SUPPLY SIDE RESEARCH SUMMARY

TRANSITIONING CAMBODIA FROM BIOMASS TO 'CLEAN' ELECTRIC COOKING

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"Affordable access to electricity can generate bottom up socio economic development which will sustain projects but more importantly, build resilience of people in the last mile." *Okra Solar*

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UKaid from the British people

MECS Modern Energy Cooking Services

Loughborough University

iDE

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1. INTRODUCTION

The Modern Energy Cooking Services (MECS) is a five-year program funded by UK Aid (through the Foreign Commonwealth and Development Office [FCDO])). It aims to break out of a "business-as-usual" cycle by investigating how to rapidly accelerate a transition from biomass to 'clean' cooking (i.e., with electricity). iDE Cambodia has been working with the MECS program since 2019, firstly to gather foundational research around current practices, drivers and barriers in adopting electric cooking in Cambodia (MECS-TRIID), followed by a second project (MECS-ECO) to test different solutions through rapid prototyping and pilots.

The MECS program believes that *"the transition from biomass to modern energy cooking in a single country will likely occur in the coming together of the policy, the supply chain and the needs of customers"*. This requires long term effort and commitment from the ground. As a result, MECS and iDE have formed an in-country partnership to gain a deeper understanding of the clean cooking ecosystem in Cambodia, building on the momentum of the two previous projects (MECS-TRIID and MECS-ECO), and accelerate the shift toward clean electric cooking solutions through engaging enablers and suppliers.

As part of the collaboration, the recent body of iDE research; including a Landscape Analysis, deploying Cooking Diary Studies, Discrete Choice Modelling Surveys and research understanding the needs of people living with disabilities and the elderly; has established an in-depth understanding of the demand (customer) side factors that could drive or restrict people's and households transition to mecs in Cambodia.

However less is known on the supply side factors that prevent a larger scale transition. **The goal for this short, country level study is to understand these supply side factors (production, distribution, and adoption of electric cooking solutions) in more detail, and identify opportunities for interventions that can strengthen Cambodia's enabling environment for electric cooking supply chains**. This study focuses on identifying opportunities to increase the availability and affordability of electric cooking solutions.

2. RESEARCH OBJECTIVES

- Understand the supply side enablers and barriers facilitating/preventing uptake of electric cooking solutions (from utility companies to manufacturers, distributors, startups, retailers)
- Uncover opportunities to promote electric cooking in the supply side (utility to retailer) ecosystem in Cambodia

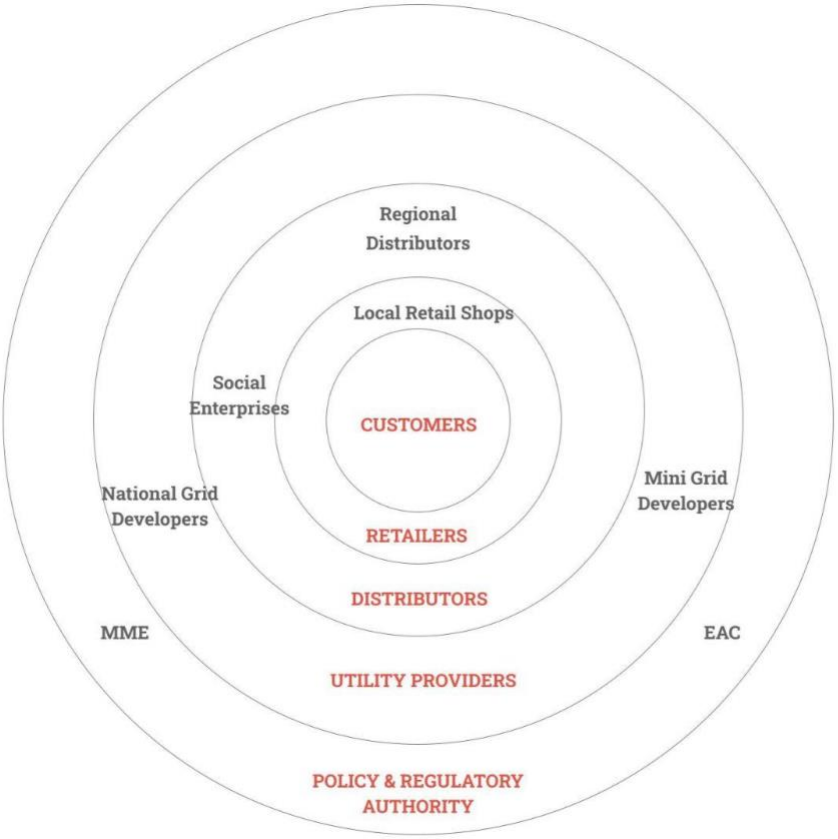
3. HIGH LEVEL RESEARCH QUESTIONS

ACTOR	HIGH LEVEL RESEARCH QUESTIONS
GRID UTILITY POLICY & REGULATORY AUTHORITY	What are the government bodies strategic priorities in enabling affordable, reliable access to electricity and extension of coverage/grid? Do/how do these policies overlap with electric cooking? What is their potential to stimulate electric cooking?
MINI GRID DEVELOPERS	What are the current priorities of electricity access for mini grid developers. Does/how does electric cooking fit with off/mini-grid energy supply?
STARTUPS/SOCIAL ENTERPRISE	What are the factors (enabling or constraining) the ability of startups and social enterprises to deliver and scale their electric cooking solutions to customers?
DISTRIBUTORS & RETAILERS	What are the factors (enabling or constraining) the ability of distributors and retailers to promote greater uptake of electric cooking solutions among their customers?

See actor specific question guides in Annex.

4. SUPPLIER ECOSYSTEM

In this study, we view the supply side ecosystem (Figure 1) at different levels mapping profiles of actors according to their proximity with end customers, from policy and regulatory authorities to retailers bringing electric cooking solutions to customers.



Map of actors influencing the *'supply side'* of electric cooking adoption

Key actors who participated in this study are defined below:

1. **UTILITY POLICY & REGULATORY AUTHORITIES**: Government authorities licensing production and distribution of electricity to grid developers through National Policy, Compliance and Regulatory Frameworks.

2. **MINI-GRID DEVELOPERS**: Utility providers engaged in production and distribution of electricity in far off, rural last mile areas where conventional grids cannot be extended.

3. **STARTUPS / SOCIAL ENTERPRISES** promoting proprietary clean and electric cooking solutions in Cambodia.

4. **LOCAL or REGIONAL DISTRIBUTORS**: national or regional businesses wholesale distributing electrical home appliances(including a range of electric cooking products).

5. **RETAILERS** businesses retailing electrical home appliances (including a range of electric cooking products)

5. RESEARCH PARTICIPANTS

We would like to thank the following organizations for their valuable input and expertise in understanding the supply landscape related to electric cooking in Cambodia.

	Profile	**Organizations**
1	Grid utility Policy and Regulatory Authorities	The Ministry of Mines and Energy, Government of Cambodia
2	Utility Mini-Grid Developers/ Start Up	Okra Solar
3	StartUp/ Social Enterprise	ATEC International
4	StartUp/ Social Enterprise	Eco Sun Cambodia
5	Electric Cooking Distributors	PENSONIC
6	Electric Cooking Distributors	K-Four Cambodia
7	LPG Retail Shops	Local LPG Retail Shop
8	Electric Cooking Retail Outlets	Dynamic Electronic Shop
9	Electric Cooking Retail Outlets	Ly Malen, Blutronic
10	Electric Cooking Retail Outlets	PANASONIC shop

6. RESEARCH METHODS

The research was conducted using a Human-Centered Design (HCD) approach and qualitative research methods to uncover explicit and latent needs of people. This involved talking with key informants to understand the supply side drivers, barriers and opportunities utilizing the following methods:

- **Phone interviews with key experts and business leaders:** Phone/Online/In-person Interviews conducted with Government Regulatory authorities, Mini grid developers and Startups involved in promoting electricity access or electric cooking. Semi-structured

interviews lasted 45-60 minutes in duration.

- **In-depth-interviews (IDI) with retailers and distributors:** To understand various challenges and opportunities for distributors and retailers of electric cooking products, these interviews conducted in participants' workplace/business, lasted 60-90 minutes in duration. Peri urban distributors and retailers outside Phnom Penh were selected for this study to understand the extent of their ability to extend their reach to rural customers.

- **Observations at retail shops:** Visiting retailers in their own shops, conducting observations on types of products, specific features, staff interactions with customers and other points of interest emerging from the conversations. Retail shops representative of available fuel/appliance options in densely populated areas were selected.

Research activities were carried out in accordance with proper consent from the local/ public administration and due consent of participants involved in interviews. **Oral consent was obtained from all participants and signed consent was obtained from participants who were interviewed in person. Research was conducted following MECS ethical research guidance following the Singapore Statement on Research Integrity.**

Notes:
1. Scope of this study focuses on supply side actors except customers.
2. A limited timeframe prevented recruitment and participation from grid developers.

7. KEY FINDINGS:

Findings addressing the research questions are categorized per the Supplier Ecosystem diagram:

A. UTILITY POLICY & REGULATORY AUTHORITIES

Profile: Two main government bodies are responsible for formulating laws and regulations of management of the power sector: The Ministry of Mines and Energy (MME) and the Electricity Authority of Cambodia (EAC). Their roles (covered in the landscape report) include:

1. MME: The MME operates under a policy design mandate, developing and amending Cambodia's Energy Policy and developing technical safety and environment standard design.
2. EAC: The EAC operates under a policy implementation and regulation mandate, issuing regulations, licenses to electricity companies.

Enablers to promoting cooking with electricity:

- **Rural Electrification:** By December 2020, the national grid was extended to 97% of villages in Cambodia, with 81.6% households having electricity access.

- **Stimulating Electricity Consumption:** Cambodia plans to spend more than US$100 million on subsidies by 2021 to reduce electricity tariffs and stimulate electricity consumption. To encourage use, electricity is currently subsidized at 380 Riels for the first 10 KW.

  "*Making sure that we provide standard reliable electricity to people for 24 hours is an important step to ensuring energy security."*

- The Ministry of Mines is also being assisted by the World Bank to develop a Clean Energy Efficiency for Cooking and Thermal Energy Use Policy Research which will be rolled out in 2021-2023.

  "Under this project we will develop a plan to focus on avoiding deforestation and reducing household pollution for people in the villages."

Challenges to promoting electric cooking:

- Although the goal is to stimulate energy consumption, the enabling environment for electric cooking suppliers or manufacturers is not strong. The government has relaxed import tariffs for solar panels and batteries; however no current supply side incentives encourage enterprises to promote electric cooking. This is partly due to a lack of proven electric cooking solutions at scale, and a lack of recognition of the potential for using electricity for cooking

- Over supply of electricity in the wet season and under supply in the dry season can be a challenge. Low water levels due to drought and climate change mean that the power generation capacity can be limited. In order to promote electric cooking at scale, this issue needs to be addressed by expanding the power generation capacity through other projects.

B. MINI GRID DEVELOPERS:

Profile: Okras Distributed Mini Grids:
Okra is a technology developer who has created an innovative system to set up and manage solar electricity sharing in the most remote parts of Cambodia. With Okra, the extra power that's not being used by one home can be shared with the community meaning more people will have access to energy for all their needs: lights, fans, pumping water and even rice cooking. To date 626 rural households have been powered by the Okra mesh grid.

Key enablers to promote cooking with electricity:

- **Innovative Technology:** As compared to mini grid systems, Okra's mesh grid costs significantly less to set up due to their decentralized architecture - most of the energy is produced and consumed at a node (household) within the network. It bypasses the need for investments in land (centralized power generation) transmission infrastructure. The technology is also integrated with a data platform aimed at monitoring energy consumption within the network and reducing maintenance costs.

- **Electric Cooking Potential:** Amongst their rural customers, the demand for productive use of electric appliances (refrigerators, freezers, pumps) is increasing.

  "There is a strong demand to use productive appliances that can generate income for households. As people climb up the ladder, there is growth in energy usage." - Okra Solar

- **Incentivizing Profitability for Energy Providers**: Mini grid developers like Okra are leveraging the opportunity to offer a range of electrical appliances to rural customers. Increased energy consumption directly increases profitability and sustainability for the energy providers.

- **Financing Cooking Appliances**: Recognizing the opportunity, Okra has been testing appliance financing. A demand for household cooking appliances such as blenders, rice cookers and ice boxes has been observed.

  "We kick started appliance financing this year, where households can pay off costs of the appliance over a year. This responds to the biggest barriers to them using more electricity is the high appliance prices and the use of these appliances can also be linked with time savings, pollution avoided and meeting the SDGs 7 and 8."

- **Lowering manufacturing risks** by contractual agreements (insurance, defective products, lead time) with manufacturers they work with.

Challenges to promoting electric cooking:

- **Low demand for cooking among customers:** For mini grid companies, the demand for electric cooking is still low as customers prioritize other income boosting applications (cold chain, refrigerators) utilizing solar energy in far off areas. Purchase of freezers and refrigerators allows for food storage and preservation possibilities reducing the burden on cooking more frequently.

  "*In terms of which specific appliances we have a survey data indicating 30% of households wanting to purchase a freezer/refrigerator. For electric cooking, 12% of our customers did report a preference for rice cookers.*"

- **Supporting high power devices is a challenge.** The energy drawn from the solar grid is currently insufficient to support high power cooking devices such as induction stoves, electric grills.

- **Finding the right manufacturer agreements:** Although, lessons learnt from iteratively working with multiple suppliers and identifying ones that closely fit with their manufacturing needs, ensuring reliability, reducing costs and managing rising cost of materials at point of manufacturing is a consistent challenge for technology startups.

- **COVID-19 Impacts:** The COVID 19 pandemic has impacted global supply chains. Rising costs of spare parts sourced externally and assembled at point of manufacturing is impacting production costs significantly.

  "Last year, one of the components for the hardware was costing us almost 10 times the previous cost due to inability to find local alternatives. Sometimes the manufacturers can also have a monopoly on price setting if they have exclusive spare parts."

C. STARTUPS & SOCIAL ENTERPRISES:

Profile: Eco Sun Cambodia
Eco Sun is a Cambodian Social Enterprise aiming to increase Cambodians' energy efficiency and access to clean energy sources in both urban and rural areas. They have developed their supply chain to market solar systems, solar pumps and electric induction stoves. Eco Sun registers monthly sales of 100 induction stoves with most demand coming from urban customers.

Enablers to promoting cooking with electricity:

- **Strong Last Mile Sales Networks:** Eco Sun has established relationships with 35 rural electronic retail shops that sell batteries and rice cookers in the last mile to market their solar products. They also support shop staff with training to build their sales skills.

- **Direct Manufacturer Links:** Entering into direct supply agreements with international(Thai, Chinese) manufacturers has allowed Eco Sun to adjust their product messaging to Khmer (which would otherwise be in a foreign language). Including communication adjustments to their product language, instruction manuals and warranty cards. This value addition has created positive results for customers and minimized effort to educate customers on the product functions.

  "We heard from our customers that they couldn't understand how to operate the stoves because the buttons were in a foreign language. Our in-house design team redesigned the buttons and we were able to send these instructions to our manufacturer quite easily."

  "This reduces the level of effort from our company side during product installation because using the product is easier if there are clear instructions that people can read by themselves."

Challenges to promoting electric cooking:

- **Limited Customer Segments, lack of demand:** Electric stoves are currently seen as aspirational cooking solutions for urban customers. Eco Sun has observed a strong demand for their stoves from urban customers, however triggering uptake of electric cooking from rural customers remains a challenge for two reasons: **perceptions around electricity costs** and **lack of reliable electricity supply**. As a result, they have focused their marketing on urban customers and prefer to wait for the demand for electric cooking to rise further before reaching rural customers.

  "We have done some tests with groups of 10 households in rural villages, we gave them the single stoves to try for a few days. Even though we asked them to try for free without paying for the stove, they were concerned about their electricity bill."

  "We learned that lack of regular electricity supply issues prevented people from using it everyday, so they just continued to cook with devices they had."

- **Alternative Financing Mechanisms:** Due to lack of alternative financing of the production and the inability to offer credit to customers, Eco Sun had to discontinue sales of their double stoves.

  "It's tough to offer credit to customers because since we buy in bulk, we need to recover the cost from the customer up front in order to be profitable. We are currently thinking

about conducting some trials with installment plans."

- **Supply Chain Disruptions:** Most companies manufacturing or sourcing products from China have experienced disruptions.

  "Due to COVID shipping container loads are now operating even at 50% capacity sometimes, containers usually stop at Vietnam and if the port is operating with limited staff due to COVID risks, this leads to further lead time for our products to arrive."

Profile: ATEC
An Australian social enterprise in Cambodia and Bangladesh marketing bio digesters and induction stoves. They have developed PAYGO technology for their induction stoves, including developing a proprietary supply chain establishing contractual relationships with Chinese manufacturers. To date 1800 bio digesters and 396 electric stoves have been sold to Cambodian customers.

Enablers to promoting cooking with electricity:

- **Innovative Technology and PAYGO financing:** ATEC combines the efficient electric stove technology with its patented PAYGO financing**.** PAYGO allows ATEC to enter into financial contracts directly with customers without the need for microfinance banks or other third party lending institutions. This removes a significant barrier for customers to adopt electric cooking.

  "Customers make periodic, generally monthly, installment payments digitally back to ATEC for a set number of months until they fully own their stove. There is no interest to be paid by the customer and no collateral taken by ATEC."

- **Breaking the affordability barrier for customers:** PAYGO is aimed at making efficient electric cooking affordable in the last mile. This requires bundling the product package (stove, pots) at a price point that matches people's willingness to pay.

- **Innovative Digital Marketing:** Traditionally, costs associated with direct marketing and customer acquisition are high and can be challenging to sustain in a new market or if sales volumes are low. ATEC leverages the rise in smartphone usage trends in Cambodia, with digitally marketing their products to customers. A data-led marketing approach, allows for tracking the performance of each customer segment, successful messages, images, call scripts and conversions on a daily and weekly basis.

Challenges to promoting electric cooking:

- **Limited distribution networks:** Due to the high costs associated with door to door sales, ATEC is transitioning their sales through digital marketing. Although there is a small local distribution capacity in areas where bio digester sales are still active, the demand for electric cookstoves in rural areas is currently low. A higher percentage of sales leans towards urban customers.

- **Digital Marketing to rural customers:** Digitally marketing to rural customers whose smartphone behaviors are not as advanced as peri urban and urban customers.

  "There are common instances of people clicking on ads just because it popped up on their feed but they are not interested in purchasing. These are screened through the call center but the current volume of drop outs from rural customers is something we're trying to address."

- **Manufacturing Side Challenges:** This is a common point for all companies sourcing/manufacturing products in China. For ATEC, high lead times, shipping delays, and rising costs of production have resulted in challenges in matching the demand generated through marketing with supply.

D. LOCAL/REGIONAL DISTRIBUTORS:

Profile: K-four
K-four is a leading Cambodian distributor and retailer of electronic home appliances including a range of electric cooking products from multiple regional and global brands. It supplies these appliances to over 20 retail customers (shops) around Phnom Penh and their own retail outlet in 4 Cambodian provinces (Phnom Penh, Siem Reap, Battambang, Kampong Thom). They estimate about 30% of the demand for their products is for cooking appliances, while 50% is for home appliances (refrigerators, washing machines etc.) and 20% for home entertainment products (TVs, stereos etc).

Enablers to promoting cooking with electricity:

- **Brand aggregation offers customers a wider range of options:** Direct partnerships with a large number of appliance manufacturers allows the company to offer a diverse range of products to customers. Although the business has been impacted by COVID-19, K-four currently has the ability to secure minimum order quantities from the manufacturers and distribute products to their retail customers (shops).

- **Leveraging Facebook to promote modern cooking appliances to an urban audience:** Live online streams and product demonstrations are aimed at building the brand and marketing products to urban customers.

- **Competitive pricing through economies of scale:** Due to their urban retail reach (supplying to 26 shops), securing larger order quantities from manufacturers allows them to minimize shipping and import costs. This allows them to set more competitive wholesale pricing which appeals to their margin-sensitive customer base.

Challenges to promoting electric cooking:

- **Cater only to a limited number of urban customers:** Their current focus in the industry is limited to niche urban customers seeking aspirational electric cooking solutions.

  "The small electric cooking products under 50-60$ are the most purchased. For example, rice cookers and kettles and airports are commonly purchased, followed by ovens and microwaves first. The stoves are not very common purchases."

  "Large construction companies are purchasing 100+ units (electric stoves) from us. They fit these in the kitchen to make the apartment look modern and attractive to the people who purchase the apartment/ condominium. Usually it's only the rich people who can buy a condo."

  "During Pchum Ben or Khmer New Year, people in the village sometimes come to purchase these products from our shops. It is not profitable to set up a shop in the village because unlike city customers, not many people will be interested in buying our products."

- **No credit lines to their retail customers (shops):** Due to the lack of alternative financing arrangements, encouraging retail customers to source higher quantity and variety of cooking devices is a challenge. This results in most shops having similar electric cooking products (electric rice cookers, kettles, microwaves, ovens, blenders and other small electric appliances) that reflect the customer's current demand preferences.

  "Per our company policy, we can only offer 2-3 week period for retail shops to complete payment. They only choose products they know they can sell, otherwise it would be a risk for them."

- **Weak Sales Skills:** Sales staff of wholesale distributors lack the skills and understanding of technology to effectively promote the value of electric cooking to customers.

Profile: Pensonic

Pensonic is a Malaysian distributor of electronic cooking appliances. Pensonic designs and manufactures electric cooking products for the regional South East Asian market and entered the Cambodian market in 2019. Partnerships with 4 retail customers (shops) have been established to shelve their range of electric cooking products including induction stoves, steamers, kettles, blenders, microwaves and electric grills.

Enablers to promoting cooking with electricity:

- **Quality control through integrated manufacturing:** localized manufacturing capacity in China and Malaysia allows greater control over production costs. Rigorous safety checks allow the company to offer product parts warranty periods of up to 5 years.

- **Developing a range of products locally adapted to Asian cuisine:** Products such as the Korean barbeque grill, multi cooker and the steam boat (a soup and grill cooking hybrid device) have been designed with keeping local cuisines and trends in mind.

Challenges to promoting electric cooking:

- **Weak Sales and Marketing Skills:** Sales staff lack the skills and understanding of technology to effectively promote the value of electric cooking to customers. They are unable to sell the benefits of locally adapted cooking devices. Other than leveraging existing trends, distributors lack a clearly defined sales strategy.

- **Limited Partnerships:** Distributors miss the opportunity to develop marketing and financing partnerships to extend their reach. Currently their supply arrangements are limited to 3 retail outlets in urban locations. Expanding to rural areas is a distant possibility given the marketing challenges to boost sales in urban areas.

- **Lack of demand:** Without significant marketing and promotion, specialized cooking devices have struggled to gain traction.

- **Budget Cuts:** Personnel layoffs due to decline in sales volumes have resulted in spill on effects on core business functions.

  "Since we lay off the staff, I have to provide product demonstrations to all new potential customers."

- **Manufacturing Delays:** High lead times, shipping delays, rising costs of production have resulted in challenges.

- **High After Sales Service Costs:** Paying for an external appliance repair technician leads to high transaction costs for the company.

E. RETAILERS:

Profile: Retail Shops

Three different retail electronic shops selling electric cooking products in their shop with similar mix of factors: retail capacity, number of staff, number of product options and business size were comparable in nature and considered to be part of this profile.

Enablers to promoting cooking with electricity:

- **Leveraged supply chains developed by larger distributors:** Taking advantage of established supply chains, retail shops develop partnerships to offer a variety of products to customers

- **Developed partnerships with banks to offer home appliance financing:** It is common for customers to draw home appliance loans especially for refrigerators, washing machines. This is through a microfinance entity where the payment default risks are absorbed by the external financing entity. This reduces barriers for retail shops to offer financing.

  "Customers who normally spend 300$ or more on a home appliance take out a loan. We help them with the paperwork, and they have to pay back the loan to the micro finance company."

Challenges to promoting electric cooking:

- **Risk averse:** Retail shops are risk averse to stock greater varieties of cooking products compared to distributors as they have a better idea of specific products that are trending. Most retail shops who do not narrow their focus exclusively to cooking rather opt for common home appliances currently trending in the market. Beyond trending appliances, they are unable to capitalize on the opportunity to stock and sell new cooking solutions. This results in most retail shops stocking a common set of electric cooking products such as rice cookers, kettles and smaller electric steamers.

- **Weak Sales and Marketing Skills:** Sales staff lack the skills and understanding of technology to effectively promote the value of electric cooking to customers. They are unable to sell the benefits of higher value electric cooking products (electric induction cookers, EPCs etc.) to customers.

- **Expanding to rural areas:** Small retail shops do not have the risk appetite to expand distribution to rural areas where instances of power cuts and electricity shortages do occur. Promoting electric cooking in rural areas is still perceived as a risk.

- **Credit offerings and credit behaviors for high value electric cooking products rarely match:** Electric cooking appliances typically priced under the threshold for drawing an appliance loan. Yet at the same time lack of instalment plans creates a barrier for entry

for customers to adopt.

- **Not all retail shops can offer credit:** Smaller sized retail shops lack the capacity to enforce payment contracts and struggle to develop beneficial financing partnerships that work for all stakeholders (the customer, the business and the financing partners).

- **Limited After Sales Service:** Especially outside urban areas, retail outlets' capacity to service appliances is limited. This negatively impacts the customer experience and may lead to customers stacking solid fuels.

- **Competition with Existing Fuels:** LPG is the most common fuel used in peri-urban and urban Cambodia. Established LPG supply chains offering competitive per unit price of LPG fuel triggers comparisons on costs, but also taste and efficacy of cooking. Retail shops believed that LPG was still the most popular fuel/stove.

8. SUMMARY OF CONCLUSIONS:

The current supply side is focused on predominantly serving the urban demand for electric cooking solutions. For a number of reasons, social enterprises and distributors lack the capacity to distribute and sell at scale in rural areas. Manufacturers increasing the price of their spare parts due to COVID-19 delays and increase in shipping costs, is causing start ups and social enterprises to absorb higher production costs.They also find it expensive to establish a last mile distribution channel. At the same time, distributors lack the expertise and commercial partnerships to offer a combination of credit lines, sales and marketing support, and customer finance options to retailers in rural areas. This leaves retailers, typically risk averse, without any incentive to invest in stock that may not be easily sold.

When viewed from a **policy and regulatory level,** clear policy targets have resulted in rapid extension of the grid to rural areas. However, the goal to stimulate energy consumption is missing an enabling environment for electric cooking suppliers or manufacturers to boost electric cooking uptake. Lack of supply side incentives and a lack of proven electric cooking solutions at scale leads to an opportunity missed in recognizing the high potential for electric cooking to mitigate climate impacts and hitting energy policy goals.

Mini grid developers engaged in expanding energy access to the last mile are well positioned to move their customers further up the energy ladder. A rise in productive use appliances (and increase in off-grid household energy consumption) can be observed. Although electric rice cookers and blenders are currently offered, the demand is still low. Further higher power electric cooking devices (induction stoves and EPCs) are not currently adapted for off-grid systems. Off-grid rural customers often rely heavily on biomass fuels for cooking leading to a missed opportunity.

Although start up **social enterprises** specialize in developing innovative and efficient electric cooking technologies, ensuring uptake in the last mile rural villages continues to be a challenge. High lead times (duration in delivery of pre-ordered goods), shipping delays, rising costs of production have resulted in challenges in matching the demand generated through marketing with supply. Limited demand results in prioritizing early adopting market segments especially in urban areas that can afford to transition to aspirational electric cooking. Positioning electric cooking as an aspirational alternative for rural customers is a current challenge.

Distributors' ability to increase electric cooking uptake is constrained by limited and relative inflexible commercial partnerships with retailers. Lacking a sales strategy, and sales skills to promote new products, distributors are reliant on current trends. A lack of flexibility in their commercial partnerships restricts their retail customers to test new, aspirational electric cooking products. The net result is limited partnerships with select retailers and a shrinking in the number of products being marketed on retail shelves (restricted to the faster moving rice cookers, kettles, ovens, microwaves and smaller appliances).

Retailers are close to customers and generally follow market trends. They are risk averse to invest in stocking new products that are not guaranteed to sell. Even if the sale is made, they have a limited capacity to offer a quality after sales service. Due to this, most retailers are confined to urban, low-risk areas where there could be a steady sales volume without large capital investments. Their ability to facilitate uptake of electric cooking is limited due to a lack of sales skills and a lack of understanding of new electric cooking technology. Little or no financing alternatives create barriers for customers to try new cooking solutions.

9. EARLY OPPORTUNITIES:

In order to facilitate the access and distribution of electric cooking appliances in the rural areas the following opportunities could be explored:

Policies advocating on the high potential for electric cooking to affect climate change and energy consumption are necessary for stimulating ground up innovation. Supply side incentives and subsidies, results based financing mechanisms and funding behavior change campaigns leveraging existing capacities of aid organizations are some of the low hanging opportunities that could catalyze greater interest from the private/ public sector.

Mini grid developers are well positioned to influence fuel stacking behaviours in the last mile**.** Optimizing technology to support the use of highly efficient appliances such as EPCs, steamers in rural last mile households offers potential to offset biomass fuel use in off grid households. These households tend to rely on solid fuels the most and transition to high efficiency, low power electric cooking devices adapted for DC mini grids could lead to a reduction in deforestation and emissions, and contribute to positive health and livelihood outcomes for

communities

For startups directly manufacturing their products, **localizing manufacturing** to aggregating parts procurement, production and assembly to a single point of manufacturing can lead to significant gains in cost reduction and quality control. Localizing manufacturing could positively enhance the suppliers ability to offer faster after sales services.

Startups can also leverage their marketing capabilities to stimulate new trends by contextualizing how to use new/innovative appliances**. Leveraging influencers and social media**, there is an opportunity to promote local, traditional Cambodian cuisine through the use of specific cooking devices and promotional marketing events to positively change customers perception and encourage willingness to adopt.

Distributors and Retailers are in need of developing sales advisory skills for sales staff. Improvements to their sales approaches could promote greater understanding of the benefits. Providing sales staff to enter into a conversation around the benefits and value of electric cooking solutions could lead to greater adoption, even without any subsidies. There is also an emergent opportunity around strategically laddering customers to cook more than rice at an attractive price point**.** Research indicates a market opportunity to select an appliance that allows people to cook the two most commonly cooked food types in Cambodia: Rice + Soup.

Small electric devices for cooking both these foods currently exist in the market, are of good quality and match the general willingness to pay range of 18-50$. This is the range for rice cookers reported by suppliers and choosing other appliances that fit within this price range could offer an avenue to increase reliance on electric cooking.

Developing competitive, affordable financing offerings for electric cooking solutions through micro loans or peer to peer lending platforms could make electric cooking solutions more affordable for low-income customers and reduce the payment risks for the business.

Financial support from donors such as development impact bonds and other performance-based investment instruments to finance clean cooking programs deployed by aid organizations could create wider behavior change and increase the demand for clean cooking solutions. Results based financing through donor funding could also be utilized as a subsidy mechanism.

Organizations with a strong social mission are better positioned to attract investments through **crowdfunding, debt/equity funding from investors, or partner with other local peer to peer lending platforms**. Partnerships with investors could provide organizations a financial buffer, to improve their cash flows by expanding to a larger customer base. These could allow them to offer subsidies to last mile, vulnerable households in most need of modern cooking solutions, and to develop partnerships with local micro finance companies in the last mile (and last mile retailers) that improve the adoption of electric cooking solutions. Outsourcing of due diligence

and payment processing to finance partners with greater resources could create a win-win for both social enterprises and financial institutions. For local businesses who have developed proprietary technology or supply chains, improving awareness on carbon credits as a source of revenue, and connecting strong local organizations to carbon schemes could also improve cash flow and scale up potential.

10. ANNEX OF QUESTION GUIDES

ACTOR	HIGH LEVEL RESEARCH QUESTIONS
GRID UTILITY POLICY & REGULATORY AUTHORITY	What are the government bodies strategic priorities in enabling affordable, reliable access to electricity and extension of coverage/grid? Do/how do these policies overlap with electric cooking? What is their potential to stimulate electric cooking?
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STARTUPS/SOCIAL ENTERPRISE	What are the factors (enabling or constraining) the ability of startups and social enterprises to deliver and scale their electric cooking solutions to customers?
DISTRIBUTORS & RETAILERS	What are the factors (enabling or constraining) the ability of distributors and retailers to promote greater uptake of electric cooking solutions among their customers?

1. UTILITY POLICY/REGULATORY AUTHORITY:

1. Could you briefly describe your role and your organization's main priorities with regards to electricity access?
2. What is the current electricity demand in your network or known utility providers network?
3. How about the current power/electricity generation capacity? Is it sufficient to meet the existing customer demand?
4. Do you have any demand forecasts for the future?
5. What are the current tariffs set for supplying electricity?
6. How are these normally set? Are there any subsidies for specific regions or communities?
7. What's the strategy once grid coverage is saturated?

8. Physical access is not the same as affordable access: How can electricity be made more affordable for ID poor households?
9. Are there any new strategies or policies that the government/MME is trying to implement? *[Free basic electricity?]*
10. How can a greater pool of utility providers be attracted /incentivized to boost supply side challenges?
11. Private partnerships are very limited, what are the key reasons behind this?
12. What are some key issues in the supply and distribution of electricity to municipalities?
13. How is it managed? Can you draw a flow diagram?
14. Do you think it could be affordable to cook with electricity?
15. Are there any incentives or solutions that could be introduced to promote electric cooking products? *[increase safety? increase confidence? improve perception? make viable commercially]*
16. What do you think about the electric cooking businesses? Selling cookstoves/other electric cooking devices in Cambodia? Why or why not?
17. Do you think electric cooking could fit with the electricity supply in Cambodia? Can there be reliable supply especially in rural areas for people to cook affordably using electricity?

2. MINI GRID DEVELOPERS (UTILITY PROVIDERS):

A. Overview:

1. Could you briefly describe your role and your organization's main priorities with regards to electricity access?
2. How many active customers do you currently have and what is the current electricity demand in your network or known utility providers network?
3. How about the current power/electricity generation capacity? Is it sufficient to meet the existing customer demand?
4. What purposes are your customers energy demands for? *[Classify in terms of Household vs Productive Use]*
5. Do you have any demand forecasts for the future? Have you observed any trends? *[upwards or downwards, in the energy use household versus productive]*

B. Product/ Technology:

6. What advantages do your technology offer compared to conventional off-grid systems?
7. Do you integrate electric cooking solutions within your package? What? How?
8. What was the rationale behind these products?
9. How do you see your products and services evolving over the next 3-4 years?
10. Are there any product add ons or customer segments that are becoming a big priority?

C. Supply Chain:

11. Reflecting on the past 5 years, what have been some of your key challenges and learnings on developing your supply chain to Cambodia?

12. In terms of manufacturing, shipping, logistics and import tariffs what are the key issues you currently experience?
13. In future, where do you anticipate your big supply chain block could come from?

D. Electric Cooking:
14. Do you think it could be affordable to cook with electricity?
15. Do you think that high power electric cooking devices such as an electric stove could be integrated in your product package?
16. What interest have you seen from the implementing partner to bundle these products?
17. Do you think electric cooking could fit with the electricity supply in Cambodia? Can there be reliable supply especially in rural areas for people to cook affordably using electricity?
18. Are there any incentives or solutions that could be introduced to promote electric cooking products? *(increase safety? increase confidence? improve perception? make viable commercially)*

3. DISTRIBUTORS(INCLUDING START UPS/ SOCIAL ENTERPRISES):

A. **Overview**
1. Could you briefly describe your role and your organization's main priorities with regards to cooking?
2. How many active customers do you currently have and what is the current monthly demand for LPG or electric cooking products you offer?
3. Do you have sufficient stock to meet the current demand?
4. How has COVID-19 impacted the demand for your services?
5. Has there been a change in people's customer preference due to COVID-19? Are they changing the choice of the cooking device they used for any reason? *[use more, use less, completely stop using?]*

B. Product/ Technology:
6. How many products do you offer? Which ones are the most popular? Why?
[Note: product could either mean the fuel or the stoves: mean LPG tanks, LPG stoves, Electric Cooking Products]
7. Which products are the most popular and which ones are the least popular? Why?
8. Which products are most suited for Cambodian cooking? Do people use them? Why/Why not?
9. What was the reason behind selling these products?
10. How do you ensure safety of the products?
11. What advantages do your products or services have compared to other competitors?
12. Do you offer credit to customers? Why or why not?

C. Supply Chain:
13. Where do the products come from?
14. How do you identify the right suppliers? How do you enter into agreements with them?

15. Reflecting on the past 5 years, what have been some of your key challenges and learnings in developing your supply chain?
16. In terms of manufacturing, shipping, logistics what are the main challenges that you currently experience?
17. In future, where do you anticipate your big supply chain block could come from? How do you solve these blocks?

D. Electric Cooking:
18. Do/will you sell electric cooking solutions in future? Why or why not? What products? How?
19. Are there any incentives or solutions that could be introduced to promote electric cooking products? *[increase safety? increase confidence? improve perception? make viable commercially]*
20. How do you see your products and services evolving over the next 3-4 years?
21. Are there any new customer segments (rural customers or peri-urban customers) that could become a priority to sell? Why?
22. Can there be reliable supply especially in rural areas for people to cook affordably using electricity?

Observation Checklist:
1. Observe product quality in terms of durability, materials, look and feel asking follow up questions about them
2. Contrast participant responses with what you can see in their office/ shop to understand if there is a difference in what they tell you and what they are selling/ their products
3. Ask participants to walkthrough the shop or office and point to specific products/ features/ challenges and request taking pictures

4. RETAILERS:

A. Overview

1. What are current trends in sales of electric cooking appliances - have they increased/decreased? Why?
2. What cooking appliances do customers prefer and why?
    a. Most popular purchases
    b. Least popular purchases
3. How do customers pay for their appliances?
    a. What are their preferences? Why?
4. Who is the customer? *[buying electric cooking appliances]*
5. What are the challenges supplying rural areas?
7. What opportunities do you see in selling electric cooking products?
8. What is the current monthly demand for LPG or electric cooking products you offer?

8. Which products are most suited for Cambodian cooking? Do people use them? Why/Why not?
9. Do you have sufficient stock to meet the current demand?
10. How has COVID-19 impacted the demand for your services?
11. Has there been a change in people's customer preference due to COVID-19? Are they changing the choice of the cooking device they used for any reason? *[use more, use less, completely stop using?]*
12. What was the reason behind selling these products?
13. How do you ensure safety of the products? What are the maximum warranty periods?
14. What advantages do your products or services have compared to other competitors?

B. Supply Chain:

13. Where do the products come from?
14. How do you identify the right suppliers? How do you enter into agreements with them?
15. Reflecting on the past 5 years, what have been some of your key challenges and learnings in developing your supply chain?
16. In terms of manufacturing, shipping, logistics what are the main challenges that you currently experience?
17. In future, where do you anticipate your big supply chain block could come from? How do you solve these blocks?

C. Electric Cooking:

18. Do/will you sell electric cooking solutions in future? Why or why not? What products? How?
19. Are there any incentives or solutions that could be introduced to promote electric cooking products? *[increase safety? increase confidence? improve perception? make viable commercially]*
20. How do you see your products and services evolving over the next 3-4 years?
21. Are there any new customer segments (rural customers or peri-urban customers) that could become a priority to sell? Why?
22. Can there be reliable supply especially in rural areas for people to cook affordably using electricity?

Observation Checklist:

1. Observe product quality in terms of durability, materials, look and feel asking follow up questions about them.
2. Contrast participant responses with what you can see in their office/ shop to understand if there is a difference in what they tell you and what they are selling/ their products.
3. Ask participants to walk through the shop or office and point to specific products/ features/ challenges and request taking pictures.
4. Observe the layout of the retail spaces.

END