model of grid development and operations.

RESULT TABLE 3: Cost additionality (%) on the no EC base case.

	NO EC 0%	10%	20%	50%	70%	100%	EC Penetration
0 NO LM	$ 697,468	24%	45%	114%	161%	240%	
5		13%	24%	61%	89%	127%	
9		3%	6%	31%	51%	88%	
16		5%	5%	30%	51%	85%	
20		4%	6%	29%	46%	84%	
29		4%	2%	21%	45%	82%	
38		3%	3%	17%	41%	76%	
48		2%	2%	16%	38%	72%	
66		2%	1%	10%	26%	55%	
87		1%	0%	9%	25%	52%	
118		0%	1%	10%	23%	48%	
Days EC off/year							

- **Result Table 3:** The $ value shows the system cost for the base case of NO EC. The % values then show the % additional cost of adding EC with or without LM programs.

The above findings in Tables 2-3 originate, based on similar boundary conditions as defined in COSMO Phase 1, where research, planning and modelling focused primarily on residential applications of electric cooking. Boundary conditions in COSMO Phase 1, in turn, relied on results from the "Kwison Elektrik" field testing of residential electric cooking.

Figure 4, below, depicts both the average electric load profile as found in the Kwison Electrik fielding test among active participants (in orange) and the adjusted individual electric cooking load profile as used for modelling purposes (in blue), after considerations for pricing elasticity and time of use clipping we considered.

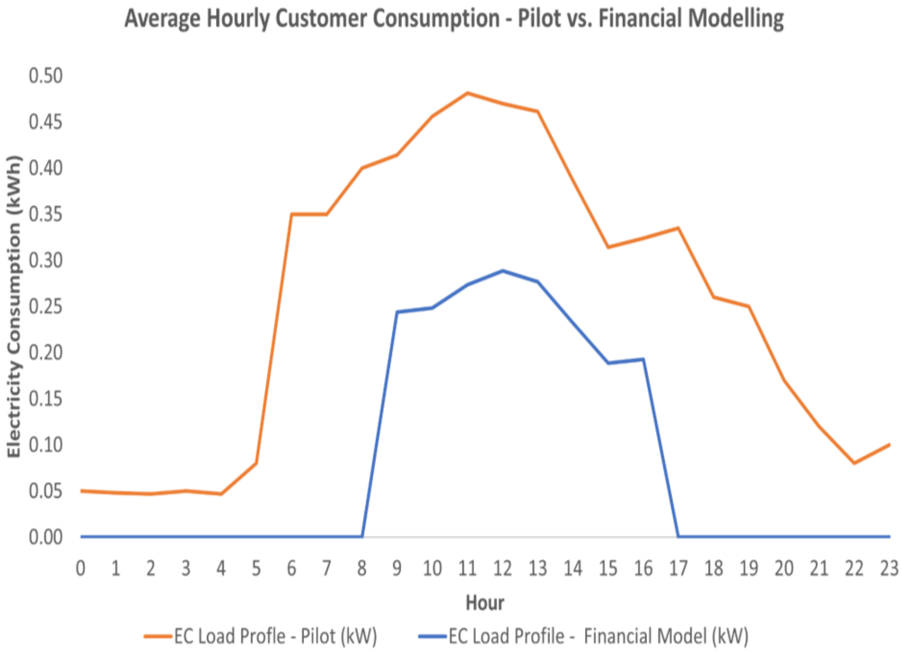


***Figure 4:** Adjusted average electric cooking loads from EarthSpark's "Kwison Elektrik" study, as applied in COSMO Phase 1*

For COSMO Phase 1, number of electric cooking appliances were quantified per microgrid and then aggregated to form the total electric cooking composition, as part of the overall hourly load profile. For example, in the case of Table 1, 25 connections each with an electric cooking appliance would result in a significant fraction of the daytime (note the grey component).

This same aggregation approach was further applied to institutional cooking, where one institutional electric cooking appliance, such as the 12 quart model intended for this study, was assumed for modelling purposes to be two aggregated EPC load profiles as used COSMO 1 modelling. Although the power rating of one 12-quart EPC is often less than double that of a 6-quart model (typically ~1600 W for 12-quart and 1,000-1,200 W for a 6-quart), the higher utilization rate in institutional applications warranted the assumed high consumption rates that allowed for more streamlined modelling.

For all other quantitative assumptions, refer to COSMO Phase 1.

4.2 System Capacity Optimization Through eCooking Integration

Contrary to assumptions that new electric loads increase system cost, Phase 2 modeling demonstrates that **eCooking can reduce overall system average cost of energy**. The small increase in CAPEX is more than compensated for by greatly increased kWh sales because of improved load balancing.

The modeling shows:

- PV and battery assets are more efficiently utilized,
- reduced overbuilding is required to meet peak evening loads,
- daytime loads smooth the load curve,
- More solar energy is used productively.

The ASES Case Study emphasizes that eCooking—when managed—creates a "virtuous cycle" where customer demand aligns with the system's natural generation profile, reducing operational costs.

4.3 Impacts on Reliability and Resilience

Key reliability-relevant findings include:

- **Even modest eCooking adoption increases system resilience**, if more energy is consumed during predictable mid-day windows rather than evenings.
- eCooking's dispatchable nature allows operators to call for **real-time load reductions** when needed.
- Modest amounts of alternative cooking with charcoal (9days per year) allows all other loads to be served with total reliability.
- Flexibility in meal timing (especially for institutions) enhances **grid balancing capabilities**.
- eCooking's with pressure cookers or other appliances with thermal storage (meals stay hot) make short-duration curtailment **minimally disruptive** to users.

These benefits mirror Phase 1's observations and deepen them with operational evidence.

4.4 Demand-Side Management (DSM) Opportunities

The modeling and field analysis confirm that eCooking is an unusually flexible and DSM-friendly load:

- meal times can be adjusted within hours
- some appliances (like rice cookers and EPCs) operate on timers
- institutions can easily shift cooking to solar-rich periods
- users can be prompted with simple messaging ("cook earlier today")
- even low-tech DSM (SMS messaging) is effective

This DSM compatibility is critical for Haiti's microgrids, which must operate reliably without diesel backup generators.

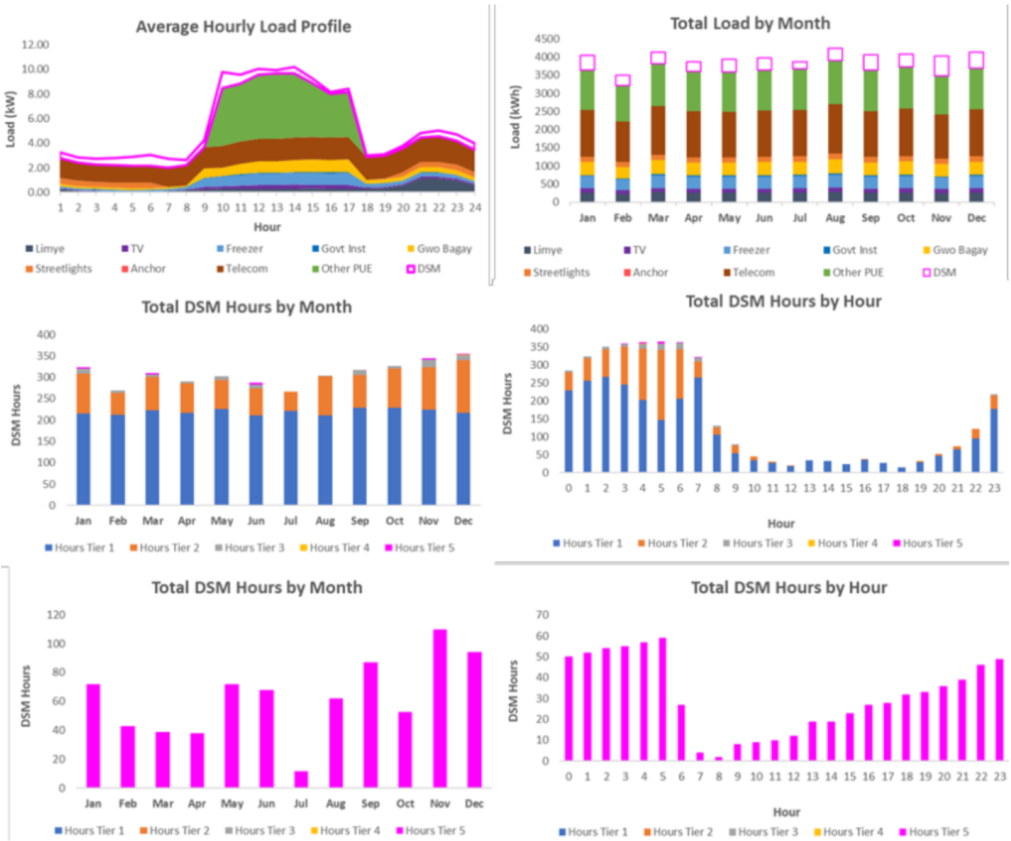


Figure 5: Example demand side management tool modeling output

4.5 Solar Clipping and Opportunity Loads

EarthSpark's operational data showed extensive **mid-day clipping**—times when solar generation exceeds load and the battery is already full.

Phase 2 finds that:

- eCooking perfectly fits these windows, reducing present or future clipping
- institutions can time meal preparation to absorb clipped energy,
- use of clipping for cooking greatly increases solar utilization,
- these loads improve overall financial performance.

DER sites provided real-world examples of this alignment, even amid system outages.

Deep dive for operations : Les Anglais grid

Below is a look at the remote monitoring portal for the Les Anglais grid. The Les Anglais grid is a solar+battery+diesel hybrid minigrid. In the image below, the system performance chart shows the diesel generator runs every night of the observation period. This means there is no available battery capacity to support additional eCooking. On most days, however, the mid-day peak shows that the solar generation is 'clipped '(prevented from being generated) because the available solar energy exceeds the ability of the batteries and the load to absorb all potential energy generation from the solar array. The clipping is not fully consistent, but it occurs meaningfully on 4 of the 7 days observed here.

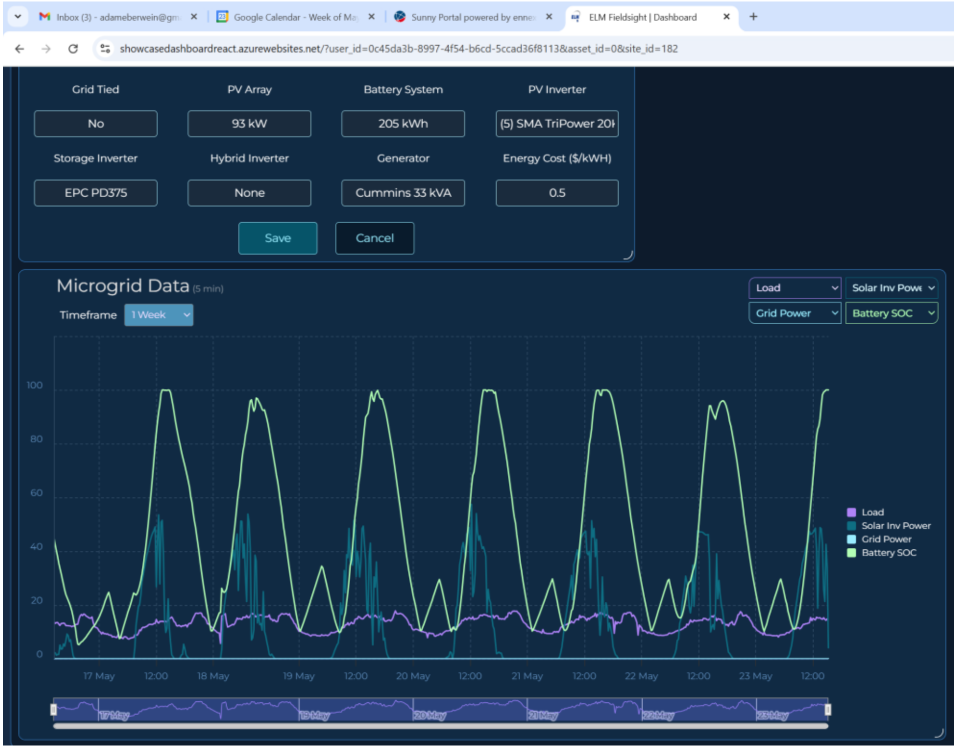


Figure 6: 7-day Les Anglais Generation Profile with Examples of Solar Clipping

In the zoomed-in mid-day peak view below we can see that under current conditions, on sunny days in Les Anglais, roughly 80 kWh of energy could be directed to eCooking between 13H and 15H without significantly impacting any other variable.

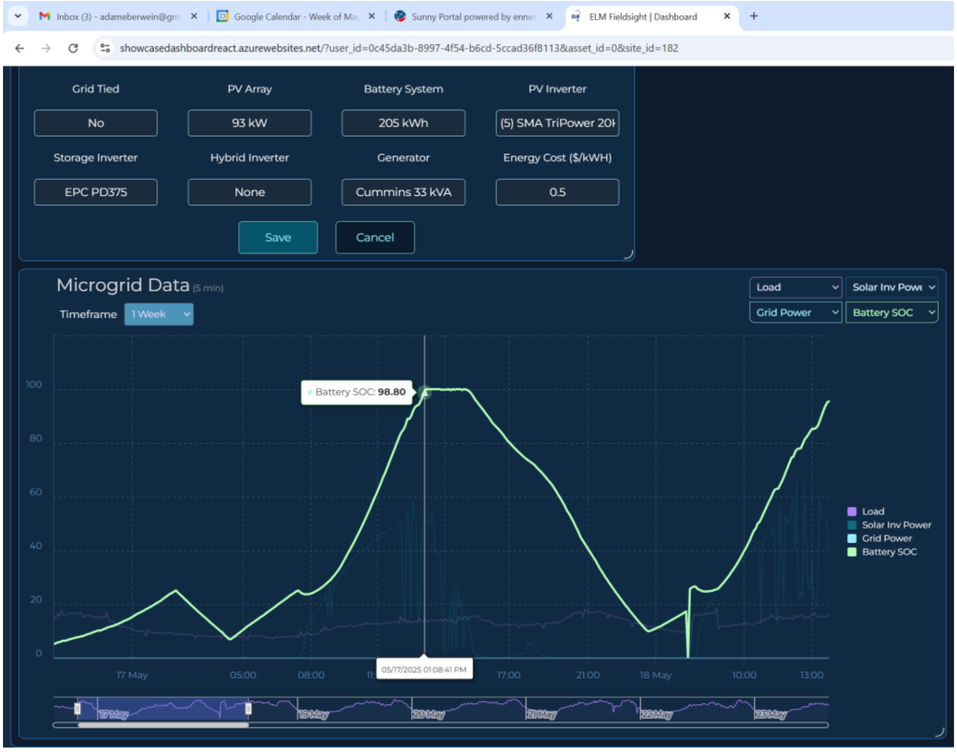


Figure 7: 1-day Les Anglais Generation Profile with Example of Solar Clipping

In the above image, the operations data show that the microgrid battery's state of charge (SOC) reaches full charge at 1:08p and remains flat for ~2 hours. This means that – for this duration – the solar array is "spilling sunshine" or in other words foregoing generation because there is nowhere useful for the power to flow. With some caveats around distribution system constraints, any additional load during this window would enhance microgrid economics and deliver additional value to customers without impacting the grid reliability or the use of the generator.

EarthSpark is planning to re-launch limited eCooking to coincide with these hours of full SOC. For the first time, EarthSpark will incorporate weather forecasts for SOC prediction and day-ahead messaging to participants to inform their cooking decisions.

Deep dive for operations: Tiburon Distributed Energy Resource ("DER")

As mentioned above, an October 2024 generation system fire brought down service of the main grid in Tiburon. One islanded solar+storage system serving the telecommunications tower and health clinic remains operational with excellent reliability and some additional capacity. The site is notable because there is frequently charcoal cooking for a school occurring directly in front of the modern inverter room for the DER. The women cooking on site as well as the institution director have all expressed interest in trialing electric cooking.

Below is an operational view from the Tiburon DER. Note that batteries reaching 100% SOC on a sunny leads to 50% SOC by the end of the night, which in turn means roughly 40% of the kWh battery bank, or a max of roughly ~28 kWh of electric cooking per day on sunny days. When thinking of solar clipping on certain days, that number is likely 40-50 kWh.

Figure 8: 7-day Tiburon Generation Profile with Example of Solar Clipping

5. INSTITUTIONAL COOKING FINDINGS

Institutional cooking emerged as one of the strongest and most actionable insights from COSMO Phase 2. Across schools, clinics, community kitchens, and local feeding programs, institutions showed a combination of **clear need, operational readiness, and high strategic value** for early eCooking adoption.

The 2025 MECS COSMO Memo documents how institutions became an implementation priority due to security disruptions and delays in household-oriented work.

As direct household trials became temporarily infeasible, institutional assessments became the primary channel for advancing real-world eCooking preparation.

5.1 Predictable Cooking Patterns Align with Solar Availability

Institutions in EarthSpark communities generally prepare meals:

- in predictable morning and mid-day windows,
- using large batch processes,
- with fixed staffing and organizational accountability.

This aligns precisely with the periods of highest solar availability in 100% renewable microgrids.

As the ASES Case Study highlights, daytime cooking offers an elegant solution to microgrid load balancing—absorbing solar energy that would otherwise be curtailed and reducing the evening load, which is typically the most constrained.

5.2 Reduced Exposure to Charcoal Costs and Supply Instability

Institutions described multiple challenges related to charcoal-based cooking:

- high and unpredictable fuel costs
- exposure to smoke for kitchen staff, students, and patients
- logistical difficulty of sourcing charcoal
- environmental concerns and community pressure to reduce deforestation.

The shift toward electric cooking addresses all of these concerns. Institutions emphasized that electric cooking offered:

- cleaner and healthier kitchens
- more reliable cooking schedules
- reduced staff time for fire management
- fuel security (tied to the microgrid rather than external charcoal markets).

Appendix A provides important insights across the surveyed institutions that shed light on the impact on firewood reduction and charcoal by extension and implications on emission reductions can be further drawn from these findings.

Additionally, COSMO Phase 1 highlighted household purchasing of charcoal was found to 2-3 cans per meal in a typical household. In the case of institutions, such as schools, 400 - 700 meals were reportedly prepared per day (492 as part of Appendix A surveying of facilities available to participate in the survey), conservatively accounting for 800 - 2100 cans of charcoal per day. In reality, the level of displacement is likely even greater due to the improved efficiencies associated with cooking in higher volume electric cooking appliances.

Table 4: Purchasing and cooking patterns for different fuel types

Fuel	Charcoal	Firewood	Propane
Purchased Quantities	Bucket: ~7 cans Bag: ~ 3 buckets or 21 cans	Bunches	Tank
Purchasing Patterns	Bucket: 1 every 2-3 days Bag: 1 every 14 days	Bunches: 1-2 bunches every 2-7 days	Tank: 1 every 8 days
Cooking Quantities	2-3 cans per meal	1/4 - 1/2 bunch per meal	1/8 of a tank per meal
Cost	Bucket: 150-250 htg Bag: 750 htg	Bunch: 50 htg	Tank: 1950 htg

These findings taken together provide indicators for how carbon and impact finance can be taken into consideration in future discussions and project offerings. Both the offsetting off charcoal from residences that would have been in use if not for institutional food programs and the offset of firewood within the institutions and at a defined scale that will allow future collaborators to incorporate methodologies, as suitable.

5.3 Operational Readiness and Staff Willingness

Contrary to initial assumptions, many institutions reported that their staff were eager to adopt electric cooking equipment, citing:

- ease of learning,
- simplification of cooking processes,
- reduced staff time
- improved safety,

- reduced temperatures in cooking spaces, and
- modernization of food service operations.

EarthSpark's early prototypes of EPC use in community settings demonstrated that institutions could effectively integrate appliances with minimal training—reinforcing Phase 1 observations that EPCs are intuitive and well-received.

5.4 Institutional Cooking as a Social Demonstration Point

Institutional adoption also carries substantial community influence. Schools, clinics, and churches serve as **trusted nodes** within rural Haitian communities. When institutions adopt eCooking:

- they normalize the technology
- increase community trust in electric appliances
- provide visible demonstrations of clean, modern cooking
- catalyze household-level curiosity and eventual demand

Phase 2 therefore identifies institutions as "load anchors" not only for technical reasons, but also for social adoption pathways.

5.5 Hedging of Participation Rates between Institutional & Residential DSM

In terms of participation rates, this COSMO Phase 2 modelling built off of the assumptions and sensitivities built into COSMO Phase 1 residential cooking applications but scaled to institutional purposes. While Phase 1 highlighted a participation of 10% of residential customers at the consumption rates as shown in Figure X as an effective level of participation, Phase 2 considered an equivalent participation rate but in terms of institutional appliances. For example, a microgrid with 500 connections would be well suited for a residential electric cooking participation rate of 50 active electric cooking appliances. In the case of an equivalent institutional cooking program, those 50 residential appliances could be replaced by 25 institutional appliances for an expected similar impact for business plan modelling purposes.

In practical terms, a blend of residential and institutional participation is the most effective means of minimizing sensitivity, as well as implementing a sign-up system that allows participation by those that want to use the service on a given day or week. Institutions are especially beneficial given their well-defined schedules for meal preparation, allowing for higher utilization rates. Any remaining system capacity could then be supplied to residential applications, based on higher variability in signups over a larger pool of applicants. While institutions are fewer and expected to have more consistent participation, residences are expected to have lower participation rates but greater level of interest, with expectations of above 30% of residents making up the expected demand.

5.6 Financial Impacts

Table 5, below, shows the results as developed in COSMO Phase 1, comparing the buildup of additional CAPEX, debt secured, OPEX and G&A with the additional revenue to manifest. In this case, 9% increase in CAPEX resulted in 25% increase in revenue over a 24 year-horizon. Given the ability in COSMO Phase 2 to aggregate institutional cooking in a similar manner, similar results would manifest; however, these assumptions are considered more conservative for institutional cooking, as institutional electric cookers are expected to have relatively lower equipment costs as well as lower OPEX costs to manage the program rollout and ongoing program support.

Table 5: Comparison of top-line financial model impacts for electric cooking and no electric cooking

Metric	Units	Total - Electric Cooking	Total - No eCooking	Change due to electric cooking ($)	Change due to electric cooking (%)
Total Portfolio CAPEX Costs	Million USD	$42.2	$38.7	+$3.5	+9%
Total Low-Interest Debt Secured for the Project	Million USD	$8.4	$7.5	+$0.9	+12%
Total OPEX Costs (24-year horizon)	Million USD	$39.5	$34.7	+$4.8	+14%
G&A Costs (24-year horizon)	Million USD	$25.7	$25.7	+$0.0	+0%
Total Operating Revenue (24-year horizon)	Million USD	$116.0	$93.2	-$22.9	+25%
Overall Average Tariff for Customers	$/kWh	$0.63	$0.69	+$0.06	-10%
Debt repayment	Years	Full repayment after 13 years	Full repayment after 11 years	+2 years	+18%
Equity distributions	Million USD	NPV $21.7M	NPV $18.1M	+$3.6M	+20%

COSMO Phase 1 highlighted, "Full debt payment for the non-electric cooking case materialises by year 11 of the Project, while the inclusion of electric cooking results in a 13-year full debt repayment timeline. Given that current versions used for financial modelling include full payment of sub-debt well within the 20-year requirement, there is inherent built in flexibility to allow for adjustments in remaining within all debt requirements." Institutions in Haiti have a unique set of challenges for raising government funding and, therefore, in cases where these types of funds are inaccessible or inadequate, public institutions are expected to resort to fundraising through separate fees collected from enrolled families to help finance the food programs. Household incomes as the backstop allows for assumptions on repayment performance and affordability thresholds fall in line with results as found in COSMO Phase 1.

6. CONSUMER FINANCE & RBF MECHANISMS

Scaling eCooking depends on affordability and accessibility. The Consumer Finance + RBF Assessment outlines EarthSpark's extensive experience with clean energy financing mechanisms—from microloans to productive-use equipment pilots—and identifies the most appropriate tools for eCooking scale.

Phase 2 strengthened financial pathway development and clarified which mechanisms will best support electric cooking rollout across multiple grid sites.

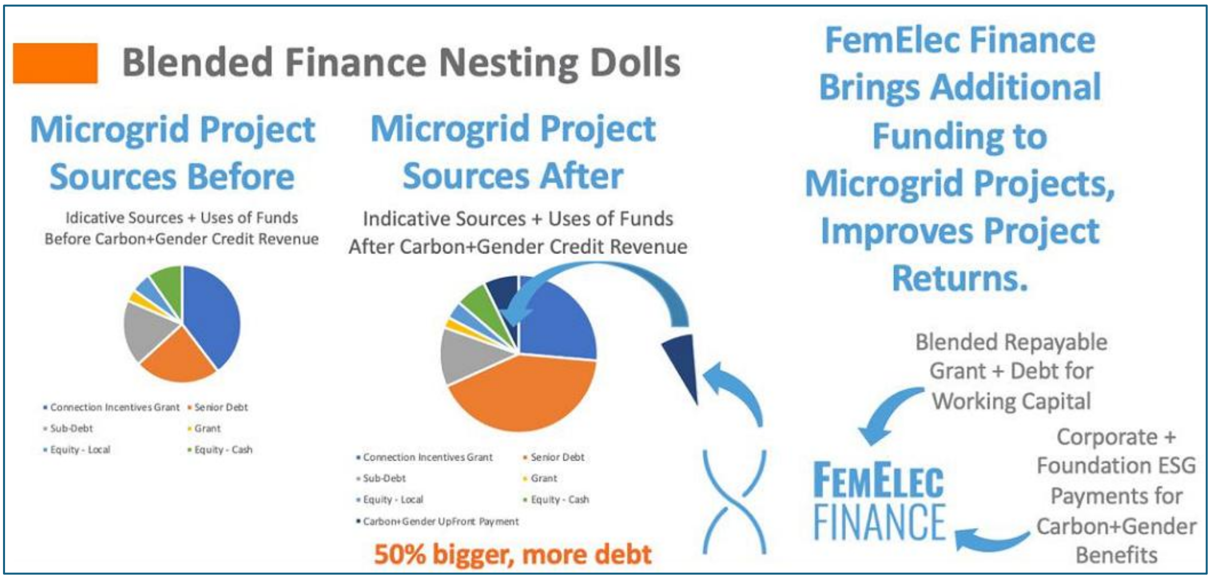


Figure 9: A slide from EarthSpark's EarthSpark's FemElec Finance pitch deck. The concept earned a lot of enthusiasm from partners but never secured funding. The most promising funding pathway, a partnership with Deetken Impact to refine and secure funding for the work, ended when USAID ended support for Deetken.

6.1 On-Bill Financing as the Primary Mechanism

On-bill financing emerged as the strongest option for eCooking scale due to:

- **high repayment reliability** (historically strong performance in EarthSpark communities);
- **low administrative burden** relative to microfinance models
- **integrated metering and billing through SparkMeter**
- smoother repayment schedules aligned with ability to pay
- avoided reliance on external lenders

The Assessment of Consumer Finance & RBF emphasizes that on-bill financing reduces risk, increases equity, and enables EarthSpark to remain the primary financing institution without complicated partnerships.

6.2 Carbon Finance and Gender Finance Pathways

EarthSpark's experience with FemElec Finance—a proposed blended carbon and gender credit approach—provided important insights into how eCooking could be supported at scale. Although the donor landscape shifted and the program was not implemented as initially envisioned, Phase 2 identifies persistent opportunities:

- electric cooking produces **verifiable reductions in charcoal-based emissions**;
- EPC adoption has **strong gender-equity impacts** (reduced cooking burden, safer kitchens, time savings);
- monitoring of appliance usage can be automated through **IoT or meter-based approaches**, lowering verification costs;
- carbon credit revenues could subsidize both appliances and program delivery.

The Assessment notes that multiple partners—including Powersouth, WOCAN with its W+ Standard, MicroEnergy Credits and Deetken Impact—had signaled formal interest in piloting carbon-backed eCooking programs. Though external circumstances disrupted these pathways, the prospects remain strong and aligned with global clean cooking finance trends.

EarthSpark has not reached a strong conclusion about the reasons the FemElec Finance initiative did not find funding. It is possible that building a new asset class was too ambitious at a moment when international development financing was retracting overall. The enthusiastic validation from credible sector partners seems to indicate that practitioners see a need for this type of instrument, but there appears to be a perspective gap between practitioners and funders. More work is needed to better understand the perspective of climate+gender funders/investors/match makers.

6.3 Results-Based Financing (RBF)

Phase 2 also explored RBF structures that reward:

- verified appliance adoption,
- consistent usage patterns,
- achievement of DSM outcomes,
- gender or social-impact metrics.

The ASES Case Study reinforces that RBF can be an enabling mechanism for early-stage markets where appliance uptake requires external support.

In future phases, an RBF structure could:

- lower upfront appliance prices;
- reward institutions for consistent use;
- enable EarthSpark to scale with reduced risk;
- enable EarthSpark to extend the instrument to other minigrid operators;
- attract donor investment into high-impact cooking programs.

One significant event that happened during Phase 2, was that EarthSpark acquired the operations of its smart metering provider, SparkMeter, Inc. EarthSpark's stepping in to take over global operations of SparkMeter Inc.'s metering enterprise was in response to the company's going out of business and EarthSpark's reliance on the advanced features of the SparkMeter metering platform for eCooking and overall grid management for its 100% solar-powered grids. SparkMeter's situation offered both a crisis and an opportunity for EarthSpark and the minigrid sector at large. EarthSpark's intention now is not only to ensure continuity of SparkMeter operations but also to evolve the service offerings to better support eCooking integration and broader integration and management of distributed energy resources. This functionality appears helpful or essential for the measurement and evaluation requirements of some of the RBF pathways.

6.4 Financial Barriers and Remaining Challenges

Despite strong potential, several barriers persist:

- upfront costs remain high for many rural households;
- electric appliance availability in Haitian markets is limited;
- supply chains are highly vulnerable to port closures and insecurity;
- institutional budgets are constrained and may require subsidies or external financing.

Phase 2 confirms that these barriers are solvable—but require structured financing mechanisms paired with robust program support. In the case of supply chain vulnerability, Phase 2 has underlined the need for flexible timelines to accommodate implementation delays. The successful arrival of some equipment to site nevertheless validates the premise that progress is still possible even when transit and logistics are highly challenging and time consuming.

7. OPERATIONAL LESSONS FROM FIELD CONDITIONS

Phase 2 was implemented during one of the most challenging operational periods in EarthSpark's history. Haiti's national instability, shipping blockages, and internal grid disruptions created conditions that tested the resilience of the COSMO program. Despite these challenges, new insights emerged that significantly advanced understanding of eCooking integration.

7.1 The Tiburon Microgrid Fire and System Downtime

In late 2024, a catastrophic fire destroyed the central generation system at Tiburon. This event:

- removed a major implementation site from Phase 2;
- forced EarthSpark to focus on adoption at the DER sire;
- required major reconstruction efforts;
- shifted program milestones substantially.

The May 2025 MECS Memo documents how this event reshaped the Phase 2 timeline and forced a pivot toward institutional preparation and technical analysis while infrastructure was being rebuilt.

This adaptive response strengthened the program's evidence base by demonstrating that eCooking could be integrated even during disrupted conditions.

7.2 DER Operational Insights

Despite grid-level outages, Tiburon's DER site continued operating reliably and offered important lessons:

- DER systems showed **ample mid-day availability**, confirming modeling assumptions.
- Appliance trials could still be conducted even during partial system operation.
- DSM strategies could be tested under constrained operating conditions.
- DER-eCooking compatibility opens new avenues for pilot demonstrations.

This experience illustrates that decentralized energy technologies can sustain eCooking even when central systems face interruptions.

7.3 Solar Clipping as a Major Opportunity Load

Field data across both Tiburon and Les Anglais highlighted significant **solar clipping**, meaning:

- batteries are often full by mid-day;
- solar panels generate surplus electricity;
- unutilized energy represents lost value.

Phase 2 validated that eCooking is one of the most effective opportunity loads for reducing curtailment. This reinforces the economic case for eCooking and provides a near-term operational strategy for EarthSpark's microgrids.

7.4 Supply Chain and Logistics Lessons

The 2025 MECS COSMO Memo describes extensive shipping delays: appliances and equipment were held in port for extended periods due to national security issues.

Key lessons:

- program design must account for timeline variability;
- local appliance availability must be bolstered;
- EarthSpark's procurement must diversify supply routes;
- contingency planning is essential for hardware-based programming.

These lessons will shape future implementation planning and risk management strategies.

Below: The appliances listed here are currently in transit - caught in customs but soon-to-be released and barged to the project implementation area.

		
60 x 12 quart Electric Pressure Cookers	22 x 60 cup (cooked) Rice Cooker + Warmer	2 x 26 quart Electric Oven + Air Fryer
MegaChef	Cuckoo CR-3032	Kalorik MAXX

8. CROSS-CUTTING THEMES

COSMO Phase 2 underscored several cross-cutting themes that influence the feasibility, desirability, and long-term impact of electric cooking in EarthSpark microgrid communities. These themes were present across technical modeling, institutional engagement, financial mechanism design, and operational experience.

8.1 Gender Equity and Women s Empowerment

As noted in both the Phase 1 report and in the Consumer Finance & RBF Assessment, eCooking presents meaningful opportunities for improving gender equity in rural Haiti.

Women in EarthSpark communities bear the majority of responsibilities associated with traditional cooking:

- purchasing charcoal;
- spending long hours personally tending smoky fires;
- managing fuel scarcity;
- coping with smoky, high heat and unsafe cooking environments, often with children in or near the cooking area.

Electric pressure cookers, rice cookers, and other eCooking appliances significantly reduce:

- cooking time,
- fuel cost burdens,
- indoor air pollution exposure, and
- physical labor associated with feeding families or institutions.

Institutional kitchens—where women often prepare meals for hundreds of children or patients—stand to benefit enormously. Electric cooking creates safer and more dignified working conditions and reduces stress associated with fuel availability.

The FemElec Finance concept explored during Phase 2 explicitly positioned eCooking as a gender-impact technology—one that could justify gender-linked carbon finance or impact-linked loan mechanisms.

8.2 Climate & Environmental Impact

Electric cooking supports Haiti's climate goals and reduces deforestation by displacing charcoal use. Phase 2 found that EPCs could replace significant portions of charcoal cooking due to:

- high energy efficiency,
- short cooking times,
- ease of use, and
- cultural appropriateness for common Haitian dishes.

The ASES documents reinforce that using solar power for cooking not only reduces emissions but also improves the utilization rate of renewable infrastructure—an important sustainability marker.

With carbon finance mechanisms maturing globally, verified reductions in charcoal consumption represent a potentially meaningful revenue stream for EarthSpark and its communities.

8.3 Community Acceptance and Social Integration

Even in the absence of household survey data for Phase 2, institutional engagement revealed encouraging signals regarding community readiness:

- institutions act as trusted demonstration sites;
- community staff showed rapid acceptance of EPC technologies;
- residents consistently expressed curiosity and interest;
- early adopters (schools, churches) can model behavior changes that ripple outward.

This aligns with Phase 1 findings, in which households expressed strong demand for modern cooking appliances.

8.4 System-Level Planning & Load-shaping Integration

Across all technical and operational analyses, eCooking emerged as a tool for **intentional load shifting**—an essential component of EarthSpark's future microgrid planning. Integrating cooking explicitly into load forecasts and DSM protocols can strengthen:

- solar and storage asset sizing and optimization,
- tariff design,
- project finances
- customer benefits
- community training programs,
- institutional cooking schedules.

This "system-first" approach mirrors the thinking embedded in Phase 1 and advanced through Phase 2's more rigorous modeling work.

9. DISCUSSION

Phase 2 demonstrates that electric cooking represents far more than an incremental service—it is a strategic asset for community microgrids and a core pillar of EarthSpark's long-term electrification strategy. The synergy between eCooking and fully renewable microgrids is not incidental; it is fundamental to achieving reliability, sustainability, and customer value at scale.

Several overarching insights emerge from the Phase 2 synthesis:

9.1 Electric Cooking Can Be Central to Renewable Microgrid Viability

The ASES Extended Abstract demonstrates that the combination of daytime-aligned cooking loads and minimal curtailment requirements allows for significant eCooking adoption without threatening system reliability.

Phase 2 strengthens the case that:

- eCooking reduces PV underutilization;
- enhances operational stability;
- enables demand-side flexibility (when the program is designed accordingly);
- reduces need for asset oversizing;
- aligns closely with customer needs and aspirations.

9.2 Institutional Pilots Form the Most Practical and High-Impact Entry Point

Given Haiti's instability and the logistical challenges that characterized the Phase 2 period, household-based pilots became less feasible. Institutions, however—schools, clinics, community kitchens—proved resilient partners.

They bring:

- strong leadership structures;
- predictable daytime demand;
- high community visibility;
- motivation to modernize and reduce charcoal reliance.

Institutional pilots allow EarthSpark to demonstrate technical feasibility, refine DSM strategies, and build community trust before scaling to households.

9.3 Financing Strategies Must Be Blended and Flexible

Phase 2 identified multiple potential financing tools that could be incorporated into a **portfolio approach**:

- **on-bill financing** for broad accessibility;
- **RBF** to support early adoption and de-risk scaling;
- **carbon finance** to reduce end-user costs;
- **gender-impact finance** to support women-forward outcomes.

This blended approach improves affordability while aligning donor funding with verifiable, high-impact outcomes.

9.4 Operational Realities Require Adaptive Program Design

The Tiburon microgrid fire, port closures, and national instability demonstrated that even strong program designs must be resilient to unpredictable events. The ability to pivot toward DER-based cooking demonstrations and institutional readiness work exemplifies EarthSpark's adaptive approach to programming.

9.5 Opportunities for Replicable and Scalable Climate & Gender Impact

eCooking provides a rare intersection of:

- measurable emissions reduction;
- measurable gender-equity benefits;
- measurable health improvements;
- quantifiable operational value for microgrids.

This positions EarthSpark as a compelling candidate for future climate-finance partnerships, especially as it engages the minigrid sector more broadly through the acquisition of SparkMeter's emerging market operations.

10. PLANNING FOR FUTURE WORK

Based on COSMO Phase 2 findings, EarthSpark is planning several workstreams for the next stage of eCooking advancement in its Haiti microgrid context.

10.1 Launch Structured Institutional eCooking Pilots

Immediate priorities include launching pilots in:

- **Tiburon** (DER-compatible deployment),
- **Les Anglais** (strong operational availability),
- **La Cahouane** (institutional demand and readiness and first 'new grid designed for eCooking').

These pilots will:

- validate DSM protocols;
- demonstrate cooking with otherwise clipped energy;
- refine maintenance and training procedures;
- generate data for carbon-credit methodologies.

10.2 Implement On-Bill Financing for Appliances

EarthSpark should:

- structure monthly payment plans for EPCs and rice cookers;
- integrate repayment into SparkMeter billing;
- pilot low-interest or interest-free terms for institutional partners;
- incorporate default protections through metering.

On-bill financing should become the core financial offering for Phase 3.

10.3 Re-engage Carbon-Finance Partners

EarthSpark should reopen carbon-finance discussions with:

- MicroEnergy Credits,
- Deetken (if appropriate under new contexts),
- climate venture philanthropies,
- gender-lens investors.

Electric cooking creates clear, verifiable carbon reductions—an increasingly valuable climate asset.

10.4 Strengthen Supply Chain Strategy

Given Phase 2 procurement challenges, EarthSpark should:

- diversify appliance sourcing channels;

- establish pre-positioned appliance inventory in-country;
- formalize customs and logistics contingency plans;
- explore local distribution partnerships.

This will reduce program delays and build market resilience.

10.5 Integrate eCooking Into Microgrid System Planning

EarthSpark's engineering team should begin integrating eCooking into:

- load forecast models;
- DSM design;
- tariff structures;
- PV and storage sizing strategies;
- operational communication plans.

Cooking loads should be treated as a **planned DSM resource**, not an ancillary service. This is also a specific point to be assessed in minigrid operator engagement around SparkMeter current and future functionality.

10.6 Additional Analysis

As other opportunities for eCooking arise additional analysis should be conducted on the sensitivity of these results to alternative solar resource regimes and cooking schedules. The impact of the additional eCooking loads on project financing should be evaluated under alternative tariff structures.

11. CONCLUSION

COSMO Phase 2 builds on EarthSpark's long-standing commitment to bringing clean, reliable energy services to rural Haitian communities—and demonstrates beyond doubt that electric cooking is a central pillar of that strategy.

Across four major work streams—technical modeling, institutional engagement, finance mechanism design, and operational field analysis—the findings converge:

- **eCooking is technically viable** within fully renewable microgrids.
- **Daytime cooking aligns perfectly** with solar availability and reduces system stress.
- **Institutional partners are ready** and strongly motivated to adopt electric cooking.
- **Financing tools exist** to make appliances affordable and scalable.
- **Operational conditions support eCooking**, even amidst national instability.
- **Electric cooking delivers measurable climate and gender impacts**.

Phase 2 therefore positions EarthSpark not only to launch institutional pilots, but also to continue with household eCooking support. EarthSpark aims for its next grids to "prove what is possible" in integrated minigrid planning and management in Haiti—forming a model for the intersection of energy access, gender equity, climate action, and community empowerment.

With strong foundations, proven technical feasibility, validated operational conditions, and aligned social demand, EarthSpark is now poised to move more confidently into the minigrid scale-up phase with eCooking serving as a planning and operational pillar—bringing the promise of clean, modern cooking to the communities it serves. EarthSpark is also well-positioned to propagate these findings and engage and enable the sector through its recent acquisition of the emerging market operations of the smart metering technology provider, SparkMeter Inc., with operations serving minigrid operators in 30 countries.

APPENDIX A - Pre-Feasibility Assessment for Electric Cooking Integration for Schools in EarthSpark s Mini-grid Communities in Haiti

Introduction

This assessment is conducted as part of EarthSpark International s ongoing collaboration with the Modern Energy Cooking Services (MECS) program under its MECS-Cooking Support on Mini-Grids (COSMO Phase 2) program. The objective is to explore the potential for electric cooking for schools in EarthSpark s mini-grid communities of Les Anglais and Tiburon in Southern Haiti.

This summary report is structured as follows:

- **Methodology** – Description of the survey and feasibility analysis methodologies for electric cooking
- **Schools Overview** – Overview of schools surveyed across Les Anglais and Tiburon
- **Cooking Habits** – Summarized observations of cooking habits, including frequency, fuels, timing, and equipment
- **Cooking Costs and Fuel Purchasing** – Estimates of baseline cooking costs and description of fuel purchasing trends
- **Opportunity for Electric Cooking** – Estimates for electric cooking fuel costs for school lunch programs in Haiti
- **Next Steps** – Discussion of next step needs for pilot deployment and field validation of electric cooking solutions for mini-grids in Haiti

Methodology

This high-level assessment followed a two-prong approach for assessing the initial potential of electric cooking for schools in mini-grid communities in Haiti:

1. **School survey** – In June 2024, EarthSpark International conducted baseline cooking surveys for 10 schools across its two mini-grid communities in Les Anglais and Tiburon in Southern Haiti. These surveys were conducted in person by Enèji Pwòp (EarthSpark's social enterprise and mini-grid operator in Haiti) staff. Questions focused on school demographics and operations, the school canteen, costs and purchasing of cooking fuels, and potential for electric cooking.
2. **Literature review and desk analysis** – In order to assess the initial potential for electric cooking to displace some of the baseline cooking demand, EarthSpark adapted observations from MECS' institutional cooking study in Kenya[1] which deployed 40L electric pressure cookers and 16L rice cookers, among other devices, for school cooking in Kenya. Observed

[1] MECS and Kenya Power "INSTITUTIONAL E-COOKING" (2023); Available at: https://mecs.org.uk/publications/institutional-ecooking/

values for cooking quantities and approach, electricity consumption, time, and costs were utilized to provide a frame of reference for developing estimates for electric cooking deployment for schools in Haiti.

Schools Overview

In total, 10 schools were surveyed (6 in Les Anglais and 4 in Tiburon) representing the majority of schools in the mini-grid footprints. These institutions represented a variety of different sizes (279 – 850 students and 15-42 staff) and types of schools (4 private schools, 3 state schools, and 3 religious schools) (Table 1).

School Name	Community	Type	Level	Existing School Canteen	Number of Students / Staff
Ecol Petit Troupau	Les Anglais	Prive (Private)	Kindergarten, Primary, Fundamental, Secondary	Yes	850 students; 42 staff
Ecole Mixte Communrot er les Anglais	Les Anglais	Prive (Private)	Kindergarten, Primary, Fundamental, Secondary	Yes	423 students; 31 staff
Ecole presbiteral Gaisbambins Colege notre Dame de lourde	Les Anglais	Kongraganis (Religious)	Kindergarten, Primary, Fundamental	Yes	600 students; 25 staff
Ecol National les Anglais	Les Anglais	Leta (State)	Primary, Fundamental	No, but they used to	485 students; 17 staff
Ecol Nidanfan les Anglais	Les Anglais	Prive (Private)	Primary, Fundamental	No, but they used to	458 students; 10 staff
Ecole mixe Baptiste les Anglais	Les Anglais	Prive (Private)	Kindergarten, Primary, Fundamental, Secondary	No, but they used to	850 students; 30 staff
Ekol pwesbiteral Sen Jan Batis	Tiburon	Kongraganis (Religious)	Kindergarten, Fundamental	Yes	279 students; 15 staff
Ecole Evangelique Baptiste la Providence de Tiburon	Tiburon	Kongraganis (Religious)	Kindergarten, Primary	Yes	400 students; 18 staff
Ecole Notre Dame de Fatima	Tiburon	Leta (State)	Kindergarten, Primary, Secondary	Yes	348 students; 26 staff
Ecole National Mix de Tiburon	Tiburon	Leta (State)	Primary, Secondary	Yes	547 students; 20 staff

Table 1: Overview of Surveyed Schools

Cooking Habits

Key observations of cooking habits for the seven schools with an active school lunch program or canteen" are as follows:

- All schools utilized firewood as their primary fuel source for cooking, but two schools also noted utilizing charcoal.
- All cooking is done indoors by employed staff
- Five of the seven schools utilize traditional three stone stoves while the remaining two utilized charcoal stoves or other traditional stoves.
- Five of seven schools cooked just once per day, while two of the schools cooked twice per day.
- Most of the schools started cooking before 5 AM and the cooking process generally took about 4 hours.
- Rice or cornmeal are generally the meals that are served across all schools, but two schools also have beans in addition to the rice and cornmeal
- Most schools cook with a combination of pots (2-6 pots) of varying sizes (2-5 mamit or ~6L-15L)
- Schools noted challenges with smoke, excess heat, and difficulty finding firewood

Cooking Costs and Fuel Purchasing

Purchasing habits were mixed across the different schools with three schools purchasing firewood every week, two schools purchasing firewood every two days, and two schools reporting buying firewood daily. Firewood was mostly bought at the market or through a street vendor and the school was responsible for paying for the food and fuel for all but one school that was receiving funding from the Bureau of Nutritional Development.

Total monthly costs ranged from 10,000 htg – 28,000 htg (~$75.57 – $211.62) [2] per month with a median monthly expenditure of 15,000 htg (~$113). All schools also reported seeing a big increase in the cost of firewood over the past 6 months. When calculated on a per student serving basis costs ranged from 0.79 – 3.15 htg/student serving ($0.006 - $0.024) with a median cost of 1.71 htg/student serving ($0.129) (Table 2). All of the schools highlighted a significant increase in firewood cost over the last 6 months.

[2] Based on an exchange rate of 132.3141 HTG / USD sourced from the Banque de la République d'Haïti on June 19, 2024; https://www.brh.ht/

Table 2: Reported Cooking Costs for School Canteens

School Name	Community	Number of Students	How often is fuel purchased?	Estimated monthly expenditures (HTG)	Estimate of fuel costs per student serving (HTG)
Ecol Petit troupau	Les Anglais	850	Chak semenn (Each week)	20,000	1.12
Ecole Mixte Communoter les Anglais	Les Anglais	423	Chak 2 jou (Every 2 days)	28,000	3.15
Ecol presbiteral Gaisbambins Colege notre Dame de lourde	Les Anglais	600	Chak jou (Every day)	10,000	0.79
Ekol pwesbiteral Sen Jan Batis	Tiburon	279	Chak 2 jou (Every 2 days)	10,000	1.71
Ecole Evangelique Baptiste la Providence de Tiburon	Tiburon	400	Chak semenn (Each week)	15,000	1.79
Ecole Notre Dame de Fatima	Tiburon	348	Chak semenn (Each week)	20,000	2.74
Ecole National Mix de Tiburon	Tiburon	547	Chak jou (Every day)	10,000	0.87
MEDIAN		**492**	**Every 3.5 days**	**15,000**	**1.71**

Opportunity for Electric Cooking

None of the schools had any experience with electric cooking previously, but all expressed interest. Some schools even highlighted some benefits of electric cooking (namely that it was better, faster, and protected the cooks) that they had heard from others including EarthSpark s past Kwison Elektrik pilot.

As highlighted above, EarthSpark leveraged MECS institutional cooking study in Kenya to develop an initial analysis comparing unit costs for potential electric pressure cookers with the baseline firewood costs. The Kenya study recorded cooking costs (and by extension electricity consumption) for cooking 4 kg of rice in 16L rice cookers. Specifically, the study found that 1 cycle of rice cookers cooking 4 kg (dry) of rice would utilize about 0.95 kWh.

Using this as a benchmark, EarthSpark developed a high-level estimate for cooking rice with the same 16L rice cookers for school lunches in Haiti. The rice cookers are assumed to be able to replace 2-3 of the traditional pots depending on the size. Assuming the same 4 kg (dry) rice, 1 cup of cooked rice per student serving, $0.36/kWh as EarthSpark s baseline regulated   average tariff", and a 132.31 HTG/USD conversion rate, EarthSpark estimated that the cost per electric pressure cooker cycle for rice was around 22.59 htg (~$0.17) and the per student serving was around 0.75 htg ($0.0057) which is substantially lower than the estimated baseline costs of 0.79 – 3.15 htg/student serving ($0.006 - $0.024) with a median cost of 1.71 htg/student serving ($0.129) (Table 3).

It should be noted that EarthSpark is still determining what tariffs are appropriate for electric cooking, but it expects to be able to offer lower tariffs for institutional electric cooking, especially in the short run, given the outsized community benefits and hopeful ability to attract development partners to support (see discussion section below). Further, with time savings (highlighted below), cooking times could shift to later in the morning when solar production is high and cost of electricity is lower. This means that the differential fuel costs for electric cooking could be lower in reality.

Table 3: Inputs to Estimate of Electric Pressure Cooker Costs for School Cooking in Haiti

Value	Unit	Notes
4	kg rice (dry) per cycle	based on 4kg cycles from https://mecs.org.uk/publications/institutional-ecooking/
198.4	grams / cup rice (dry)	Based on 7 oz per cup dry from USA Rice
20.2	cups of rice (dry) / cycle	
3	Volume ratio for cooked to dry rice	
60.5	cups of rice (cooked) per cycle	
1	cups of cooked rice per student serving	Observations from survey enumerators, based on an average serving across all ages.
60	student servings per cycle	
0.95	kWh / cycle	Calculated based on 29ksh cost per cycle at 30.58 ksh/kWh using the 16 L rice cooker in Kenya
$0.36	$/kWh	Regulated tariff for EarthSpark's mini-grids
132.31	HTG / USD	Exchange rate from the Banque de la République d'Haïti on June 19, 2024
$0.34	cost per EPC cycle ($)	
45.17	cost per EPC cycle (htg)	
$0.01	cost per student serving ($)	
0.75	cost per student serving (htg)	

Time savings are also not factored into this assessment, but the rice cookers in the Kenya study had a cooking time of 30 minutes for 4 kg of rice which is significantly lower than the 3-4 hours for the current baseline stoves and pots in Haiti.

A key gap for this, of course, is the upfront cost of the rice cookers. While the 16L rice cookers are expected to be less expensive than the 40L EPCs from the Kenya study (landed cost of almost $1100), they are still expected to have a higher price point than what is affordable for the schools in Haiti.

Next Steps for Potential EarthSpark + WFP Collaboration

All of this highlights a need to field test and validate assumptions and calculations for the cost and impact of integrating electric cooking, particularly rice cookers, into school canteen cooking in Haiti.

To do this, EarthSpark is proposing to develop a rice cooking pilot project deploying rice cookers for institutional cooking at the one public school in Les Anglais and the two public schools Tiburon. The initial target will be to procure 7 16L rice cookers that will be deployed across select schools. Testing will be done to help adapt local rice recipes to the rice cooker and then training will be provided to the school staff on the operation and maintenance of the equipment.

The goal of this deployment will be to validate assumptions on electric cooking integration for schools, particularly providing primary data for potential institutional cooking business models for the mini-grid context in Haiti. Among others, key metrics and learnings the pilot will track include:

- Appliance suitability and utilization for school lunch meals
- School staff perception of electric cooking appliances
- Taste suitability or acceptance by staff and students
- Recipe adaptations for the rice cooker
- Per cycle yields for different recipes
- Shifts in cooking times
- Comparative fuel costs between traditional firewood/charcoal and electric
- Comparative cooking times between traditional firewood/charcoal and electric
- Potential carbon emissions savings from observed fuel displacement including how these emissions could be verified for carbon markets to help with upfront device costs.
- Electricity use per day, per cycle, per serving as well as the associated load profiles and aggregated impact on the minigrid
- Utilization of solar vs. battery/diesel to cover cooking loads
- Total landed cost for electric rice cookers (to factor into full business model)
- Key challenges and opportunities for rice cookers in the institutional cooking context

All of this data will help EarthSpark and WFP to develop a framework and collaboration model for institutional electric cooking (including strategies for addressing upfront costs) that can be replicated for other schools.

As EarthSpark scales its mini-grid model to other communities in Haiti, and as WFP refines its Climate Smart Schools program, there appears to be much room for mutual support and amplified impact through this partnership. Staff time constraints based on limited funding and competing priorities seem to be the most important limiting factors to further collaboration.