COLUMBIA UNIVERSITY
School of Professional Studies

Killed by Breathing

Addressing Cooking Poverty: Current State, Gaps and Challenges, and Proposed Solutions to Achieving SDG7

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AN INDEPENDENT STUDY
WITHIN THE SUSTAINABILITY MANAGEMENT PROGRAM
(SUMAPS5998_001)

JUNE 2021

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Table of Contents

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Summary

Cooking poverty remains one of the largest unsolved public health, climate, and equality crises humans have ever experienced. It kills over four million people annually and affects 3.83 billion people in 71 countries[1]. While the costs of eradication are high, costs of inaction – in terms of health, gender equity, and climate impacts – are even higher. Estimates of the social and environmental cost of this burden reach $2.4 trillion per year.[2] Alleviation of cooking poverty received only $131 million in 2018[3], while the estimated cost for achieving *improved* cooking for all by 2030 is roughly $10 billion annually for the next 10 years.[4] In order to reach *modern* cooking, the price tag is $150 billion yearly.

Cooking Poverty
Using wood, charcoal, dung or other solid fuels on three-stone fires or low-quality stoves in poorly ventilated conditions; includes individuals in Tiers 0-3 of the five-tier Multi-Tier Framework.

Achieving "affordable, reliable, sustainable, and modern" cooking for all is essential to addressing the greater issue of energy poverty and meeting Sustainable Development Goal (SDG) #7 in addition to reaching adjacent SDGs aimed at prosperity, gender equity, health, and climate. [5] The cooking poverty sector – a multitude of development organizations, governments, NGOs, and small and medium enterprises – is not on track to reach 2030 Sustainable Development targets. At present the industry's current emphasis on "success" creates the appearance of progress. That needs to change when, in fact, neither the funding nor the human and institutional infrastructure exist at scale to eradicate cooking poverty in the foreseeable future.

Sustainable Development Goal 7
Ensure affordable, reliable, sustainable, and modern energy for all.
7.1 Ensure universal access to energy services:
→ 7.1.1 – proportion of population with electricity access
→ 7.1.2 – proportion of population with primary reliance on non-solid fuels
Source: UNDP

Continuing on the current path will lead to the failure to eradicate cooking poverty, the related failure of SDG7 and the resulting failure of other sustainable development goals.

We believe another path exists. The cooking poverty sector has the opportunity to realign with the electricity access sector's ecosystem and value chain. Within electrification efforts, an enormous base of experience is available for rapid dissemination; there is accessible infrastructure (e.g., physical, institutional, human resources, investment platforms, etc.) to expedite deployment of necessary resources and sufficient capital to be utilized if certain actions are taken:

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[1] ESMAP.2020. *The State of Access to Modern Energy Cooking Services (English)*. Washington, D.C.: World Bank Group. http://documents.worldbank.org/curated/en/937141600195758792/The-State-of-Access-to-Modern-Energy-Cooking-Services

[2] Ibid.

[3] "Energizing Finance: Understanding the Landscape 2020." SEforALL, November 19, 2020. https://www.seforall.org/publications/energizing-finance-understanding-the-landscape-2020.

[4] Ibid.

[5] "Goal 7 | Department of Economic and Social Affairs." United Nations. United Nations. https://sdgs.un.org/goals/goal7.

Action 1 – rebrand and reframe the issue, using the term "cooking poverty" rather than "clean cooking" or similar terms. As clean or modern cooking services today represent only a fraction of the *solution* to cooking poverty, the name of the sector should reflect both the unsolved *problem* and the diversity of solutions to this complex issue (examples include public health, gender empowerment, enterprise development). While modern cooking is the end-goal in eradicating cooking poverty, harm reduction, incrementalism and "leapfrogging" to modern where possible are the means, and each needs attention. Only focusing on modern cooking due to its mortality reduction benefits shortchanges the end-user, stalls investment, and forces communities in need to wait for a leapfrog solution (electrification, high-end fuels) to modern cooking.

Action 2 – execute a moonshot effort to consolidate all presently available knowledge and information into a multipurpose and easy-to access Playbook, which must be accessible to new entrants and existing actors across the public and private sectors as well as civil society. Initiatives within the sector are currently *ad-hoc*, knowledge and information sharing across entities is inconsistent, and best practices are hard to find and build upon. A Cooking Poverty sector strategy that empowers information sharing and collaboration on industry knowledge and expertise can bridge this gap and accelerate new entrants.

Action 3 – address SDG 7.1.1 and 7.1.2 <u>together</u> rather than in separate silos. Even if the tactical issues across the cooking sector (branding, collaboration, information sharing) are solved, and financial investment *somehow* reached the scale needed to reach SDG7 in the next nine years, the sector lacks the capacity to support solutions needed for 3.8 billion people - more than half the world's population - that cook with solid fuels. Merging electrification and cooking efforts will require strong leadership, planning, and incentives.

Figure 1: Experts across the energy poverty sector should combine subsystems into the existing electrification infrastructure and its extensive finance, technical and policy support system.

Action 4 – use these reconstructed energy access initiatives to tap unprecedented amounts of climate finance. There is significant opportunity for a streamlined approach to utilizing carbon markets to finance small businesses and achieve improvements in energy, health, climate, and gender equality goals.

Action 5 – organize a donor/investor/government Compact around the principle of "complete and balanced support for all phases of the transition from cooking poverty to modern cooking." This should align the largely ad hoc approach to fundraising, technical assistance, and policy creation (though this can still be specialized by technology or fuel).

These actions are essential to the success of SDG7 in addition to enhancing future development efforts. The *Killed by Breathing* report aims to energize both the sector at-large and individual actors across our defined Value Chain to take bold actions to transform cooking poverty.

--June 2021

Gaps and Possible Solutions

Advocacy
The processes to elevate the importance of cooking poverty to the level of awareness commensurate with the scale of the problem and the required solutions.

Gaps include lack of consistent messages; failure to coalesce around a common approach to resource aggregation and deployment; confusion between objectives for improved vs. modern cooking and stove/fuel standards.

Solutions for better advocacy include rebranding the issue to term it "cooking poverty"; frame it on the scale of HIV/AIDS, Malaria, and TB; consistent rather than ad-hoc messaging; use "success stories" only when presented in conjunction with messages about what is still needed to achieve scale.

Governance
How the actors and activities within the sector aggregate resources to increase the success and scale of solutions. Governance is focused on strengthening the capacity of national governments and public sector players that contribute funding, strategy, and technical assistance to projects and assist in developing policy and regulation.

Gaps include a lack of sector strategy combined with too much *ad-hoc* work implementing technical assistance, policy, and regulation; inconsistent national frameworks to support in-country progress towards SDG7.

Solutions include the negotiation, monitoring and reporting on a donor-lender-investor Compact to realize a complete and balanced approach to fundraising, technical assistance, and policy creation; codification of standards for in-country consistency; empowerment of clearly responsible country agencies and action plans for cooking poverty eradication national, local and where appropriate, regional levels.

Behavior Change
How individual and institutional behavior evolve to determine the success, failure and sustainability of solutions; this change is centered around end-user adoption.

Gaps include the broad failure to look at cooking poverty as a "people problem" and a lack of understanding of the end-user and underlying determinants of cooking poverty.

Solutions include collaboration with local enterprises and community organizations and incorporating behavior change into every step of implementation as essential to project success.

Funding
The mix of public and private sector resources appropriate to solutions and the mechanisms available to allocate these.

Gaps include insufficient mainstream lending; poor disbursement with too few countries and solutions receiving majority of funding; under-utilization of carbon finance; and lack of intermediation to align funders with solutions.

Solutions include investment across the entire value chain utilizing mechanisms such as results-based financing, carbon finance, microcredit and intermediaries; and, a donor-lender-investor compact for a balanced approach.

Knowledge and Information

The availability and effectiveness of a centralized source of information, resources, and support to allow new or expanding actors to increase their participation in the sector.

Gaps include overall siloed and *ad-hoc* nature of the sector; lack of a center of excellence or widely accessed platform for knowledge-sharing; insufficient empowerment of individual actors to encourage scaling-up successful initiatives.

Solutions: centralize sector knowledge and experience knowledge in a collaborative, timely, experienced-based repository, a "Playbook." The Playbook should ensure all actors and new participants have access; highlight solutions of all types and tiers; identify experts across the Value Chain to ensure synergy rather than competition.

"The women and children are killed by the everyday act of breathing, in what should be the 'safety' of their own homes."
Dr. Flavia Bustreo
World Health Organization

Background

The team examined the role of sector actors and interviewed stakeholders (Annex 1 is an illustrative "Quick Tour" of actors and activities within the sector). These included World Bank and UN professionals as well as small and medium enterprises, and sector intermediaries.

We reviewed literature (and web sites) with a focus on what the sector most recently reported about itself, including:

- The State of Modern Energy Services, 2020
- Energizing Finance 2018 and 2020
- Clean Cooking Fund
- Clean Cooking Alliance (CCA)
- Clean Cooking Ecosystem Map[6]
- Burning Opportunity, WHO 2016
- SEforAll Charrettes, June 2019
- Clean Cooking Sector Strategy-Insights from Interviews

Clean Cooking Sector Strategy

In June 2020, CCA—with Dalberg Advisors (DA)—began a deep-dive to understand the current state and structure of the Clean Cooking sector. The main goal or intention of this was to provide guidance in identifying the current challenges and to pinpoint sector opportunities. The Clean Cooking Sector Strategy team conducted over 70 interviews collecting internal and external perspectives from identified stakeholders within the value chain, including: market enablers, funders, industry association, enterprises, research institutions, stove artisans, investors, government officials, and donors.

The process included mapping and interviewing selected actors, leading to more than two dozen "insights"[7] to the Clean Cooking Sector. The following types of insights played a role in how we, as researchers, approached our analysis and recommendations.

- SMEs are the vehicle to provide incremental solutions to low-income segments.
- Biomass is the only uniform solution for many segments.
- There exist implicit institutional biases towards "leapfrog" solutions (Modern Cooking or MTF Tier 4/5).
- Cookstove Artisans serve 10M+ customers without subsidiaries, representing a great market opportunity.
- SME financing space largely ignores cookstove and fuel manufacturers and distributors.
- Technology innovations include:

[6] Clean Cooking Ecosystem Map can be found at https://www.cleancookingsystemsstrategy.org/clean-cooking-landscape.php.

[7] Dalberg. (n.d.). Clean Cooking Systems Strategy - Dalberg Report. Retrieved May 04, 2021, from https://cleancookingsystemsstrategy.org/current-challenges.php

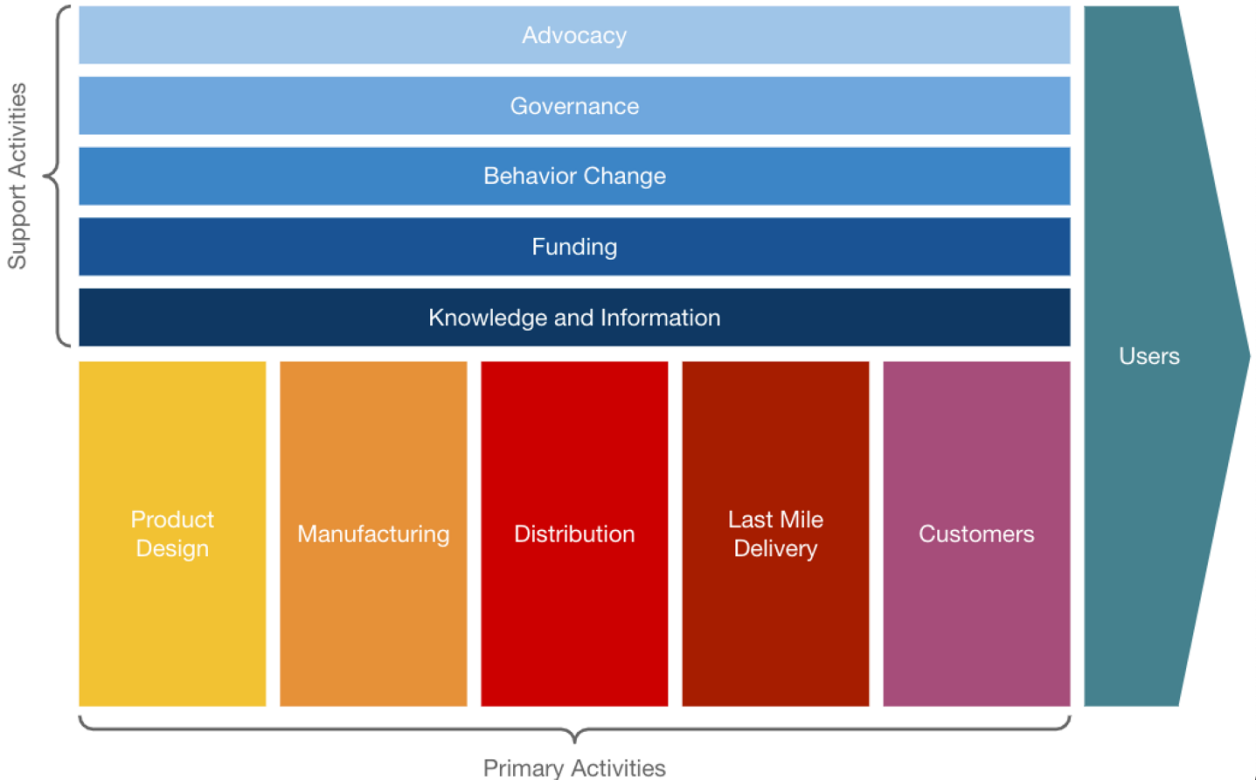
    - Smart meters, payment systems and sensors.
    - Higher efficiency of biomass pellets.
    - Improved electrical cooking.
    - Biofuel cooking solutions and fuel value chains.
- The "clean cooking" sector's inability to accelerate progress since its creation in 2010 has undermined its ability to attract resources and investment.
- Adjacent Sectors (Public Health, Enterprise Creation, Gender Empowerment) Value Chain, Carbon Markets and COVID-19 recovery and healthcare represent potential strategies to attract capital and achieve SDG7.
- Pragmatic ask of adjacent sectors are not sufficiently compelling.
- Sector ideas are not collectively shared; knowledge loss is significant.
- Often, end-users are not involved in the solutions, local markets or politics, causing a lack of diversity in opinions and actions.
- The following stakeholders remain important:
    - Heads of government.
    - Advocacy groups and associations.
    - Local and social media.
- Industry associations represent a promising link between the clean cooking and commercial fuels sectors.
- Solutions are local.
- Clean cooking awareness is in the shadow of large-scale national energy efforts, even though they are connected.

In order to organize observations of and proposals for the sector, the team devised a framework based on Porter's Value Chain[8].

At its most basic, this sector can be presented as a supply chain of goods and services directed to users that is heavily dependent on a set of support activities and actors. The Value Chain has two segments: Support Activities and Primary Activities, the latter being the diverse value chain for improved and modern energy goods and services (dissecting which we concluded was beyond the scope of the project).

This report focuses on the Support elements – Knowledge and Information, Advocacy, Governance, Behavior Change, and Financial Investment. These five elements make up the requirements for delivery of products. While Porter's Value Chain culminates in "Margin," our culminating point is the value end-users derive from cooking poverty solutions.

[8] Institute for Strategy and Competitiveness - Harvard Business School. "The Value Chain." Accessed May 2, 2021. https://www.isc.hbs.edu/strategy/business-strategy/Pages/the-value-chain.aspx.



End-user: the individual or household acting as primary operator of the stove or fuel. This can differ from the customer, which is the household, business, or entity responsible for purchasing the product.

Figure 2: *An adapted version of Porter's Value Chain to frame the cooking poverty sector and our analysis of actors and activities.*

Acknowledgements

This report benefitted from and acknowledges the help of numerous individuals who spoke candidly about the current state of the Clean Poverty Sector. However, the opinions and conclusions within this report are the teams alone.

Thanks especially to: Alisha Pinto (World Bank), Bastiaan Teune (SNV), Carlos Gould (Columbia University), Christina Barstow (University of Colorado Boulder), Christine Eibs Singer (SEforAll), Dymphna van der Lans (CCA), Darby Jack (Columbia University), Ed Brown (Loughborough University), Erik Wurster (BioLite), Greg Murray (KOKO Networks), Ipsita Das (Duke University), Jeffrey Prins (IKEA Foundation), Joshua Kabugo (UNCDF), Ken Newcombe (C-Quest), Sandra Cavalieri (UN Climate and Clean Air Coalition), Sonja Heiles (CCA), Verena Brinkmann (GIZ), Virginia Echavarria (Simoshi), Yabei Zhang (World Bank).

Problem Statement

More than half of the global population, 3.83 billion people in 71 countries[9] do not have access to modern cooking. They live in "cooking poverty".

Nearly 4 million people die each year from cooking poverty. That is roughly 11,000 people per day losing their lives from a problem that can be eradicated.

Cooking poverty currently accounts for more annual deaths than HIV/AIDS, Malaria and Tuberculosis *combined* (2.8 million)[10], but efforts to tackle cooking poverty have not reached the breadth or scale of responses to these other leading causes of death.

Cooking Poverty

Using wood, charcoal, dung or other solid fuels on three-stone fires or low-quality stoves in poorly ventilated conditions; includes individuals in Tiers 0-3 of the five-tier Multitier Framework or MTF

Achieving SDG7[11] – let alone other vital health, climate, gender equality, and overarching employment goals – is dependent on the eradication of cooking poverty, but global commitments have thus far not met the need. Transitioning more than half of the world population to cooking would cost roughly $10 billion annually over the next 10 years, while the same analysis highlights that "[...] cost of inaction for health, gender, and climate/environment is *sixteen times greater* over the same 10-year period".[12]

That $2.4 trillion yearly cost of inaction[13], which remarkably some think *too conservative*, is divided into three categories: Health Impact, Gender Impact and Climate Impact.

NOTE: These estimates do not consider the incremental impact and cost associated with COVID-19, which will likely increase the number of people living in cooking poverty and expand the pervasiveness of underlying conditions.

Health Impact - $1.4 trillion yearly

Recent studies of national stove-and-fuel transition and distribution programs have highlighted the transformative health benefits of switching to cleaner cooking solutions. In China, for example, a report showed that switching to clean stoves reduced exposure to both ambient pollution and HAP by 47% over 10 years (2005–15), corresponding to an estimated 0.4 million averted premature deaths per year.[14] Results of a recent study in Rwanda, which included household purchases of sustainably produced biomass pellets and leasing of micro-gasification cookstoves with lab-verified emissions reductions, reported significant

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9 ESMAP, World Bank, and MECS. The State of Access to Modern Energy Cooking Services. International Bank for Reconstruction and Development The World Bank, 2020. https://documents1.worldbank.org/curated/en/937141600195758792/pdf/The-State-of-Access-to-Modern-Energy-Cooking-Services.pdf.

10 "Fact Sheets." World Health Organization. World Health Organization. Accessed May 10, 2021. https://www.who.int/news-room/fact-sheets.

11 "Goal 7 | Department of Economic and Social Affairs." United Nations. United Nations. https://sdgs.un.org/goals/goal7.

12 ESMAP.2020. *The State of Access to Modern Energy Cooking Services (English)*. Washington, D.C. : World Bank Group. http://documents.worldbank.org/curated/en/937141600195758792/The-State-of-Access-to-Modern-Energy-Cooking-Services

13 Ibid

14 Zhao, B., H. Zheng, S. Wang, K. R. Smith, X. Lu, K. Aunan, Y. Gu, Y. Wang, D. Ding, J. Xing, X. Fu, X. Yang, K. N. Liou, and J. Hao. 2018. "Change in Household Fuels Dominates the Decrease in PM2.5 Exposure and Premature Mortality in China in 2005–2015." Proceedings of the National Academy of Sciences of the United States of America 115 (49): 12401–06

health improvements for primary cooks, including reductions in systolic blood pressure and self-reported shortness of breath.[15]

It should be noted, however, that even a 50% reduction in exposure to HAP would not halve the health risks. Rather, exposure reductions of up to 90% may be required to realize improved morbidity and mortality rates. It has been found that other areas in the house beyond the kitchen carry air pollutants. Therefore, the WHO's indoor-air-quality guidelines for household fuel combustion are formulated based on a 90% reduction[16] – an enormous feat. It is noted in many studies that of the available solutions, the cleanest from a health perspective tend to be the most difficult to adopt.

Gender Impact - $8 billion yearly

This estimate assumes that women spend up to six hours per day performing cooking-related tasks, including fuel collection, cooking, and stove cleaning, and where the cost of women's time is 0.54 cents/hour. Women bear a disproportionate share of the negative health risks from HAP, as well as the time poverty associated with traditional household cooking. Addressing this impact would lead to direct opportunity costs (i.e., more time for education, rest and leisure, and income-generating activities).

Parity in fuel collection differs across countries.[17] It has been found that risks of physical abuse and sexual violence are particularly high for refugee women and female children, who are more vulnerable to sexual violence because of their low status in host communities and the resulting daily need to leave their camps (often during predawn hours) in search of wood for cooking.[18]

NOTE: Though time did not permit a deeper analysis, the team believes that the above estimate understates the value of imputed time. The methodology and assumptions used require substantial refinement.

Climate Impact - $200 billion yearly

Carbon Dioxide (CO2), Black Carbon (BC), and other particles produced with incomplete combustion of fossil fuels from cooking poverty all play a significant role in anthropogenic causes of climate change. The Center for Climate and Energy Solutions states that BC "[...] has recently emerged as a major contributor to global climate change, possibly second only to CO2 as the main driver of change."[19] The Climate and Clean Air Coalition (CCAC) attributes 58% of global BC to household cooking and heating. CCAC also notes that BC has a warming impact on climate that is 460-1,500 times stronger than CO2. Numerous studies have shown that BC is short-lived because it only remains in the atmosphere for up to two weeks. If we are able to curb BC, we can immediately reduce the impact of near-term warming.[20] The correlation between BC and cooking poverty, and the opportunity to make an immediate impact on climate through behavior change is simply too large to ignore.

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[15] Jagger, P., I. Das, S. Handa, L. Nylander-French, and K. Yeatts. 2019. "Early Adoption of an Improved Household Energy System in Urban Rwanda." EcoHealth 16 (1): 7–20. https://doi.org/10.1007/s10393-018-1391-9.

[16] Chapman, R. S., X. He, A. E. Blair, and Q. Lan. 2005. "Improvement in Household Stoves and Risk of Chronic Obstructive Pulmonary Disease in Xuanwei, China: Retrospective Cohort Study." British Medical Journal 331 (7524): 1050.

[17] Cooke, P., G. Köhlin, and W. F. Hyde. 2008. "Fuelwood, Forests and Community Management—Evidence from Household Studies." Environment and Development Economics 13: 103–35.

[18] Clancy, J. S., et al. 2011. Gender Equity in Access to and Benefits from Modern Energy and Improved Energy Technologies. s.l.: Nor/Soer-konsulenterne.

[19] Center for Climate and Energy Solutions. "What Is Black Carbon?" Black Carbon, February 4, 2020. https://www.c2es.org/document/what-is-black-carbon/.

[20] Global Environment Facility's Scientific and Technical Advisory Panel, and World Health Organization (WHO). "Black Carbon." Climate & Clean Air Coalition, January 1, 1970. https://www.ccacoalition.org/en/slcps/black-carbon.

The $200 billion yearly cost of inaction from the catalytic warming effects also considers forest degradation and the local deforestation from current biomass cooking solutions - ultimately removing carbon sequestration mechanisms. As discussed in "The State of Access to Modern Energy Cooking Services" it is important to point out that forest degradation and deforestation are mainly related to agriculture and infrastructure development, but the need for charcoal and other cooking fuels should not be discounted as they are a part of the aggregate issue.[21]

Employment Impact

On the road to eradicating cooking poverty, society will need a transition of the current job landscape to provide jobs with new cookstoves and the transition to cleaner fuel solutions. While highly negative from the standpoint of cooking poverty, dependence on fuels like biomass support rural livelihoods and mean employment for tens of millions of small-scale wood collectors[22], charcoal producers, transporters, and last-mile retailers around the globe.

Thus, the economic impact of biomass fuel cannot be defined unequivocally as negative because the wood fuel value chain employs millions of poor rural and urban households. The World Bank estimates that the Sub-Saharan Africa charcoal sector alone employs 7 million people, with aggregate employment expected to reach 12 million people by 2030.[23]

Cooking Poverty and the SDGs

Sustainable Development Goal 7 (Energy) has four interconnected parts: increasing electricity access, transitioning to clean cooking, energy system decarbonization and efficiency.

If the global community does not lift more than half of the world's population out of cooking poverty, we will not achieve SDG7. Failure to eradicate cooking poverty will not only lead to SDG7 failing, but it will contribute to missed goals and targets on many SDGs. A study done by the Clean Cooking Alliance[24] pointed to at least 10 SDGs that are directly linked to eradicating cooking poverty.

- SDG1 (No Poverty): Cooking poverty increases financial and time losses.
- SDG2 (Zero Hunger): improved cooking reduces the amount of fuel needed to cook reducing the burden on families who would otherwise have to collect it, buy it, or trade their food for it.
- SDG3 (Good Health and Well-being): Reducing smoke inhalation reduces morbidity rates.
- SDG4 (Quality Education): Children, particularly girls, are often kept out of school so that they can contribute to household tasks, like cooking and collecting fuel.
- SDG5 (Gender Equality): Unpaid work, including collecting fuel and cooking, remain a major cause of gender inequality.

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21 ESMAP.2020.*The State of Access to Modern Energy Cooking Services (English)*. Washington, D.C. : World Bank Group. http://documents.worldbank.org/curated/en/937141600195758792/The-State-of-Access-to-Modern-Energy-Cooking-Services

22 World Bank. 2011.Wood-Based Biomass Energy Development for Sub-Saharan Africa: Issues and Approaches. Energy Sector Management Assistance Program (ESMAP) Working Paper 74545.Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/26149.

23 ESMAP.2020.*The State of Access to Modern Energy Cooking Services (English)*. Washington, D.C. : World Bank Group. http://documents.worldbank.org/curated/en/937141600195758792/The-State-of-Access-to-Modern-Energy-Cooking-Services

24 DELIVERING ON THE SDGS THROUGH CLEAN COOKING. (2015). Retrieved from https://sustainabledevelopment.un.org/content/documents/11416Global%20Alliance%20for%20Clean%20Cookstoves%20-%20Delivering%20on%20the%20SDGs%20through%20Clean%20Cooking.pdf

- SDG8 (Economic Security): Improved and modern cooking create jobs, as well as inclusive economic growth.
- SDG11 (Sustainable Communities): Cooking poverty contributes to ambient air pollution, resource efficiency, and climate vulnerability.
- SDG13 (Climate Action): Cooking poverty has been directly linked to increased GHG emissions as well as the production of Black Carbon (BC).
- SDG15 (Life on Land): Up to 34% of wood fue.l harvested is unsustainable, contributing to forest degradation, deforestation, and climate change

Additionally, SDG16 (Peace, Justice, and Strong Institutions) and SDG17 (Collaboration) will be negatively affected if governments and other institutions cannot mobilize financial and non-financial resources and collaborate on solutions to scale.

In short, the problem of cooking poverty stretches far beyond SDG7, stretches far beyond other Sustainable Development Goals, and encompasses a challenge of historic proportions.

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The following sections of this report describe:

- Methodology
- Advocacy's role
- Governance requirements
- Centrality of behavior change
- Financial investment in the sector
- Information needs and knowledge dissemination.

These sections are supplemented with three Annexes:

- Illustrative Inventory of Sector Actors and Activities
- Abbreviations
- Terminology

Methodology

Initial Approach

Cooking poverty is complex to the point where simple or single-tactic solutions would not work alone (e.g., improved stoves and appliances, improved fuels, modern fuels, awareness campaigns, consumer finance programs, education and empowerment initiatives, creation of country specific strategies, etc.). Additionally, there exists a variety of actors across public purpose, private sector and civil society that engage in activities at the international, national and community level.

Initial research consisted of familiarizing ourselves with the various players within the sector, whether it was an **Organization** (e.g. ESMAP), **Program** (e.g. Modern Energy Cooking Services), **Transaction** (e.g. trend tracking in 2021 Industry Snapshot Report), **Activity** (e.g., research and report publication and workshop), **Country Focus** (e.g. 71 countries in five regions), or **Individuals**.

For a more exhaustive sector description, we note and acknowledge the "Clean Cooking Sector Ecosystem[25]"—an elaborate presentation of the sector's interrelationships depicted at an actor-level—however we've chosen to frame it at a broader, function level.

Central to our thinking was to place cooking within Maslow's Hierarchy of Need, and ask ourselves, where does cooking fit with respect to other human needs and other energy needs in particular? Physiological needs, under which cooking falls, should take precedence over many of the other energy services provided in conjunction with electrification. Therefore, it is reasonable for the cooking poverty agenda to leverage established systems such as electrification in order to meet rapidly approaching 2030 goals.

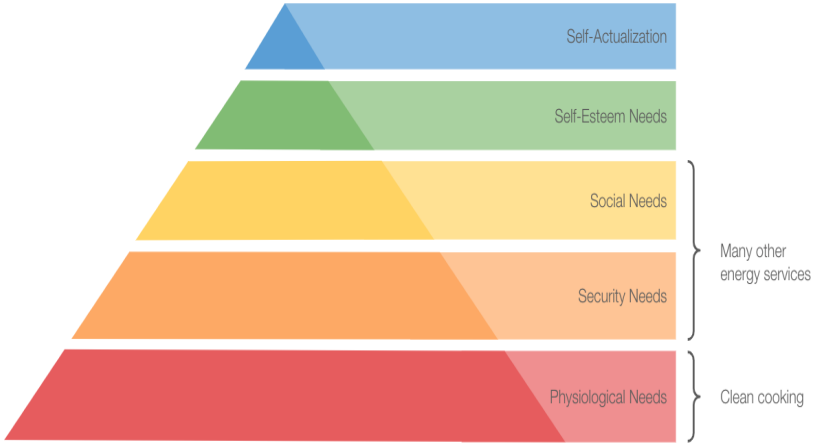


Figure 3: *Outlines Maslow's Hierarchy of Needs, in which Clean Cooking ought to be prioritized over or in parallel with other energy services, given its value add to society.*

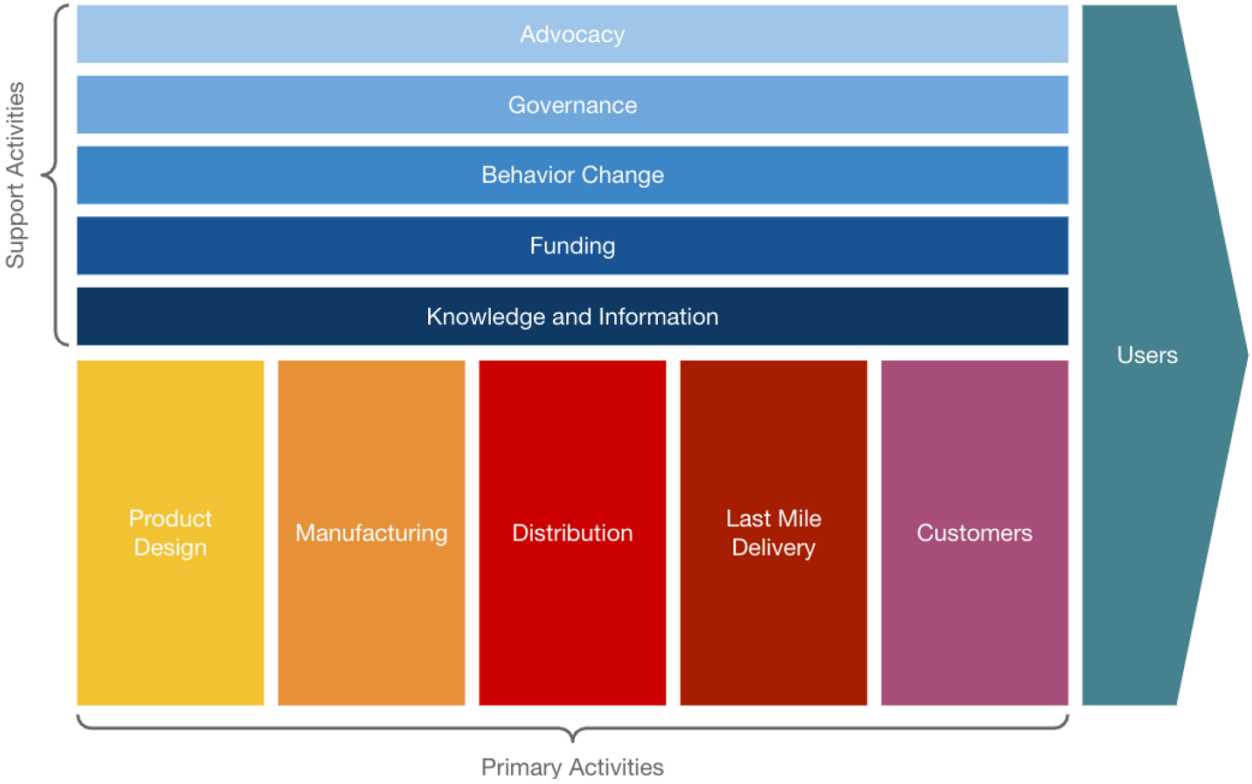
[25] Dalberg. (n.d.). Clean Cooking Systems Strategy - Dalberg Report. Retrieved May 04, 2021, from https://cleancookingsystemsstrategy.org/current-challenges.php

Identifying the Value Chain: Two Segments, Ten Elements

As a result of our initial research, we identified ten of the cooking poverty sector's major elements. The following is meant to (a) provide an overview of the sector rather than a comprehensive description and (b) explain the sector framework used in the balance of this report.

We frame the sector using an adapted version of Porter's Value Chain.[26] At its most basic, this sector can be presented as a value chain of goods and services directed to users that is heavily dependent on a set of support activities and actors.

Overview of the Cooking Poverty Sector (Sector Framework)



Segment 1: Support Activities

The Support Activities are the horizontal operations that support the sector as a whole. While there are sequences to these activities (e.g., research for Knowledge and Information support may need to precede Advocacy efforts), these operations tend to occur much more in parallel when compared to the Primary Activities. We identified the following:

1. **Advocacy:** the processes to elevate the importance of cooking poverty to the level of awareness commensurate with the scale of the problem and the required solutions.

[26] Institute For Strategy And Competitiveness - Harvard Business School. "The Value Chain." Accessed May 2, 2021. https://www.isc.hbs.edu/strategy/business-strategy/Pages/the-value-chain.aspx.

2. **Governance:** how the actors and activities within the sector aggregate resources to increase the success and scale of solutions. Governance is focused on strengthening the capacity of national governments and public sector players that contribute funding, strategy, and technical assistance to projects and in developing policy and regulation.

3. **Behavior Change:** how individual and institutional behavior evolve to determine the success, failure and sustainability of solutions. This change is centered around end user adoption.

4. **Funding:** the mix of public and private sector resources appropriate to solutions and the mechanisms and platforms available to allocate these.

5. **Knowledge and Information:** the availability and effectiveness of a centralized source of information, resources and support to allow new or expanding actors to increase their participation in the sector.

Segment 2: Primary Activities

The Primary Activities align closely with a typical supply chain and have a more distinct chronology to their order of operations. We considered the following high-level categories:

6. **Product Design:** expert researchers investigating and proposing innovations or adaptations of existing goods and services that provide improved or modern cooking services (e.g., Aprovecho Research Center).

7. **Manufacturing:** enterprises that produce improved or modern goods and services (e.g., BURN in Kenya, Toyola in Ghana).

8. **Distribution:** an enterprise that takes bulk shipment of manufactured products, facilitates logistics and makes products available to other firms who directly transact with customers.

9. **Last Mile Delivery:** the enterprises that consummate direct transaction with the Customer (e.g., UpEnergy in Uganda, Xpress Gas in Ghana, KOKO Networks in Kenya).

10. **Customers:** the household, business or public entity making the purchase decision; it should be noted that the end users and the customer are, at times, different stakeholders, due to market, gender, or other dynamics

Utilization of the Sector Framework

We used this model due to its distinction between Support Activities and Primary Activities. The two activities are dynamic in the cooking poverty sector between broadly focused partners, focusing on research, policy and investment, for example, and the more traditional supply chain operations of product design, manufacturing, and so on. While Porter's Value Chain culminates in "Margin", **we believe our culminating point is the value end-users derive from cooking poverty solutions, whether that is value in terms of convenience, health, gender equality, environmental impact or other dimensions.** Specifically, end-users benefit in ways such as cleaner indoor air, fewer eye infections, less drudgery, and faster cooking, whereas society realizes climate change mitigation, a more productive workforce, and decreased public health expenditure, etc.

Given that the Primary Activities are the vehicle in which solutions are delivered locally/nationally, we've chosen to concentrate our research on Support Activities. With each Support Activity, we identify the current state, identify gaps and/or challenges, and attempt to provide cases that support our observations.

To complement this report methodology, we include a quick tour of actors identified in our initial research to provide more detail if readers are interested.

Advocacy

> **Advocacy**
> *The processes to elevate the importance of cooking poverty to the level of awareness commensurate with the scale of the problem and the required solutions.*

Cooking poverty will not be eradicated without a focus on organized advocacy. The **global community** needs to be made fully aware of cooking poverty while understanding that, through coordinated campaigns, the path to a solution can be realized. From our observations, there seems to be a lack of consistent messaging as well as failure of actors to coalesce around a common approach to resource aggregation, deployment and implementation. We have seen a gap with elevating the awareness of cooking poverty to the level commensurate with the scale of the problem and achieving required solutions. **In order to garner global change, advocacy needs to be a key driver to successfully influence governance, financial investment, and behavior change, and the creation and dissemination of sector knowledge.** While there are many advocates in the sector, success will be determined by a focused, sustained effort on synthesizing individual efforts and raising awareness that (1) the problem is not being solved and (2) failure to solve it threatens the entire structure of sustainable development goals.

While all actors in the sector are feasibly advocates for themselves, there are a few significant actors in the field that currently advocate, or could advocate along these lines, for the sector. Some of the key actors/players identified in advocacy are Clean Cooking Alliance (CCA), SEforALL, World LPG Association, and World Bank/ESMAP.

The focus of the following sections concentrates on CCA, the Clean Cooking Sector Strategy (CCA and Dalberg), and transitioning to modern cooking.

Clean Cooking Alliance (CCA)

Current State

CCA currently is meant to be a one-stop location for all stakeholders. It functions much like an "industry association", providing services to partners and stakeholders. Interested parties can find clean cooking stoves and fuels information through a stove catalog; become a part of their clean cooking catalyst, meant to drive behavior change and investor education and prepare enterprises for investment; review a resource library, with videos, articles and sector reporting; utilize mentorship opportunities for gender equality and through guidance on entrepreneurship; attend regularly run series on leadership and investments; and explore the overall sector strategy work-in-progress through the Dalberg summary.

This report utilizes the most recent data including the 2021 Industry Snapshot[27]. This recent report highlights that, while there has been an increase in investment over the past couple of years, there is still a gap to achieve SDG7 by 2030. The emphasis is on success stories rather than the current state of the sector vis-à-vis the scale of the problem and the sector's need for resources.

[27] 2021 Clean Cooking Industry Snapshot. (2021). Retrieved from https://www.cleancookingalliance.org/2021-Industry-Snapshot/index.html

In order to understand better what the CCA offers as an advocacy group and a prime actor/player in the cooking poverty sector, we researched their current websites[28]. We reviewed the multitude of co-authored reports available, as well as internal links to external websites (i.e., links to the Clean Cooking Systems Strategy). In order to review the current state, we identified 12 Key Points. While the Key Points do not capture every single aspect of what CCA currently does, they illustrate the manner of overall CCA's operations at the time of writing. The 12 Key Points identified were (1) clean cooking catalog, (2) clean cooking catalyst, (3) partners directory, (4) resource library and links, (5) clean cooking campaign, (6) cooking-climate videos, (7) entrepreneurship, mentorship and gender, (8) clean cooking leadership series, (9) clean cooking investment series, (10) COVID-19 Interventions, (11) resources (finances), and (12) sector strategy.

CCA Gaps and Challenges

At the outset of this study CCA's CEO, Dymphna van der Lans requested that we look at the sector and its strategic and operational approach "whole", separate from any sector strategy work being undertaken. We did so. The largest gap observed is the fact that the sector, despite its age and decade of engagement, has just begun to formulate a strategy, a related set of tactics and a philosophy under CCA leadership. Such a strategy is needed to empower actions in seventy-one different and needy countries. The largest *operational* gaps found were the lack of consistent sector messages (Is it climate? Health? Gender?); failure to coalesce around a common approach to resource aggregation and deployment, especially in bringing donors to a common path; and, confusion between sector objectives for improved vs. modern cooking and stove/fuel standards.

Currently the CCA family of websites has links, resources, and libraries intended to be a one-stop database for publications, research, and other content relevant to the sector. Remaining constant and relevant is a challenge with updating any data, not to mention technical support to do the task. This is a missed opportunity. Information access and usability of the website tools could be greatly enhanced in order to create a streamlined user experience, which in its current state feels like information overload and lacks cohesion.

Advocacy should focus on the cause (to eradicate cooking poverty) and be directed to "plead in favor of" changes that are needed, whether these involve resource aggregation, deployment or policy. CCA does a good job of identifying and promoting sector successes, but that is not the same as sector advocacy. CCA does a good job of aggregating information (members/partners, stoves, etcetera) but that is not the same as teeing up information to accelerate new entrants or growth by existing partners.

Bridging the Gaps in Advocacy

There is an unmistakable opportunity to "get on message" by highlighting the (1) likelihood of failure; (2) reputational and collateral damage of such failure; (3) enormous gap between problem and resources; (4) the cost and consequences of inaction; and (5) challenges to be met.

This messaging needs to be macro (global) while concurrently micro (country and local). Success stories (e.g., Rwanda Clean Cooking Fund, new Spark + Fund commitment) need to be put in context with the size of the unmet problem. At present the emphasis on "success" creates the appearance of progress. That needs to change. In order to advocate, lost lives need to be the focus, accompanied by the fact that fully one-half of the world population is in cooking poverty.

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[28] "Clean Cooking Alliance." Accessed May 4, 2021. https://www.cleancookingalliance.org/home/index.html.

And the messaging needs to be bigger than the "clean cooking sector". Cooking Poverty is a Health issue. Cooking Poverty is a Women's issue. Cooking Poverty is a Gender and Discrimination issue, a Jobs issue, a Drudgery issue. It is not just about aggregating resources and deploying technology and business models, it is about changing society.

Advocating a Modern Cooking Solution through Incrementalism

The "modern cooking" approach aims for all households to meet at least Tier 4 status over a 10-year time frame. This may be exceedingly optimistic, and at $1.5 trillion unaffordable [29]. For this reason, a second modeling exercise, the Improved Cooking Scenario, was conducted. This alternative forecast uses similar assumptions for population growth and urbanization but focuses on achieving "improved cooking" A more pragmatic approach, using incrementalism as a solution, estimates the **total cost of approximately $100 billion over the next 10 years**. We believe this incremental approach should be adopted across the sector with two caveats: (1) where it is possible to "leapfrog" from unimproved to "modern" cooking, do so—this could involve raising the installed capacity for new electricity access to the point where electric cooking is viable; and (2) where even incremental improvements are unlikely, "harm reduction" (e.g., improved ventilation) should now be considered an integral part of cooking poverty eradication.

Nepal represents a good example of success regarding moving towards eradicating cooking poverty through incrementalism. Specifically, the country has set a goal of dissemination of three million improved cookstoves, installing 600,000 biogas digesters, and increasing biomass briquettes and pellets production to 20,000 metric tons per year.[30] Per a 2018 White Paper published by the Ministry of Energy, Water Resources, and Irrigation, strategically addressing the current issue of cooking poverty will help Nepal work towards placing their stated goal to place electric cookstoves in all households while also allowing them to phase out LPG use.[31]

Governance

Eradicating cooking poverty requires support from organizations of every kind. It demands commitments from large entities like the World Bank, political actors in national governments and interest groups, and every entity working on in-country distribution. We have seen that some of these commitments exist; however, poor governance inhibits meaningful progress toward reaching SDG7 by creating inefficiency within national governments and limiting public sector contributions. In order to achieve this common goal, sector leaders like the World Bank/ESMAP and the UN must reorganize and adopt a common framework to disseminate implementation strategies and frameworks to national governments; supporting actors must coalesce around this sector strategy rather than just their own institutional goals.

Governance

How the actors and activities within the sector aggregate resources to increase the success and scale of solutions. Governance is focused on strengthening the capacity of national governments and public sector players that contribute funding, strategy, and technical assistance to projects and assist in developing policy and regulation.

[29] ESMAP.2020.*The State of Access to Modern Energy Cooking Services (English)*. Washington, D.C. : World Bank Group. http://documents.worldbank.org/curated/en/937141600195758792/The-State-of-Access-to-Modern-Energy-Cooking-Services

[30] "Biomass Energy Strategy of 2017." Ministry of Population and Environment, Government of Nepal, 2017. https://www.aepc.gov.np/uploads/docs/2018-07-29_Biomass%20Energy%20Strategy%202073%20BS%20(2017)%20English.pdf.

[31] "White Paper on Energy, Water Resources, and Irrigation Sector." Ministry of Energy, Water Resources, and Irrigation, Government of Nepal, 2018. https://cip.nea.org.np/wp-content/uploads/2020/09/KMS-6-white-paper-on-energy-water-resources-and-irrigation-sector.pdf.

Current State

The World Bank's development of its Regulatory Indicators for Sustainable Energy (RISE) Framework provides centralized information on country progress towards strong governance for energy access. The World Bank and ESMAP developed this cross-cutting monitoring system, which tracks and compares regulatory frameworks across regions and countries. In 2020, RISE added a "Clean Cooking" pillar, highlighting that "Of the four pillars of sustainable energy, clean cooking is the most often overlooked when it comes to policy making."[32] The pillar measures: planning; scope of planning; standards and labeling; incentives and attributes. RISE reports several South Asian countries, including Bangladesh and Nepal, that are leading the way in policy frameworks that support the eradication of cooking poverty.[33]

There are several entities focused on improving the regulatory and "doing business" conditions in a country. We reviewed many of these (See Annex 1), including the World Bank and its technical assistance arm, ESMAP; various UN agencies, including UNFCCC and the Clean Development Mechanism (CDM) framework; and bilateral and international organizations such as GiZ and SNV. These organizations have a global presence and are leading or assisting in some of the biggest projects in clean cooking (e.g., Clean Cooking Fund / ESMAP in Rwanda; GCF-funded programming; EnDev).

The Issue: Empowering good governance needs to be distinguished from advocating for good governance. Providing Rwanda with ideas for sector reform and improvement equates to advocacy. Connecting those reforms to funding and packaging cooking in a larger infrastructure project loan-grant combination is *more than advocacy*. We distinguish "soft" efforts at advocacy from "hard" efforts that tie change to increases in resources and connection to larger agenda items". While CCA has taken on notable advocacy responsibilities, the efforts from organizations like ESMAP or other technical agencies to link changes and reforms to funding and other benefits directly empower good *governance* in countries striving to eliminate cooking poverty. This is a tactic that warrants greater attention.

Gaps

- Project by project, donor by donor *ad hoc* initiatives create inefficient or missed opportunities, including missed carbon finance opportunities.
- Advocating for improvement is not paired with empowering such changes through resource provision and creative bundling.
- The knowledge and information "package" needed for good governance and system improvement is not readily available for governments to embrace.
- There is insufficient communication of governance successes and models among national governments.
- Inconsistent product and fuel standards.
- Failure to align priorities with adjacent sectors such as environment/climate, gender, health.

Lastly, it is important to note that there is a lack of coordination among stakeholders, which will inhibit the sector's ability to scale up capacity alongside electrification infrastructure, which is a viable option for eradicating cooking poverty.

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[32] "RISE 2020 - Sustaining the Momentum." World Bank Group, 2020. https://rise.esmap.org/data/files/reports/rise-cleancooking.pdf.

[33] Ibid.

Bridging the Gaps

To further foster strong governance across the sector, a thorough strategy or "Compact", agreed upon by representatives from leading public sector organizations, donors, and investors would ensure a complete and balanced approach to funding in order to meet the needs of national governments and enterprises focused on cooking poverty eradication. It will encourage the necessary expansion of capacity at the national level. This approach, rooted in the successes of some governments and partner enterprises should promote the following:

- Establishment of decision-making and enforcement authorities within national and regional/local governments.
- Creation of specialized agencies to tackle the issue and work in tandem with other energy and adjacent sector agencies (e.g., health, rural development).
- Scaled-up and harmonized financing plus efficient use of increased funds, including utilization of results-based financing and carbon finance opportunities.
- Coordinated communication of priorities.
- Knowledge sharing of sector strategy and viable tactics across entities – discussion of successes and failures at various points in the value chain.
    - This includes successful national governance i.e., policy frameworks and accountability.
    - Allows for dissemination of a "Playbook".
- Increased cross-sector accountability for sector and adjacent sector partners, including the UNFCCC and its COP deliberations.
- Implementation of consistent product standards and monitoring.

National Frameworks to Observe as a Solution

We have included several successful examples of strong national governance structures that have prioritized the eradication of cooking poverty: Bangladesh, Nepal, and Rwanda.

The government of **Bangladesh** has been a crucial proponent of eradicating cooking poverty for years, and it is likely a core driver for the international investment seen in this country. Since the development of the *Country Action Plan for Clean Cookstoves in 2013*[34], the government has supported the initiative via several policies. Steps the government has taken to assist in the transition are:

- 10% import duty reduction for improved cook stoves (ICS).[35]
- Establishment of the Household Energy Platform: the sector coordinator and advocate, supported by CCA.[36]

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[34] "Country Action Plan for Clean Cookstoves." Ministry of Power, Energy and Mineral Resources, Government of the People's Republic of Bangladesh, November 2013. https://policy.asiapacificenergy.org/sites/default/files/CAP%20for%20clean%20cookstoves.pdf.

[35] Clean Cooking Alliance. "Bangladesh." Accessed May 2, 2021. https://www.cleancookingalliance.org/country-profiles/focus-countries/6-bangladesh.html.

[36] Ibid.

- Waiver of import duty for LPG and adjusted Advance Income Tax (AIT) (5% to 2%).[37]
- Investment in women-led businesses.[38]
- Creation of the "Market Development Initiative for Bondhu Chula" to utilize micro-entrepreneurs across supply chains.[39]
- Economic Relations Division (ERD) support for CDM projects.[40]

The combination of these government investments and initiatives helped encourage actors to expand into this space and empower them in their operations longer-term. By ensuring that initiatives are supported, financially and politically, the government has promised a favorable environment for clean cooking endeavors.

Nepal's support of biogas digester solutions has been productive in reducing cooking poverty. Although Nepal has a relatively high electrification rate of 94% (71% on the national grid, 23% off-grid), households have not yet made the transition to modern cooking at the same rate. The installation of micro hydropower plants in rural areas offers opportunities for transitions to electric cooking, but reliability especially during peak hours remains a steep challenge.[41]

Nepal continues to strive for universal access to electric cookstoves while prioritizing best available technology, including ICS, on the way.[42] Electric cooking is not yet a viable option for all households and fuel stacking is still common.[43] In 2019 about 69% of households were still using traditional biomass for cooking (firewood, animal waste, crop residue or plant biomass). Nepal has worked to prioritize provision of ICS in addition to biogas digesters through national energy policies, which outline annual installation goals and provide strict subsidy frameworks for ICS and biogas.

We see strong government commitment through widespread policies like the Renewable Energy Subsidy Policy and the Biomass Strategy of 2017 from the Ministry of Population and Society, which outlines specific targets for ICS, Biogas, and biomass pellet installation/production.[44]

The Biogas Support Programme (BSP) is an important case study, showing a government's role in bringing solutions to households and communities. Initially launched in collaboration with SNV and KfW, its success is attributed to strong government subsidy and quality policies, linked to digester size and location, coordinated with partners that could reach rural and poor families, with access to micro-credit mechanisms.[45] Between 1992 and 2009, over 200,000 digesters were installed in Nepal with an estimated

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37 "Energizing Finance: Understanding the Landscape 2020." Sustainable Energy for All (SEforALL), 2020. https://www.seforall.org/publications/energizing-finance-understanding-the-landscape-2020

38 Ibid.

39 Ibid.

40 Ibid.

41 Will Clements and Surendra Pandit. "Unlocking Electric Cooking in Nepal." Modern Energy Cooking Services (blog). Accessed May 3, 2021. https://mecs.org.uk/blog/unlocking-electric-cooking-in-nepal/.

42 Paudel, Dipti, Marc Jeuland, and Sunil Prasad Lohani. "Cooking-Energy Transition in Nepal: Trend Review." Clean Energy 5, no. 1 (March 1, 2021): 1–9. https://doi.org/10.1093/ce/zkaa022.

43 Will Clements and Surendra Pandit. "Unlocking Electric Cooking in Nepal." Modern Energy Cooking Services (blog). Accessed May 3, 2021. https://mecs.org.uk/blog/unlocking-electric-cooking-in-nepal/.

44 IEA. "Renewable Energy Subsidy Policy of Nepal," 2017. https://www.iea.org/policies/6228-renewable-energy-subsidy-policy-of-nepal.

45 "Biogas Support Programme (BSP)," 2010. https://snv.org/cms/sites/default/files/explore/download/biogas_support_programme_nepal_2010.pdf.

budget of about $50 million.[46] The project received funding from development partners and the Government of Nepal in addition to CDM – carbon revenues.[47]

Although only approximately 3.1% of the population use biogas as primary fuel source[48], the structure and capacity of the program since the 1990s is a notable case study for pursuing clean cooking solutions and technology deployment. It remains an example of strong government policy, technical assistance, long-term donor commitment, and ongoing monitoring.[49] Importantly, the project also supported the establishment of a specialized agency in charge of overseeing activities: the Government of Nepal's Alternative Energy Promotion Centre (AEPC) was formed in 1996 and AEPC remains the leader in promoting renewable energy access today.

Rwanda was top three in the world's fastest movers towards electricity access from 2010 (10% access) to 2018 (35% access). The country's NST1 electricity access plan focuses on policy, regulation, feed-in tariffs and securing long-term funding partners. With approximately 80% of Rwandans still reliant on firewood, the country has been working to implement policy changes to eradicate cooking poverty; Rwanda has earned an above average RISE score (60) in Clean Cooking with its strong institutional capacity, broad scope of planning, and supplier incentives.[50]

Rwanda's success has been seen through a continued government focus on rationalizing tariffs, increasing electrification, improving utility creditworthiness, boosting affordability through lending and co-financing, and promoting improved cook stoves. Some influential changes in the energy space include:

1. Tariffs - 2017 "Electricity Access Roll-out Program" cut tariffs in half and removed upfront payments, implementing more cost-effective tariff structures, tariff subsidies, feed-in tariffs, and competitive auctions.

2. Electrification - on-grid and off-grid electrification projects.

3. Strengthened creditworthiness of utilities - utility framework changed to increase participation from the private sector.

4. Creation of the Rwanda Energy Group (REG) to monitor electricity utilities while separating development and operations.

5. Increased affordability through local lending and co-financing with organizations such as National Fund for Environment and Climate Change.

6. Enforcement of cookstove standards.

Importantly, Rwanda is the first country to participate in the Clean Cooking Fund (CCF). The Energy Access and Quality Improvement Project (EAQIP), approved by the World Bank in September 2020,

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46 "Energizing Finance: Understanding the Landscape 2019." Sustainable Energy for All (SEforALL), 2019. https://www.seforall.org/system/files/2019-11/EF-2019-UL-SEforALL-w.pdf.

47 "Biogas Support Programme (BSP)," 2010. https://snv.org/cms/sites/default/files/explore/download/biogas_support_programme_nepal_2010.pdf.

48 Alisha Pinto, Han Kyul Yoo, Elisa Portale, and Dana Rysankova. "Nepal - Beyond Connections, Energy Access Diagnostic Report Based on the Multi-Tier Framework." ESMAP, 2019. https://energydata.info/dataset/nepal-multi-tier-framework-mtf-survey/resource/35124cc5-0ebf-49c7-b7df-ec7fc961eb1d.

49 Ibid.

50 "Rwanda." RISE. Accessed May 2, 2021. https://rise.esmap.org/country/rwanda.

notably combines the country's pursuit for cleaner cooking with electrification.[51] It is part of the Rwanda Universal Energy Access Program, which aims to achieve the country's targets.[52] The project includes $10 million in a loan from the World Bank's International Development Association (IDA), $10 million as a grant from CCF, and an additional $30 million investment from other public and private donors.[53] It aims to reduce cooking poverty, supporting Tier 2 and eventually Tier 3 solutions, for 2.15 million Rwandans.[54] Rwanda's robust national capacity for energy projects is a crucial enabling factor that led to international investment from a new initiative.

Behavior Change

Behavior change is critical to transitioning out of cooking poverty. Throughout our research, every successful company or organization we spoke with had a similar focus on behavior change. Moreover, nearly every failed implementation can be attributed in part to lack of understanding of the end-user. A change in human behavior can be significantly enhanced through societal awareness and understanding the final consumer. While educating households about poor indoor air quality and how it contributes to illnesses such as lung cancer, pneumonia or asthma is important, true behavior change must encompass an understanding of the user's values and motivations, and the practicality, feasibility, and affordability of the solution.

Behavior Change
How individual and institutional behaviors evolve to determine the success, failure and sustainability of solutions; this change is centered around end user adoption.

Current State

Behavior change is a critical step in the elimination of cooking poverty, but its analysis has not always been part of the solution. Organizations such as SNV-- an implementing partner of EnDev, a multi donor initiative to enhance access to modern energy[55]-- analyze behavior change for their implementation plans. Starting in 2015, SNV assisted a successful transition to improved cookstoves in over 250,000 households in Laos and is now using a similar framework in Cambodia. The initial year of their five-year cooking project in Cambodia is dedicated to a comprehensive behavior change analysis. SNV has outlined repeatable factors to be considered in their analysis: objectives (time, fuel reduction, health, gender, etc.), field testing, distribution and adoption through surveys and analysis, project design and budgeting. Creating a structure for analyzing societal behavior across different countries and cultures has allowed SNV to implement sustainable improvement plans that address the unique needs of the end-user.

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[51] "Rwanda Energy Access and Quality Improvement Project (P172594), International Development Association Project Appraisal Document." The World Bank, 2020. http://documents1.worldbank.org/curated/en/819241600653622828/pdf/Rwanda-Energy-Access-and-Quality-Improvement-Project.pdf.

[52] World Bank. "World Bank Project to Boost Household Access to Affordable Energy," September 17, 2020. https://www.worldbank.org/en/news/press-release/2020/09/17/world-bank-project-to-boost-household-access-to-affordable-energy.

[53] Ibid.

[54] "Rwanda Energy Access and Quality Improvement Project (P172594), International Development Association Project Appraisal Document." The World Bank, 2020. http://documents1.worldbank.org/curated/en/819241600653622828/pdf/Rwanda-Energy-Access-and-Quality-Improvement-Project.pdf.

[55] Daniel Salinas, "Changing Behaviour: One Clean Cookstove at a Time," 2019, http://snv.org/update/changing-behaviour-one-clean-cookstove-time.

Another important component to understanding behavior change includes the secondary factors of cooking such as existing benefits of smoke considered as mosquito control or cultural and social preferences. The tier advancement that is achievable as the next stage is also assessed through this SNV approach. It may make sense at specific financial and time constraints to move to an improved cookstove, rather than a higher more advanced tier.

Gaps

Though receiving more attention, as in the above section, end-user behavior continues to be overlooked or undervalued. This needs to change. We have seen heavy emphasis on the supply side with specific technologies, with less emphasis on understanding the ability for the consumer to adapt to and understand the importance of change. Projects continue to fail globally as the following factors are not studied properly to effectively sustain improvements:

- Consumer willingness and motivation to change.
- Impact of cultural, religious and societal beliefs.
- Ability and accessibility to transition to new energy sources.
- Financial burden to consumer.
- Daily change in the specific tasks needed to cook.
- Ability to replicate the same meals.

Bridging the Gaps

In order to understand how to bridge the gaps in Behavior change, we researched multiple countries and companies to understand failures and successes through research and interviews of actors in the space. The examples below highlight a failed effort in India that exposes major oversight in consumer understanding, while KOKO Networks' story highlights a thorough Behavior analysis that led to breakthrough advancements in cleaner cooking. Behavior change analysis with respect to understanding the end-user is a fundamental action essential to any cooking poverty eradication strategy.

India LPG Failure

LPG transition in India failed because of lack of understanding consumers. In recent years, the most prominent effort in India by the government in terms of improving access to clean cooking energy was the Pradhan Mantri Ujjwala Yojana (PMUY) project which provided subsidized LPG connections to over 77 million households as of August 2019. Despite the government efforts and initial spike in LPG consumption, adoption to LPG remains low largely as a behavior analysis of the end user was overlooked.

Leaders in India did think progressively and aimed to provide LPG canisters to users in need with the intention to replace dirty fuels with a cleaner (though fossil fuel based) alternative. This strategic approach on a national level, however, failed to address the behavior and consumer demands for sustainable implementation. The government did not consider steps beyond distributing the LPG canister, they merely assumed that the people would figure out how to utilize, finance and source LPG. If a thorough behavior

change study of the end user had been conducted, they would have realized they were **missing key steps to creating habitual change**.

Such a study would have identified the monetary motivations to devise a strategic affordability plan, customer accessibility to LPG supply, and consumer willingness to change which would have led to an education and awareness strategy.

KOKO Networks Success

Even at more advanced levels of clean cooking, the same underlying behavior concepts still apply. KOKO Networks, a climate technology company operating in Kenya and India, has spent the last seven years developing product and business model innovations that enable clean bioethanol cooking to scale rapidly, starting in Nairobi, Kenya.[56] They spent their initial years intensely studying human cooking behaviors. Specific food dishes like Matoke which is made from green banana leaves, requires many hours of cooking and was thought to be only economically feasible for users if they cooked it with charcoal. KOKO Networks took the time to figure out how to prepare the exact same dish using ethanol and then even went as far as to make instructional videos to teach and market the capabilities. They also studied culturally specific adaptations to the design of the cookstoves themselves.

Having developed its product with target customers, KOKO launched an ambitious new cooking solution in Nairobi aimed at out-competing dirty cooking fuels in the two areas that matter most to consumers: affordability and convenience. Through a Network of 700 Clean Fuel ATMs inside neighborhood shops across Nairobi, and a range of other technologies, KOKO enables clean, renewable bioethanol cooking fuel to undercut charcoal by 50%. The customer experience is modern, clean, safe, and delivers material savings to household budgets.

After five years of R&D, including building high-tech manufacturing facilities in Kenya and India and writing and enabling legislation, the first Network was rolled out in late 2019 and scaled rapidly through 2020. KOKO's approach tackles the ecosystem holistically: the product and service, the supply chain and delivery, purchase and fulfillment. With nearly 150,000 unique customers across Nairobi, behavior change around fuel purchase and refill habits has been a key driver of their success, and they now have continent-wide expansion plans now that the business model is proven at scale.

[56] "KOKO," accessed May 4, 2021, https://kokofuel.com/.

Funding

There is a significant gap between the amount of funding needed to eradicate cooking poverty and the actual investment flowing into this sector. However, there is no clear bottleneck in which funding is being blocked or a specific gap that, if closed, would solve this underinvestment. Instead, the sector must continue to seek investment across the value chain via a myriad of providers and financial instruments. However, certain factors definitely determine/deter the flow of financial investments. Markets with strong governance attract a large chunk of investment. The lack of awareness regarding the scale of the problem combined with lack of detailed sector information might cause investors to sit on the sidelines.

Funding
The mix of public and private sector resources appropriate to solutions and the mechanisms and platforms available to allocate these.

Each year the cost of inaction, as defined in the problem statement, is many times the one-time cost of transitioning more than half of the global population from cooking poverty. A scale increase in funding to the sector is essential. [57]

Current State

Financial investment in the sector comes from a variety of sources such as governments, private donors, bilateral organizations, self-financed enterprises, "family and friends" loans and international actors. Capital is generally in the form of grant, debt or equity. Grants or loans come from a handful of public institutions such as the World Bank, CCF, UNDP, Green Climate Fund, and the international agencies of national governments (GIZ, USAID, DFID etc. and development finance institutions and specialized facilities).

According to SEforALL, in the *2020 Energizing Finance* report, public funding contributed the majority (60%) of the total $131 million in financing for clean cooking access in 2018.[58]

Given its standing, the World Bank has an important role to play in eradicating cooking poverty. At the country level, the World Bank mobilizes resources for loans and grants through analytical and advisory services provided by ESMAP, the technical assistance arm of the World Bank for energy. Although it reports nearly $400 million in active lending for clean cooking and heating programs,[59] it is unclear how much of such funding is directed at eradicating cooking poverty annually. In 2020, ESMAP reportedly disbursed only $13.42 million for clean cooking and heating.[60] Recent and notable about the World Bank and ESMAP's activities are the launch of a $500 million Clean Cooking Fund (CCF) and the subsequent

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[57] ESMAP.2020.*The State of Access to Modern Energy Cooking Services (English)*. Washington, D.C. : World Bank Group. http://documents.worldbank.org/curated/en/937141600195758792/The-State-of-Access-to-Modern-Energy-Cooking-Services

[58] "Energizing Finance: Understanding the Landscape 2020." Sustainable Energy for All (SEforALL), 2020. https://www.seforall.org/publications/energizing-finance-understanding-the-landscape-2020

[59] The World Bank. "Energy - Overview." Text/HTML. Accessed May 4, 2021. https://www.worldbank.org/en/topic/energy/overview.

[60] "Energy Sector Management Assistance Program Annual Report 2020." ESMAP, 2020. http://documents1.worldbank.org/curated/en/712171609756525808/pdf/Main-Report.pdf.

approval of its first project in Rwanda (see Governance).[61] Over the next five years, CCF will aim to scale up both public and private funding for the sector.[62]

A variety of financial instruments from these sources can help deliver funding in the way individual actors can most efficiently use it, or in the way that most effectively mitigate their risk. While there are many instruments that achieve the above, we have identified eight that are promising from the *2020 Energizing Finance* report. These eight are: (1) pay-as-you-go financing, (2) catalytic smart subsidy programs, (3) results-based financing (RBF) schemes, (4) pay-per-service models, (5) securitization, (6) currency risk management instruments, (7) crowdfunding, and (8) project preparation facilities.[63]

These financial instruments and program designs are essential to mitigating the risks that have historically precluded private investors from actively participating in the sector. Private investments have been a low percentage of total investment in the sector but must grow into a more active role if the sector is to achieve its overarching goals. Given the lack of progress in the space, private investors have found it difficult to justify risk with what is viewed as an uncertain return profile.

Carbon financing is starting to again draw renewed attention to ICS, and we are hopeful that the investors will start to realize the opportunity in the sector. Dramatically increasing the current investment to eradicate cooking poverty, today, and continuing over the following 10 years, is critical in ensuring we achieve SDG7.

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61 The World Bank. "Accelerating Access to Clean Cooking: The Efficient, Clean Cooking and Heating Program and the Clean Cooking Fund." Accessed May 4, 2021. https://www.worldbank.org/en/results/2020/11/10/accelerating-access-to-clean-cooking-the-efficient-clean-cooking-and-heating-program-and-the-clean-cooking-fund.

62 Ibid.

63 "Energizing Finance: Understanding the Landscape 2020." Sustainable Energy for All (SEforALL), 2020. https://www.seforall.org/publications/energizing-finance-understanding-the-landscape-2020

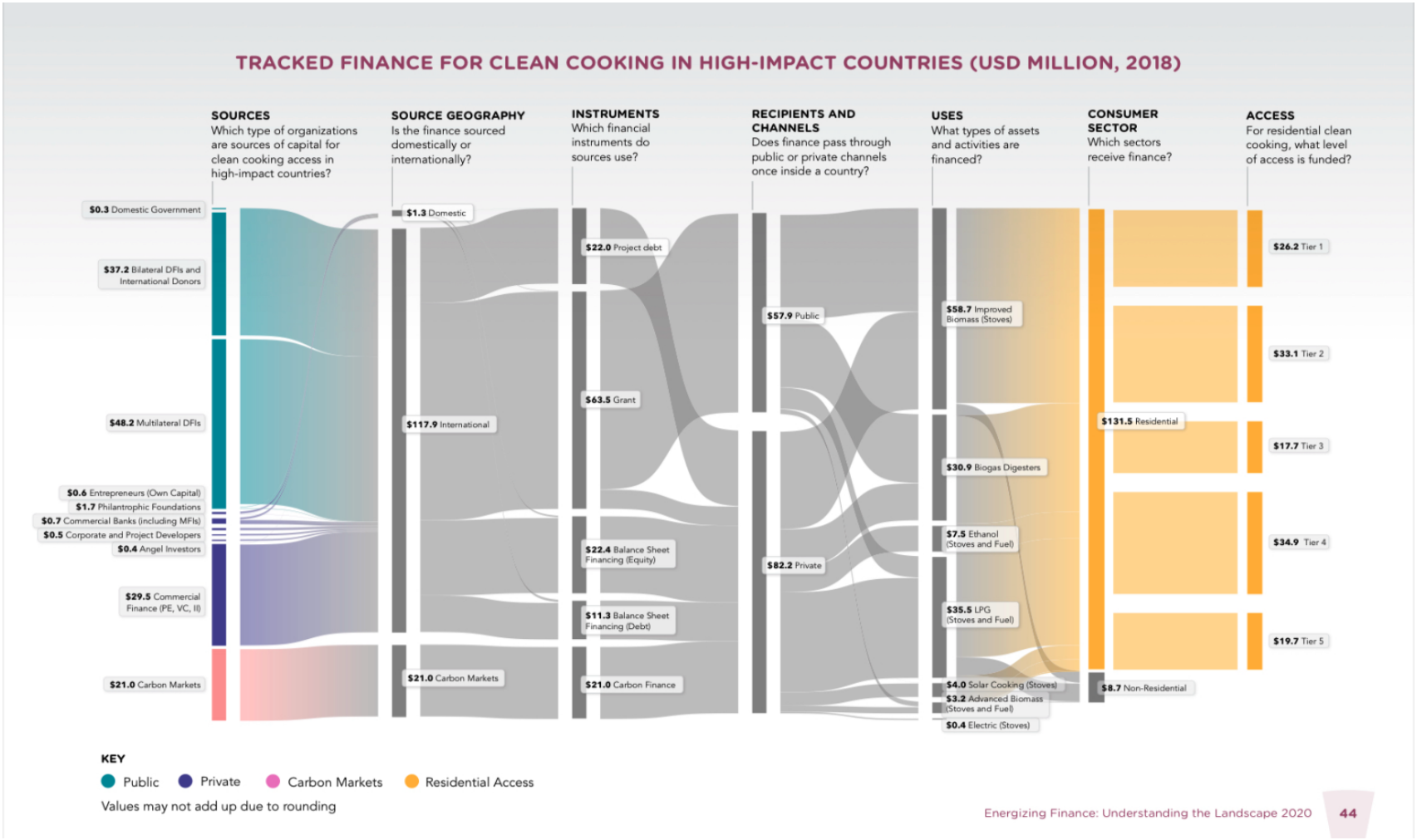

Figure 4: Details the finance invested in 2018 towards the Clean Cooking Sector

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64 "Energizing Finance: Understanding the Landscape 2020." SEforALL, November 19, 2020. https://www.seforall.org/publications/energizing-finance-understanding-the-landscape-2020.

Gaps

The cost of inaction includes indirect costs of health, gender, and climate consequences, which are externalities the sector itself is not directly paying for. While the sector does not directly bear these costs, it is governments, regions, and individuals within the sector that pick up the bill. This lack of accountability of the sector's externalities does not create motivation for investors, as the returns are often intangible. This is compounded by a gap in the value users are willing to assign improved or modern cooking and the benefits investors and international organizations are expecting to see (such as lowered GHG emissions, improved morbidity and mortality rates, and gender equality advancements). Business cases, then, must be tailored to two different audiences: users and financiers. These contribute, in part, to the four primary gaps we have identified:

1. Lack of financial commitments (~$10 billion yearly), due in part to inadequate incentives and lack of confidence, needed to meet long-term targets (SDG7 and others).

2. Insufficient mainstream lending and poor disbursement: too few countries receiving majority of funding due to lack of governance, infrastructure and adaptation.

3. Under-utilization of carbon finance.

4. Lack of intermediation to align funders and entrepreneurs with solutions.

Investments flow to a handful of countries, but generally not to countries most in need. Countries like The Democratic Republic of the Congo and Ethiopia, where 95 percent of the population fall into cooking poverty, attract less than 1 percent of the annual investment needed. In contrast, Bangladesh accounted for nearly half (47%) of total tracked clean cooking investment.[65]

Private sector actors remain elusive in the cooking poverty sector. Private sectors invest mainly in renewable and modern fuels such as ethanol, biogas, and LPG, unlike public sectors that focus on improved cookstoves. The overall lack of investment can be attributed in large part to limited public finance to alleviate risk for private sector investors and to stimulate consumer demand.

In part, this is because companies invest in the projects that align with their own values and are prioritizing across many different projects and SDGs. The IKEA Foundation, for example, only considers fully renewable, higher-tier projects. While our research team believes solutions across all tiers serve a necessary purpose, we also understand the need for organizations to operate within their values. The sector can adapt to these constraints by facilitating more tailored connections between projects and potential investors.

(NOTE: broadly defined energy investments are not flowing to the right technologies. Despite sunny op-ed pieces, investment in fossil fuel-generated electricity has increased, locking countries into decades of carbon emissions, import dependency, and stranded asset risk. Ostensibly in response to COVID-19, the Government of India has commenced the commercial auctioning off more than 41 coal mines, aimed at making India 'self-reliant' and attracting $4.4 billion in private sector investment.[66] Even if money flowed

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65 "Energizing Finance: Understanding the Landscape 2020." Sustainable Energy for All (SEforALL), 2020. https://www.seforall.org/publications/energizing-finance-understanding-the-landscape-2020

66 The Economic Times. "Commercial Coal Auctions Start with 41 Mines Entailing Rs 33,000 Crore Investments," June 18, 2020. https://economictimes.indiatimes.com/industry/indl-goods/svs/metals-mining/commercial-coal-auctions-start-with-41-mines-entailing-rs-33000-crore-investments/articleshow/76444278.cms?from=mdr.

to renewable solutions, there is still a large gap between what is being generated and what is being shared. A 2020 report by the International Renewable Energy Agency (IRENA)[67]found that while public flows reached $21.4 billion in 2017, only 12% of that money reached the countries in the most need.)

Carbon financing as a funding channel is largely underutilized, likely due to complex regulatory and logistical hurdles. While it is often only available for certain higher tier solutions, this is one way for institutions to proactively mitigate the funding gaps on their own.

Stories That Have Bridged Gaps

Results Based Financing (RBF) in Zambia

Global experience indicates that, when implemented well, RBF can be a solution towards eradicating cooking poverty. A useful example of success comes from Beyond the Grid Fund for Zambia (BGFZ). Funded by The Swedish International Development Cooperation Agency (Sida) and managed by the Renewable Energy and Energy Efficiency Partnership (REEEP), BGFZ was launched in 2016 with the aim to expand access to clean, reliable, affordable off-grid solar energy and mini grids in rural and peri-urban areas in Zambia. The program supports four companies, Fenix International, VITALITE Zambia, Emerging Cooking Solutions, and Standard Microgrid, which work closely with the government in its efforts to build a thriving market for off-grid solar energy services and are on track to connect 1.6 million Zambians by 2021.

At the core of the BGFZ is a $23.5 million results-based "social impact procurement" fund. Unlike a challenge fund or other traditional concessional financing, the BGFZ operates rather like a traditional public procurement – following strict guidelines on eligibility and tender from potential awardees, enforcing deployment and delivery schedules.[68]

In September 2020, Sida with the Nordic Environment Finance Corporation (NEFCO), commenced a new initiative, the Scaling of Clean Cooking Solutions Program. The first phase will include detailed scoping in Zambia looking into ways to test the use of RBF to incentivize the development and sales of innovative clean cooking solutions at scale. This phase will be followed by a design phase. Sida has allocated nearly $600,000[69] to the program. The focus will be on accelerating the use of higher tier clean cooking solutions such as (bio)ethanol / liquid biofuels, biogas, solid sustainable biofuels such as pellets and briquettes, LPG and solar (electric) cooking.

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67 : IEA, IRENA, UNSD, World Bank, WHO. 2020. Tracking SDG 7: The Energy Progress Report. World Bank, Washington DC. © World Bank. License: Creative Commons Attribution—NonCommercial 3.0 IGO (CC BY-NC 3.0 IGO).

68 More on BGFZ can be found here https://www.bgfz.org/

69 "Sweden and NEFCO Kick off New Initiative on Clean Cooking Financing Solutions." Nefco, September 11, 2020. https://www.nefco.int/news/sweden-and-nefco-kick-off-new-initiative-on-clean-cooking-financing-solutions/.

Microcredit Schemes and Localization in Bangladesh

Bangladesh comprised 47% of total investments in the clean cooking sector in 2018.[70] These investments have been deployed in several ways, with the primary intention of reducing the financial barrier to entry for actors in this space. Infrastructure Development Company Limited (IDCOL) offers microcredit schemes to support the NGO partners, in addition to a "subsidy/safety net program" from the government to promote renewable energy alternatives. These financial resources offer a lot of inventive models for how to empower individual actors, though there is still much room for Bangladesh to improve on this front. Bangladesh could scale opportunities in microcredit, subsidized loans and credit guarantees for improved cooking in order to steer away from the collateral requirements and high interest rates that are discriminatory towards the lower-income households. An increase in short-term financing opportunities for supply side investment would provide advancement in areas such as research and development. Additionally, the free distribution of these alternative cookstoves has been explored but it does impact the ability of other technologies to compete effectively. The financial balance of affordability is critical as people are accustomed to their current cookstoves, and an improved cookstove costs approximately one day's salary.[71] Microfinancing can help bridge this gap.

Bangladesh has had a profound focus to localization in its business implementation model. This was supported by ESMAP in Bangladesh by the leveraging of local entrepreneurs, partner organizations including nongovernmental organizations, and raw material suppliers to manufacture and distribute cookstoves.[72,73] This coordination and execution requires a strategic business and behavior understanding. IDCOL provides financing, primarily through a "cluster-based program [that] ensures economies of scale and reduces transaction cost for these organizations" by defining segmented regions and then supporting specific partnering organizations within each area.[74] This market dynamic is especially important, as many global clean cooking initiatives have failed due to an inability to reach a mature enough scale to operate sustainably; additionally, the local jobs created throughout the entire supply chain empower the community holistically, rather than just via their cooking.

Consumer Lending in Uganda with Simoshi

95% of schools in Uganda were cooking with traditional open fire stoves in 2011[75] which is where children eat most of their meals. Simoshi aims to transition cooking poverty in and with schools in Uganda to more efficient cookstoves produced by Ugastove. These stoves reduce wood consumption by 50%, increase savings for customers over time, and improve air quality. They use a service-orientated approach that involves constant upkeep, cleaning, and training to keep the savings sustainable. A manufacturer-only approach will not suffice as the improved product does not solve the problem on its own. To date, Simoshi has 82 schools that have implemented new institutional ICS. Twenty-eight of these schools have received free institutional ICS from the government, while 54 have been exclusively financed by Simoshi through a

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70 "Energizing Finance: Understanding the Landscape 2020." Sustainable Energy for All (SEforALL), 2020. https://www.seforall.org/publications/energizing-finance-understanding-the-landscape-2020

71 "Clean Cooking in Bangladesh: The Experience from One Million Households." Accessed May 4, 2021. https://blogs.worldbank.org/energy/clean-cooking-bangladesh-experience-one-million-households.

72 Amit Jain and Zubair K M Sadeque. "Clean Cooking in Bangladesh: The Experience from One Million Households." Accessed May 4, 2021. https://blogs.worldbank.org/energy/clean-cooking-bangladesh-experience-one-million-households.

73 ESMAP. "Bangladesh Offers Model of Successful Clean Cooking Program." Accessed May 4, 2021. https://www.esmap.org/impact_story_bangladesh_model_for_sucessful_clean_cooking.

74 Amit Jain and Zubair K M Sadeque. "Clean Cooking in Bangladesh: The Experience from One Million Households." Accessed May 4, 2021. https://blogs.worldbank.org/energy/clean-cooking-bangladesh-experience-one-million-households.

75 "Institutional Improved Cook Stoves for Schools and Institutions in Uganda." United Nations Carbon Offset. Accessed May 10, 2021. https://offset.climateneutralnow.org/institutional-improved-cook-stoves-for-schools-and-institutions-in-uganda#:~:text=In%202011%20the%20Ministry%20of,in%20the%20past%206%20years.

lending program that lasts approximately 15 months. Essentially the schools use the savings from consuming less firewood to pay for the new cookstoves and once the loan is paid off, the school begins accruing savings for replacement and other uses. Fourteen new schools have been included this year with the support of the GIZ COVID-19 Relief Fund. Simoshi has the capacity to undertake 450 schools but financing the purchase of the institutional ICS is the largest challenge.[76]

Simoshi utilizes Carbon Financing to Fund Improved Cookstoves

Carbon credits can be generated and monetized with ICS through the carbon emission reductions that occur based upon a specific project. The issuance of the credits is calculated, monitored and certified by organizations such as the Gold Standard and CDM. Gold Standard recently released a report from Vivid Economics finding: "[...] for every carbon credit issued from a clean cookstove project, $267 in economic value is created."[77]

Simoshi goes through a very well-documented process to account for and value the carbon that is avoided by using ICS. They can sell each credit for roughly $15 per metric tonne.[78] They recently issued 3,950 certified emission reductions (CERs) using the Clean Development Mechanism and Gold Standard (GS), which was half the size of last year given schools have been closed due to COVID-19. Fortunately, they are on track for a third closing period in Dec 2021 to issue 10,000 CERs in early 2022. In 2018, 8,457 GS CERs were issued and to date 90% of those have been sold, exclusively through the UNFCCC Climate Neutral Now platform[79]. The profit received from the carbon credits produced by the project is used towards education and upkeep for the stoves, this is critical to the sustainability of the business model. Currently, Simoshi is providing 5 years of free service and maintenance and is strategizing on how to ensure schools incorporate the cookstoves in perpetuity. When this was discussed with Virginia Echavarria of Simoshi, she reported that including service, maintenance and training have "[...] been the added value necessary for the long-term behavioral transition to happen. The inclusion and empowerment of kitchen staff in Simoshi's continuous training and monitoring model, gives them a sense of ownership and a voice in future decisions as the model adapts to changes and innovates to improve".[80]

Carbon Financing with Biogas in Nepal

Nepal's pursuit of biogas and its participation in the CDM program can also be viewed as a success. According to the UNFCCC, "the biogas is used as a fuel for cooking, therefore the displacement of non-renewable biomass (NRB) is counted as emission reduction under the CDM and Gold Standard."[81,82] The project has had 10 approved CDM program activities (CPAs) under its two registered Programme of Activities (PoA). This has been supported by the Government of Nepal since 2005.[83] Moreover, the involvement with the UN and its CDM framework catalyzed the development of further/more robust institution capacity on the government level. The AEPC established the Carbon and Climate Unit (CCU)

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76 "Simoshi," Simoshi, accessed May 4, 2021, http://www.simoshi.org.

77 "Report: Valuating the Benefits of Improved Cooking Solutions | The Gold Standard." Accessed May 4, 2021. https://www.goldstandard.org/blog-item/report-valuating-benefits-improved-cooking-solutions.

78 "United Nations Online Platform for Voluntary Cancellation of Certified Emission Reductions (CERs). All Projects," accessed May 4, 2021, https://offset.climateneutralnow.org/AllProjects?SearchTerm=simoshi.

79 Echavarria, Virginia. "8,457 Certified Emission Reductions Issued." Simoshi. Simoshi, November 20, 2019. http://www.simoshi.org/blog/2019/11/20/8457-certified-emission-reductions-issued.

80 V. Echavarriawhich (personal communication, May 19, 2021)

81 "CDM: Nepal Biogas Support Program-PoA." Accessed May 4, 2021. https://cdm.unfccc.int/ProgrammeOfActivities/poa_db/7BSCYZMH2U05TWXFJKELND18PRQ96O/view?cp=1.

82 Gold Standard Impact Registry. "WWF Nepal Gold Standard Biogas Voluntary Emission Reduction (VER) Project." Accessed May 4, 2021. https://registry.goldstandard.org/projects/details/890.

83 AEPC. "Carbon and Climate Change." Accessed May 4, 2021. https://www.aepc.gov.np/carbon-and-climate-change.

in July 2010 to manage - among other activities - carbon projects in the renewable energy sector. CCU under the 2012 National Rural and Renewable Energy Programme is charged with monitoring and quality assurance.[84]

Carbon Credit Market Opinion

The carbon market can be inconsistent and complicated for small businesses like Simoshi. Without steadfast leadership and connectivity, markets can be confusing and difficult to access. There is significant opportunity for a streamlined approach to utilizing carbon markets to finance small businesses and improvements in cooking.

The pricing market needs to be better defined to make sure pricing is aligned properly as some similar projects have been selling their credits too low due to a lack of market understanding. Some markets value carbon at a higher price than the $15 referenced above, but in places like Laos per our conversations with SNV, the credits generated have been valued much lower. It is vital that when investing in the carbon market, benefits are received by the end user and the actor providing the solution to the end user. We envision a substantial benefit to harmonizing and streamlining the accessing of carbon monetization services across the sector.

Knowledge and Information

Knowledge and Information
The availability and effectiveness of a centralized source of information, resources, and support to allow new or expanding actors to increase their participation in the sector.

The sector has been working on eradicating cooking poverty for decades: the ITDG / Practical Action / Sri Lanka Anagi Stove Program is sixty years old. There is a wealth of knowledge and experience in this space that new entrants should leverage. However, they are often unable to do so due to a lack of awareness or lack of efficient education and information channels.

Reducing the barriers to entry into a market, sharing learnings of past failures and successes, and facilitating partnerships across new and existing actors should be a top priority of any sector hoping to accelerate its growth. Whenever possible, these new and existing actors should prioritize partnerships and scaling existing solutions so that initiatives can reach the economies of scale necessary to operate sustainably.

Gaps

One of the major gaps we have identified is in the sector's underinvestment in the empowerment of individual actors in this space, whether they are entrepreneurs, policymakers, or others. The siloed nature of many initiatives often sets up newcomers for failure, as they have not been able to learn from similar efforts, to leverage the resources from people or companies outside of their immediate networks, or reach the economies of scale necessary for a company in this industry to operate sustainably without significant external funding.

While strides have been made in centralizing raw information related to cooking poverty (e.g., Clean Cooking Alliance's stove database), there is a difficult challenge to solve between representing the sector in a centralized and holistic way while simultaneously providing information that is specific, relevant and

[84] Ibid.

accessible to individual actors. Many of the people we spoke with did not feel represented by the broader cooking poverty sector, because they are working on a specific solution, like a specific tier in the MTF or a specific region. Tools for them and their successors are badly needed.

Bridging the Gaps

The sector needs to centralize and share knowledge and information in a way that allows individual actors to imitate proven practices, partner with existing initiatives, and scale ongoing solutions in the ways that work best for them.

This requires a relatively unbiased and objective approach to any repository, providing information regardless of the tier of the solution, of the problem they are trying to solve, and so on.
Connecting the electrification sector may prove valuable here as well, as many of the Support Activities and distribution operations have existing overlap across sectors. As the electrification sector is at a more mature state, the cooking poverty sector may be able to leverage a lot of learnings from adjacent work that has been done.

One solution for these Knowledge and Information gaps may be what we are calling a "Playbook" that identifies current or past initiatives, categorized based somewhat on the Value Chain and the Multi-Tier Framework, and then provides additional information for each of those initiatives.

A "Node" within such a playbook would open to additional information on that work, with the intention of highlighting learnings, either successful or unsuccessful, and provide additional resources or ideas relevant to that initiative. If done well and open source, this would create a method to collect and centralize much of the historical knowledge and experience in this sector in a way that individual actors could utilize in a very tailored way. It would also empower people to make connections with others engaging in similar efforts so they could more easily reach a sustainable scale of operations.

Ideally, this could be housed on a website so that it could have interactive functionality and be actively maintained by a leader in this space so that the information stays as relevant as possible. Ideally this would be a collaborative learning tool, curated but open source. We believe such a Playbook is an essential piece of any architecture for the Cooking Poverty Sector to increase in scale.

Additionally, the international organizations supporting this space may see more success if they further specialize within specific functions of the value chain. Then they could "own" the historical knowledge, resources, and solutions within that segment, ensuring they have a broad remit without conflicting with the other major organizations' work. This can turn competition into collaboration and ensure that the sector stays focused on the big picture rather than all actors pivoting toward the area of most recent need. This potential over-pivoting to the "shiny new thing" is something we found in our conversations as organizations independently identified gaps in the demand side of the supply chain.

Example Playbook Landing Page

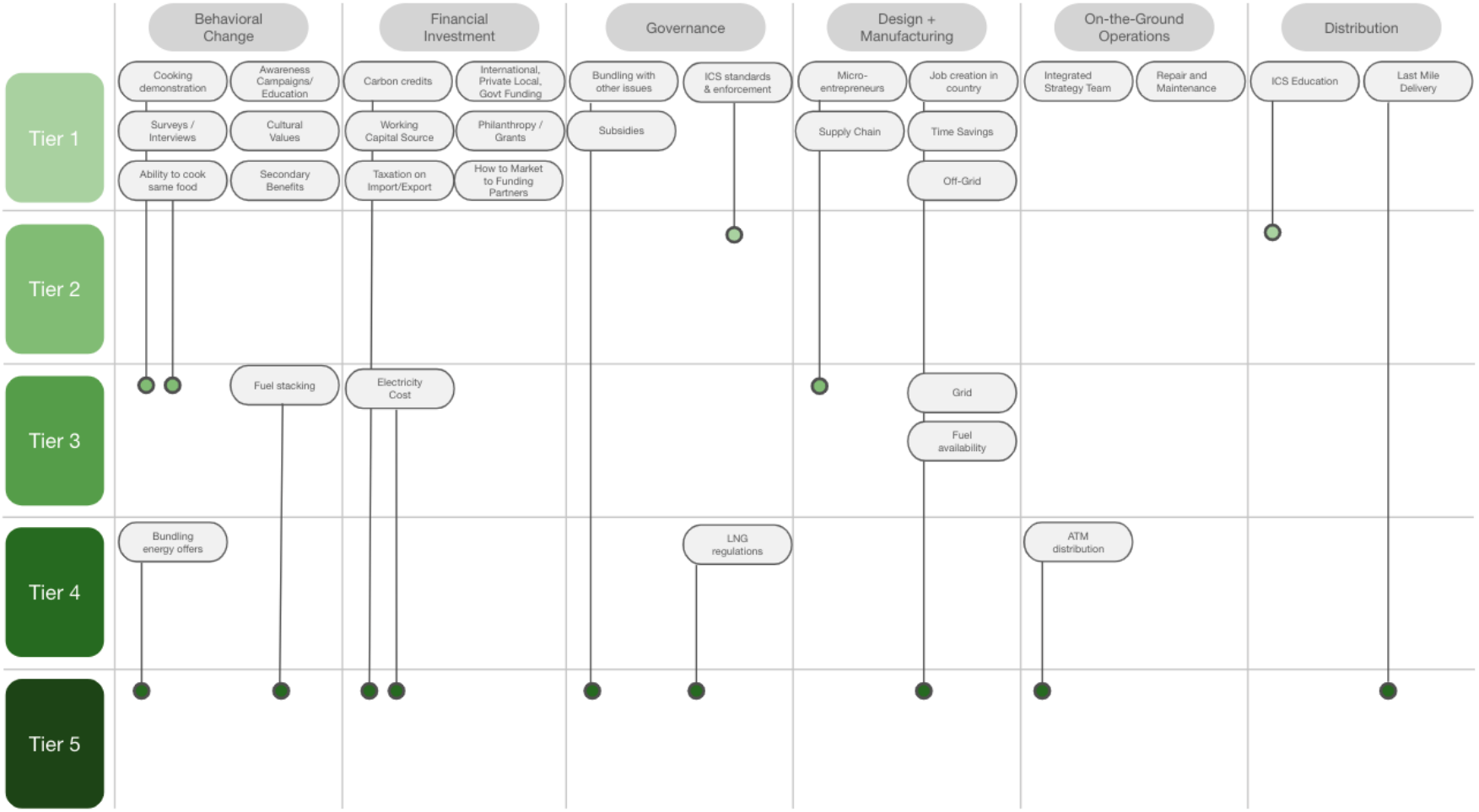

Figure 5: *The Playbook provides Cooking Tier examples across the Value Chain in an effort to centralize information*

Figure 6: *Example Node Pop-Up*

Conclusion

Our aim in publishing this report is to energize individual actors across our defined Value Chain to align strategies and tactics to eradicate cooking poverty. We believe our analysis highlights opportunities for the sector to become more efficient as we work towards achieving modern cooking for all while meeting SDG7, and many related SDGs.

As we have presented, the sector addressing cooking poverty needs a clear set of tactical improvements across its Support Activities, which we believe need equal attention in order to achieve sector goals. Solving this crisis of cooking poverty requires holistic solutions. No single measure can fix the burden for the nearly 4 billion people that bear it. We close with a series of recommended actions. The remarkable scale of this problem demands bold, coordinated change.

Action 1 – rebrand and reframe the issue, using the term "cooking poverty." As clean or modern cooking services are only a fraction of the solution to cooking poverty, the name of the sector should reflect the diversity of solutions to this complex issue. Ensure that while modern cooking is the end-goal in eradicating cooking poverty, harm reduction and incrementalism (and "leapfrogging" to modern where possible) are the means. Only focusing on modern cooking due to its mortality reduction benefits shortchanges the end-user, stalling investment and forcing communities in need to wait for a leapfrog solution to modern cooking.

Action 2 – execute a moonshot effort to consolidate all presently available knowledge and information into a playbook, which must be accessible to new entrants and existing actors across the public and private sectors. Initiatives within the sector are currently ad-hoc, and knowledge and information sharing across entities are inconsistent and hard to find. A sector strategy that empowers information sharing and collaboration on industry knowledge and expertise can bridge this gap.

Action 3 – address SDG 7.1.1 and 7.1.2 together rather than in silos. Even if the tactical issues across the sector (branding, collaboration) are solved, and financial investment somehow reaches the scale needed to reach SDG7 in the next nine years, the sector lacks the capacity to support solutions needed for 3.83 billion people - more than half the world's population. Merging electrification and cooking efforts will require strong leadership, planning, and incentives.

Action 4 – use these reconstructed energy access initiatives to tap unprecedented amounts of climate finance. There is significant opportunity for a streamlined approach to utilizing carbon markets to finance small businesses and achieve improvements in energy, health, climate, and gender equality goals.

Action 5 – organize a donor/investor/government Compact around the principle of "complete and balanced support for all phases of the transition from cooking poverty to modern cooking." This should align the global approach to fundraising, technical assistance, and policy creation, which remains largely ad-hoc.

We believe the development community has every reason and tool to address this issue; putting it all together is a matter of strategic investment, organized information-sharing, and steadfast collaboration. We also whole-heartedly believe that this level of change, while not simple, is possible. This is an opportunity to transform the lives of billions - it is imperative that we take it.

##

Annexes

Annex 1 - Quick Tour of **Sector** Actors

An actor is defined throughout, as an entity that plays a role in solving Cooking Poverty. There are a variety of actors and activities occurring across the Clean Cooking Sector. Presented below is a representative *sample* of more than sixty of these actors and activities. These are the actors we have either extensively studied or with whom we have had direct conversations. Though lengthy, this presentation is not meant to be exhaustive but merely illustrative. It should be noted that in an immature sector, it is not uncommon for firms to play multiple roles within the goods and services value chain or in support activities.

- **Africa Clean Energy (ACE):** an enterprise that produces and distributes biomass-solar hybrid stoves.
- **Aprovecho Research Center:** a not-for-profit organization that tests stoves and publishes "Clean Burning Biomass Cookstoves" 2021.
- **BAR-HAP (Benefits of Action to Reduce Household Air Pollution) Tool:** WHO sponsored planning tool developed by Duke University to measure the costs and benefits of sixteen different cleaner cooking solutions.
- **Boiling Point:** an international journal on household energy. Originally published by Practical Action for 52 issues, it is now published by HEDON.
- **Biogas Support Program, Nepal (BSP):** is a multi-decade program to disseminate household biogas systems based largely on cow dung and anaerobic digestion technology.
- **Burning Opportunity:** a 2016 report by the WHO highlighting the causes and consequences of indoor air pollution related to cooking.
- **Carbon Monetization-Clean Development Mechanism**: the process of converting greenhouse gas savings into certified or voluntary emission reductions that can be used by purchasing entities to offset their carbon emissions.
- **CCA:** Clean Cooking Alliance was established in 2010 with the support of the United Nations Foundation. CCA is a nonprofit that advocates for universal access to clean cooking solutions by raising awareness, promoting research in the sector, mobilizing investments and using its strategic partnerships to advocate for policy and knowledge-sharing. Their focus is divided into 3 pillars: (1) Driving consumer demand through behavior change and awareness, (2) bringing together investments and investors to provide "clean" cooking alternatives through a scalable solution, and (3) advocating solutions through policies that are based on relevant data collection.
- **CCF:** In 2019 at the UN Climate Summit, WB/ESMAP launched a $500 million Clean Cooking Fund (CCF) to scale-up both public and private investments in clean cooking. It has also received funding pledges from international donors such as the Netherlands, Norway, and Denmark. CCF will use results-based financing (RBF) at national and subnational levels and plans to leverage $2 billion for the sector over the next five years. In September 2020, CCF launched its first co-financed project in Rwanda. Several other co-financing projects are in the pipeline.
- **Climate and Clean Air Coalition (CCAC):** As part of the UN secretariat and hosted by UNEP, CCAC has voluntary partnerships with 71 countries and 78 non-states. It has funded over $4.85 million towards household energy since 2012 which includes mitigating Black Carbon.
- **COVID-19 Interventions:** industry wide collaborations and initiatives to assist enterprises and consumers manage the consequences of the pandemic. Many links.
- **CPI: Climate Policy Initiative**-an organization of analysts and advisors focused on land use changes and energy policies including the Energizing Finance Report series.

- **C-Quest Capital:** a firm that develops carbon finance projects in the clean cooking, efficient lighting and sustainable energy sectors
- **Dalberg Associates:** Founded in 2001, Dalberg is a global consultancy that specializes in advising their clients on strategy, policy, design and other specialties.
- **Ecosystem Map:** The Clean Cooking Alliance, with the help of Dalberg, mapped out five (5) subsystems within the Clean Cooking Sector Ecosystem: End Users, Cooking Solutions, Funding and Financing, Data and Intelligence, and Policy, Advocacy and Coordination. Adjacent and overlapping Sector actors include Global Health, Climate & Environment, Gender, Rural Development & Rural Livelihoods, Micro, Small, and Medium Enterprise (MSME) Development, Fast-moving Consumer Goods (FMCG) retailers & distributors, and Food Systems & Nutrition. Cooking solutions are introduced to end users through sales and distribution and behavior change campaigns, sometimes supported by local NGOs and other partners.
- **Energizing Finance:** a research series produced by Sustainable Energy for All and its partners, it reviews the industry-wide investment in the energy and clean cooking landscapes and the associated gaps and opportunities, highlighting the ongoing gap in financing.
- **Energy Sector Management Assistance Programme (ESMAP):** See World Bank and ESMAP below
- **Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ):** Started in 2005 to help the German government achieve its sustainable development goals using an integrated group of global partnerships that has funded over $3.5M in energy development including clean cooking.
- **FENIX International,** solar PayGo business that sells efficient cookstoves to solar customers in Uganda that have been repaying their solar installments steadily over a 6-month period. Fenix has branded their cookstoves, engaged in various marketing efforts, and hired and trained sales agents on how to sell cookstoves with a mission to service all of a customer's energy needs for life.
- **Global Women's Network for the Energy Transition (GWNET):** aims to advance the global energy transition by empowering women in energy through interdisciplinary networking, advocacy, training, and mentoring.
- **Household Energy Assessment Rapid Tool (HEART):** Created by the WHO, which has been used by over ten countries.
- **Infrastructure Development Company Limited (IDCOL):** Since its inception, IDCOL has played a major role in bridging the financing gap for developing medium to large-scale infrastructure and renewable energy projects in Bangladesh. The company now stands as the market leader in private sector energy and infrastructure financing in Bangladesh.
- **MECS: Modern Energy Cooking Solutions:** The MECS Program aims to accelerate the global transition from traditional biomass-based cooking to modern-energy cooking solutions. Cooking poverty affects 90 percent of lower- and lower-middle-income countries, and about half of the global population cannot cook efficiently, cleanly, conveniently, reliably, safely, and affordably. We identify the MECS goal throughout the paper as "Modern Cooking"
- **RECF: Renewable Energy Challenge Fund:** a program of the United Nations Capital Development Fund supported by the Swedish government, the RECF focused on energy access in Uganda. It has invested in over 10 companies, which have sold more than 485,000 clean cooking products including 472,500+ improved cookstoves to households, 150 improved cookstoves to institutions, 12,676 LPG kits and 505 biogas digesters. The partners also sold 5,229 tonnes of briquettes and offset 663,241 mt of CO2.
- **SEforALL: Sustainable Energy for All**: Founded in 2011 by a proposal from then the UN's secretary-general Ban Ki-moon. Because of this history, it is closely affiliated with the UN. As their name suggests, their mission is to ensure equitable access to modern energy, including clean cooking to support SDG7 and the Paris Agreement. They accomplish this by engaging key actors including governments, private sectors and consumers and empowering them with data and evidence from the field. Their *Energizing Finance* series of reports provide up to date information on the state of financing for the sector.

- **Simoshi:** A women-owned and led business selling Institutional Improved Cookstoves (IICS) to schools and Improved Cookstoves (ICS) to households using the schools as a distribution channel. Simoshi also packages offsets for sale through the United Nations Carbon Offset platform
- **SNV:** Netherlands Development Organization is a not-for-profit international development organization focused on alleviating poverty through locally owned solutions. SNV leads their current cooking projects with behavior studies and uses carbon finance to support the financing.
- **State of Modern Energy Cooking Service:** a 2020 report that highlights the population without modern cooking (3.83B) and disaggregates that population into tiers, estimating the cost to achieve different tiers of improvement.
- **United Nations (UN) Organizations:** The following UN organizations also play a role in SDG7, as well as the research gathered regarding eradicating cooking poverty. These groups include UN Children's Fund (UNICEF), UN Climate Change (UNFCCC), UN Department of Economic and Social Affairs (UN-DESA), UN Development Programme (UNDP), UN Statistic Database (UNDATA), UN Energy, UN Environment Programme (UNEP), UN Food and Agriculture, UN Industrial Development Organization (UNIDO), UN -WHO Household Fuel Combustion Study, and UN Women.
- **United Nations Capital Development Fund:** The program is focused on energy access in developing countries. UNCDF's almost 50 partners have sold over 1 million clean energy products reaching 6.2 million beneficiaries. The portfolio is offsetting over 1 million tons of CO 2. The 1 million products include over 800,000 cooking products. UNCDF is currently active in Uganda, Ethiopia, Burkina Faso, and the Democratic Republic of Congo. It provides early-stage financing in the form of grants, loans and guarantees.
- **World Bank and ESMAP:** One of the crucial funding and technical actors in the clean cooking sector is the World Bank and its technical assistance arm, the Energy Sector Management Assistance Program (ESMAP). At the country level, the World Bank mobilizes resources for loan- and grant-making using ESMAP analytical and advisory services, the overarching aim being to provide "affordable, reliable, sustainable, and modern energy for all." World Bank has an active lending portfolio across 21 countries aimed at providing cooking and heating solutions. ESMAP, a partnership between WB and 19 partners, takes on analytical work that informs policy and advisory services thus strengthening WB investments.
- **World Health Organization (WHO):** The WHO completed a research paper in 2016 titled *Burning Opportunity: Clean Household Energy for Health, Sustainable Development, and Wellbeing of Women and Children*, which studied health and gender impacts due to household air pollution. The WHO has been conducting rapid situational assessment and stakeholder mapping of key stakeholders and programs active in the household energy and health sector. They introduced and have utilized the resource Household Energy Assessment Rapid Tool (HEART), which has been used by over ten countries. The WHO also convenes the Health and Energy Platform of Action (HEPA) along with UN DESA, UNDP, and the World Bank. HEPA aims to mobilize commitments across a variety of stakeholders to tackle health and energy and related SDGs.

Annex 2 - Abbreviations

All currency in United States dollars (USD or US$), unless otherwise indicated

ACCES: African Clean Cooking Energy Solutions
AGECC: Advisory Group on Energy and Climate Change
BC: Black Carbon
BLEENS: Biogas, Liquefied Petroleum Gas, Electricity, Ethanol, Natural Gas, and Solar
CCA: Clean Cooking Alliance
CCF: Clean Cooking Fund
CDM: Clean Development Mechanism
CO2: Carbon Dioxide
EEA: European Environmental Agency
ESI: Energy Supply Index
ECCH: Efficient Clean Cooking and Heating
ESMAP: Energy Sector Management Assistance Programme
EUEI: European Union Energy Initiative
FRES: Foundation Rural Energy Services
GDG: Guidelines Development Group
GDP: Gross Domestic Product
GHG: Greenhouse Gas
GIS: Geographic Information System
GIZ: Deutsche Gesellschaft für Internationale Zusammenarbeit
GTF: Global Tracking Framework
HAP: Household Air Pollution
HPTE: High-Power Thermal Efficiency
IAEA: International Atomic Energy Agency
IAQ: Indoor Air Quality
ICS: Improved Cooking Stoves
ICT: Information and Communication Technology
IDCOL: Infrastructure Development Company Limited
IEA: International Energy Agency
IER: Integrated Exposure Response
IHDS: India Human Development Survey
IMF: International Monetary Fund
ISO: International Organization for Standardization
IWA: International Workshop Agreement
kW: kilowatt
kWh: kilowatt hour
LPG: Liquefied Petroleum Gas
MECS: Modern Energy Cooking Solution

MEPI: Multidimensional Energy Poverty Index
MTF: Multi-tier Framework
NGO: Non-governmental organization
NOx: Nitrogen Oxides
PM: Particulate Matter
QA: Quality Assurance
RBF: Results-based Financing
RE: Renewable Energy
RECF: Renewable Energy Challenge Fund
RISE: Regulatory Indicators for Sustainable Energy
RTE: Renewable Thermal Energy
SDG: Sustainable Development Goal
SEforALL: Sustainable Energy for All
SOx: Sulfur Oxides
UN: United Nations
UNDATA: United Nations Statistic Database
UNDESA: United Nations Department of Economic and Social Affairs
UNDP: United Nations Development Programme
UNIDO: United Nations Industrial Development Organization
USAID: U.S. Agency for International Development
WB: World Bank
WHO: World Health Organization

Annex 3 - Terminology

Access to energy services: The ability of an end user to utilize energy services (such as lighting, phone charging, cooking, air circulation, refrigeration, air conditioning, heating, communication, entertainment, computation, motive power, etc.) that require an energy appliance and suitable energy supply.

Affordability of energy supply: An attribute of energy supply that implies ability of the end user to pay for energy needed for a defined package of energy consumption. Affordability encompasses one-time connection charges, energy charges, capacity charges, maintenance charges and replacement. The affordability of energy access is a function of the defined package, the price of energy (including all the above-mentioned charges), and the user's income level. Energy supply is affordable when the cost of energy for a defined package of energy consumption does not exceed a normative percentage of the household income.

Appliances (also called end-use devices): Equipment, powered by electricity or other energy sources, that accomplish some function or task to deliver an energy service (e.g., light bulb, electric fan, cookstove, refrigerator, radio, washing machine, x-ray machine, drilling machine, etc.).

BLEENS cooking solutions: Biogas, LPG, electricity, ethanol, natural gas, and solar cookers are cooking solutions that typically deliver high performance in terms of reducing household air pollution - often (although not always) regardless of the type of cookstove used - and are collectively called BLEENS. These cooking solutions are often considered "modern" or "clean" solutions.

Cooking Poverty: Using wood, charcoal, dung or other solid fuels on three-stone fires or low-quality stoves in poorly ventilated conditions; includes individuals in Tiers 0-3 of the five-tier Multi-Tier Framework or MTF

Clean cookstoves: Cookstoves that produce significantly less household air pollution than traditional three-stone open-fire stoves and meet a specified emission standard are often called clean cookstoves. Clean cookstoves may also be called advanced cookstoves or clean fuel stoves.

Convenience of energy supply: An attribute of energy supply that relates to the time and effort involved in securing, processing, and using the energy source (such as fuels).

Efficient cookstoves: Cookstoves that use less energy to deliver a given amount of usable heat compared to traditional three-stone open-fire stoves and meet a specified efficiency standard. Efficient cookstoves may also be called improved cookstoves.

End User: The ultimate consumer who requires energy for desired energy services at any locale—a household, productive enterprise, or community institution.

Energizing Finance: Reviews the industry-wide investment in the energy and clean cooking landscapes and the associated gaps and opportunities, producing crucial reports articulating institutional knowledge. The Energizing Finance report series highlights the ongoing gap in financing for these issues, especially in private financing and in the countries with the greatest need.

Energy access: The ability of the end user to utilize energy supply that is usable for the desired energy services. Improvement in energy access is achieved through enhancement of the usability of the energy supply with improvement in attributes. Energy access can be defined either inclusive or exclusive of use of appliances. When defined inclusive of appliances, it is called access to energy services, and when defined exclusive of appliances, it is called access to energy supply.

Energy carrier or energy source: A substance or means that can be used to produce mechanical work or heat or to operate chemical or physical processes. Energy sources (or energy carriers) include fuels and renewable energy sources that are harnessed directly as well as grids and mini-grids powered by fossil fuels and renewable energy sources. They provide energy supplies that are used by end users to utilize energy services.

Energy poverty: The state of being deprived of certain energy services or not being able to use them in a healthy, convenient, and efficient manner, resulting in a level of energy consumption that is insufficient to support social and economic development. Although energy poverty can be measured using binary indicators (by specifying a minimum package of energy services or minimum amount of energy use), it is a continuous variable encompassing deprivation on a range of energy services.

Energy results chain: The series of causal linkages between energy investments and socioeconomic development impacts. It entails a seven-step causality chain (inputs, intermediate outputs, outputs, intermediate outcomes, outcomes, intermediate impacts, and impacts) with reducing attribution of results to the energy intervention due to external factors increasingly coming into play at each step.
Energy services: Amenities that are delivered using energy when converted into light, sound, heat (or cold), motion, signal, etc. Energy services encompass lighting, cooking, air circulation, refrigeration, air conditioning, heating, communication, entertainment, computation, motive power, etc.
Energy supply: The provision of energy regardless of the availability of end-use equipment.
Fuels: Any material that stores energy that can be extracted through a combustion process to perform mechanical or heating work. Fuels are often classified in three types: solid (wood, coal, dung, etc.), liquid (diesel, kerosene, LPG, etc.), and gaseous (natural gas, biogas, etc.).
Health attribute: An attribute of energy supply that relates to the risk of adverse health consequences from the use of energy. This attribute is particularly important for fuel-based energy for cooking and heating.
Improved cookstoves: Cookstoves that use less energy to deliver a given amount of usable heat and produce less indoor and overall air pollution compared to traditional three-stone open-fire stoves but may or may not meet any specified emission or efficiency standards.
Improved Cooking (in transition): Refers to a household context that has met at least Tier 2 and Tier 3 standards of the MTF across all six measurement attributes but not qualified for Tier 4 or higher. Household contexts with a status of MTF Tier 2 or Tier 3 are considered *in transition*.
Incrementalism: An approach to eradicate cooking poverty through a step-by-step basis. Focus is on transitioning those households classified as unimproved cooking to improved cooking on the road to modern cooking.
ISO: They are Voluntary Performance Targets (VPTs) for cookstoves based on laboratory testing.
Unimproved Cooking: Refers to a household context that equates to Tiers 0 and 1 of the MT..
Locales of energy use: The broad locations of end use of energy for availing energy services. Locales of energy use generally include households, community institutions, and productive enterprises.
Multi-Tier Framework (MTF) for cooking: Multidimensional, tiered approach to measuring household access to cooking solutions across six technical and contextual attributes with detailed indicators and six thresholds of access, ranging from Tier 0 (no access) to Tier 5 (full access).
The six attributes being:

1. *Exposure:* Personal exposure to pollutants, which depends on both stove emissions and ventilation (higher tiers indicate lower exposure)
2. *Efficiency:* Combination of combustion and heat-transfer efficiency
3. *Convenience:* Time spent collecting/purchasing fuel and preparing the stove
4. *Safety:* the severity of injuries caused by the stove over the past year
5. *Affordability:* Share of household budget spent on fuel (higher tiers indicate the lower share of spending)
6. *Availability:* Readiness of the fuel when needed by the user

PayGo: A payment structure often used for cleaner cooking solutions in which the customer can pay on an installment basis rather than upfront.
Quality of energy supply: An attribute of energy supply that implies correct level and stability of voltage (and frequency) in case of electricity, and absence of adulteration (including excessive moisture) in case of fuels so that desired combustion characteristics can be achieved.
Reliability of energy supply: An attribute of energy supply that entails absence of unpredictable outages of energy supply. It is measured by the frequency and length of unpredictable outages.
Safety: An attribute of energy supply that relates to the risk of injury from the energy supply.
Stacking: The use of multiple energy solutions (such as different fuels) to meet a single energy need.
Sector: when this is used, it is meant to identify the whole of the clean cooking sector, the area identified to eradicate cooking poverty. This includes all in the ecosystem map.

Usability of energy supply: The potential to use energy supply when required for desired energy services. Usability can be enhanced by improving the attributes of energy supply, such as capacity, availability, reliability, affordability, safety, convenience, etc.