MODERN ENERGY COOKING: REVIEW OF THE FUNDING LANDSCAPE

REPORT 5 OF THE FINANCING CLEAN COOKING SERIES

MECS AND ENERGY 4 IMPACT
FEBRUARY 2022

Disclaimer: This research is funded by UK aid. However, the views expressed do not necessarily reflect the official policies of the UK government.

This report was compiled by Modern Energy Cooking Services (MECS) at Loughborough University in collaboration with Energy 4 Impact.

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MECS and Energy 4 Impact would like to thank Acumen, ATEC International, BURN Manufacturing, Clean Cooking Alliance, Circle Gas, Emerging Cooking Solutions, KOKO Networks, Sustainable Energy for All and Shell Foundation for their valuable contributions to this report.

Cover photo: Over half of the workforce in Burn Manufacturing's modern cooking device factory, Nairobi, are women. Women are actively involved in appliance manufacturing at Burn, as well as sales and distribution. Photo credit: Jon Leary, MECS

ACRONYMS

ADALYS	Averted Disability Adjusted Life Years
AFDB	African Development Bank
BIX	Bottom of the Pyramid Impact Exchange
BMZ	Federal Ministry for Economic Cooperation and Development (Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung, Germany)
BoP	Bottom of Pyramid
CCA	Clean Cooking Alliance
CDM	Clean Development Mechanism
CER	Certified Emission Reductions
CFO	Chief Financial Officer
Ci-Dev	Carbon Initiative for Development
CIC	Cooking Industry Catalyst
CO2	Carbon Dioxide
DFI	Development Finance Institution
DFID	Department for International Development
DIB	Development Impact Bond
DIV	Digital Innovation Ventures
ECS	Emerging Cooking Solutions
EEP	Energy and Environment Partnership Trust Fund
EPC	Electric Pressure Cooker
ESMAP	Energy Sector Management Assistance Programme
ERP	Emission Reduction Purchase
ERPA	Emission Reduction Purchase Agreement
ESG	Environment, Social and Governance
EU	European Union
FCDO	Foreign, Commonwealth & Development Office
FMO	Netherlands Entrepreneurial Development Bank
FX	Foreign Exchange
GHG	Greenhouse Gas
GIS	Geographic Information System
GIZ	German Agency for International Development
GS	Gold Standard
GSM	Global System for Mobile Communications
GSMA	Global System for Mobile Communications Association
HIC	High Impact Countries
ICS	Improved Cookstoves
ICROA	International Carbon Reduction and Offset Alliance
IFC	International Finance Corporation
IoT	Internet of Things
ISO/TR	International Organization for Standardization Technical Report
KPI	Key Performance Indicators
LPG	Liquefied Petroleum Gas
M4DU	Mobile for Development Utilities
MDB	Multilateral Development Bank
MEC	Modern Energy Cooking
MECS	Modern Energy Cooking Services
MIT	Massachusetts Institute of Technology
MRV	Measurement, Reporting, Verification
NGO	Non-Governmental Organisation
NORAD	Norwegian Agency for Development Cooperation
OBF	On-bill financing
OBR	On-bill repayment
P2P	Peer to Peer
PAYGO	Pay as You Go
PFAN	Private Financing Advisory Network
PREO	Powering Renewable Energy Opportunities
R&D	Research and Development
RBF	Results-Based Funding
SAFE	Safe Access to Fuel and Energy
SDG	Sustainable Development Goals
SF	Shell Foundation
SHS	Solar Home System
SME	Small and Medium-Sized Enterprise
SOGE	Scaling Off-Grid Energy Grand Challenge for Development
SPV	Special Purpose Vehicle
SSA	Sub-Saharan Africa
TA	Technical Assistance
UK	United Kingdom
UNCDF	United Nations Capital Development Fund
US	United States
USD	United States Dollar
USAID	United States Agency for International Development
VC	Venture Catalyst
VCS	Verified Carbon Standard
VCU	Verified Carbon Units
VER	Verified Emission Reductions
VPT	Voluntary Performance Targets
WFP	World Food Programme
WHO	World Health Organisation

KEY TERMS

Carbon credits – A form of financing based on certified CO_2 emission reductions. The carbon credits can be traded through emission reduction trading schemes and voluntary carbon markets. The credits can be earned by clean cooking projects by reducing the amount of CO2 being released compared to a baseline figure, for example, through the introduction of energy-saving stoves. The credits can then be sold to organisations to offset their carbon emissions or in similar schemes.

Clean Cooking Solutions – Cooking facilities are considered 'clean' if their emissions of carbon monoxide and fine particulate matter are below certain levels as defined by the WHO. These are fuel-stove combinations that achieve emissions performance measurements of Tier 4 or higher following ISO/TR 19867-3:2018 Voluntary Performance Targets (VPTs), which refer to the World Health Organization's 2014 guidelines for indoor air quality.

Improved Cookstoves (ICS) – ICS stands for a range of improved biomass stoves developed to replace highly inefficient traditional charcoal or wood-burning stoves. 'Improved Cooking Services' refers to households meeting at least Tier 2 standards across all six attributes, but with at least one attribute not reaching Tier 4.

Modern Energy Cooking – Households that meet the standards of Tier 4 or higher across all six attributes under the Multi-Tier Framework can be considered to have gained access to Modern Energy Cooking services. The most relevant modern cooking technologies are likely to be Biogas, LPG (liquefied petroleum gas), other gaseous fuels (e.g., bioLPG), ethanol, biomass pellets with a forced draft gasifier stove and electric cooking.

Multi-Tier Framework – The tiered framework developed by Energy Sector Management Assistance Programme (ESMAP) measures household access to cooking solutions across six attributes, with six thresholds of access ranging from Tier 0 (no access) to Tier 5 (full access). The six attributes are: exposure to pollutants, efficiency, convenience, safety, affordability and fuel availability.

Pay-As-You-Go (PAYGO) – PAYGO technology removes or reduces the upfront price barrier of the cooking appliance and fuel, by allowing end-users to pay a small or zero deposit followed by affordable instalments over time.

Results-Based Financing (RBF) – Financing usually in the form of grants provided to companies or institutions after agreed-upon results have been achieved and verified. For clean cooking, a company could receive funds for every stove verified as delivered and in use by an end-user. The company has flexibility on how they spend money to achieve the results and the financier disburses funding only when the results have been verified.

Reverse Auction – An auction in which sellers place bids on the price or subsidy they require for selling a certain volume of clean cooking appliances in a particular area. The winning bidder(s) are the ones that bid the lowest prices.

Solar Home System (SHS) – SHS are stand-alone photovoltaic systems that provide basic power supply (e.g. for lighting and operation of smaller appliances) to remote/rural households that are not connected to the electricity grid.

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Photo: Jon Leary/MECS

THE FINANCING CLEAN COOKING SERIES

Energy 4 Impact and Loughborough University, the lead implementing partner on the UK aid-funded Modern Energy Cooking Services Programme (MECS), signed an agreement in 2020 to collaborate on research into financing for the clean cooking sector.

The **Financing Clean Cooking** series aims to facilitate the transition to clean cooking through financing and investment. The series is targeted at a diverse range of public and private stakeholders in clean cooking, including NGOs, donors, investors and suppliers.

Modern Energy Cooking: Review of the Funding Landscape is the fifth report in the series. It analyses the financial landscape and potential for scale-up of clean cooking in developing countries and makes recommendations on potential interventions. As the research was undertaken, the team became increasingly aware of changes in the wider energy sector, particularly around LPG and electricity. This meant that conceiving of clean cooking as its own standalone sector runs the risk of seriously misrepresenting the clean cooking landscape. This report focuses strongly on the 'traditional' cooking sector. In a report to be launched in 2022, MECS will consider in more detail how cooking fits within the rapidly changing dynamics of the wider energy access financing landscape.

The other reports in this series looked at **Crowdfunding** for clean cooking, **End-user finance for appliances**, clean cooking **Concessions for displaced people** and **Results-based financing**. These are available on the MECS website: *https://mecs.org.uk/publications/*

1. EXECUTIVE SUMMARY

This report provides an overview of the funding landscape for Modern Energy Cooking (MEC) solutions, including electric (grid and off-grid), ethanol, liquefied petroleum gas (LPG), other gaseous fuels, biogas and biomass gasifiers. The report is based partly on primary and secondary research conducted by Energy 4 Impact in 2020. This included desk research and two online surveys – one for clean cooking companies and another for funders – and interviews with 20 organisations.

Funding available for companies seeking to offer clean cooking can be broadly separated into conventional funding instruments, such as equity and debt, and grant funding, in the form of carbon credits, results-based funding (RBF) and other grant type payments explicitly linked to impacts. Clean cooking is well documented as having significant climate and Sustainable Development Goals (SDG) benefits, which can attract grants in various forms. Given the importance of these types of funding to the sector, it is considered essential to cover both types of funding in this report.

Until recently, cleaner cooking solutions were predominantly focused on lower-tier improved cookstoves (ICS) using biomass. Therefore, the 'clean cooking sector' was (not unreasonably) perceived by many as being low technology, unprofitable, unscalable and highly localized. As a result, and despite the recent growth of a number of larger and more commercially-oriented businesses, clean cooking is still considered by many to comprise of country-level producers of low technology cookstoves. This perception has contributed to the sector remaining relatively marginalized amongst the majority of capital providers and development finance institutions.
The sector has undergone rapid change, especially over the last three to five years. Clean cooking is no longer a homogenous market. Now, it involves a range of different fuel types, company types and business models. Electricity companies, such as utilities, mini-grid developers and solar home system (SHS) companies are entering the market and groups using fuels other than charcoal or firewood, such as LPG, ethanol and biogas, have been progressing strongly. The emergence of electric cooking on energy-efficient appliances as a viable market will further enhance the scalability of the whole sector. This is not only via exploiting the existing market presence of electric appliance manufacturers, but also via the potential role of large utilities, mini-grid companies and SHS companies in facilitating the spread of the technology. Historically, the clean cooking sector has been treated separately to, and often detached from, other energy access initiatives. As a result, many energy funding interventions did not integrate clean cooking into their planning and design, even though this can make an important contribution to their results. There is a growing recognition of the need to rethink the clean cooking landscape and its place in a wider, more holistic, energy access framework. Coordinated promotion of electric cooking provides a way to channel the capital available for electrification towards clean cooking objectives. This, in turn, has major implications for the financial landscape, since it requires that the clean cooking landscape considers the broader energy landscape and how MEC can fit into this. It also raises the question of how investment in infrastructure that enables clean cooking should be considered within the analysis of the financial landscape.

Despite the efforts to enhance access to clean energy in the last decade, 2.8 billion people globally are still cooking with solid biomass and 789 million are without reliable access to electricity.[1] This implies that approximately 2 billion people now have access to some form of electricity, but continue to cook with biomass. New technologies and business models are emerging that make cooking with electric appliances increasingly cost-effective. However, the great potential of modern energy-efficient electric cooking appliances remains largely untapped. The results indicate that there is a growing potential to enable modern energy-

1. Source: ESMAP 2020. *https://www.esmap.org/cooking_with_electricity_a_cost_perspective*
2. 2021 Clean Cooking Industry Snapshot report; Clean Cooking Alliance, 2021

efficient electric cooking with grid and off-grid electricity, enhancing both reliability and access.

Despite years of international efforts, investment in clean cooking has remained insignificant compared to the sums required to achieve universal access. The Clean Cooking Alliance (CCA) estimates that in 2019 the main clean cooking businesses attracted total investments of US$70 million.[2] This is widely perceived as being wholly inadequate to meet the SDGs on energy access and is a small fraction of the overall investment in modern energy access (cooking and electrification).

The small amount of funding invested historically and the limited range of financial instruments used in the clean cooking sector reflect the exclusion of electricity as a potential clean cooking solution. If electric cooking with energy-efficient appliances is cost-effective for the consumer, as ESMAP/MECS reporting suggests, then the very much larger investments being directed at the electricity sector can be leveraged to promote the cooking sector.

The rapid technological changes underway within the clean cooking sector have implications for the financing landscape. Whereas the traditional discussion of financing for cleaner cooking was focused largely on providing support to small-scale stove manufacturers and distributors, the growing universe of companies and projects involved in MEC opens up greater opportunities for financing institutions to support the sector. In the past, Multilateral Development Banks (MDBs) and other large Development Finance Institutions (DFIs) have tended to neglect the cooking sector in their mainstream operations, as the ICS projects did not correspond with the larger investment profiles they normally target. MEC increasingly provides an important opportunity for the larger DFIs to incorporate clean cooking into their strategies. Their public and private sector teams have a major role to play in supporting different energy access initiatives by integrating clean cooking components and their financial sector teams in channelling funds to consumers

Photo: Jon Leary/MECS

through their lines of credit – as demonstrated by their role in accelerating the rollout of SHS and lighting products over recent years. These organizations are extremely well-placed to play this role, given their expertise and financial strength.

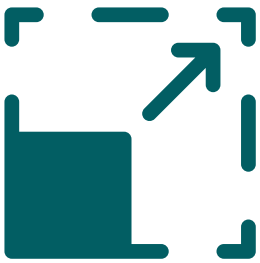
A major priority for funders in the sector has been to support the growth of the more successful scalable commercially-oriented companies. These companies are starting to show how new technologies (and business models built around them) can be successfully implemented. This, in turn, can attract more investment and bring other companies into the market. Several modern energy companies are now demonstrating the potential for scale and a much higher level of technical sophistication. Encouragingly, this is true for all of the main clean cooking fuel types, including electricity, as the company profiles set out in Section 5 of this report illustrate. A further positive development is a trend towards stronger financial viability, supported by rising carbon credit prices.

However, funding for innovative companies in the sector remains a major challenge, especially in the early stages of their development. The report suggests that the life cycle of clean cooking companies has typically followed the S-curve shape of many innovative businesses. The S shape represents growth over time starting slowly (seed stage), picking up speed (early and late growth stage), and then tapering off as growth slows (mature stage). Along the S-curve, a company's funding strategy changes from just grants (including carbon credits) and equity, to grants, RBF, equity, debt and other more complex and advanced products. The immaturity of the legacy cooking sector can be seen from the fact that much of the funding for clean cooking initiatives, until recently, was derived heavily from grants and equity.

The increasing use of modern energy cooking has been driven by technological innovations that have generated reduced appliance costs, as well as improved efficiency and performance. This, in turn, has led to greater consumer awareness of the benefits of modern energy cooking. A corollary of this is that many modern energy cooking companies now use 'smart data' features and pay-as-you-go (PAYGO) technologies that can remotely track the usage of fuels and manage digital payments. This is discussed in more detail in the paper on Appliance Finance in this *Financing Clean Cooking series*.

The smart data on the levels of energy use and its patterns creates new opportunities for the cost-effective provision of impact funding by donors and private investors, due to the opportunity to measure and report impacts more efficiently and accurately.

Carbon credits are a highly important source of income for cooking companies. Certification agencies, such as Gold Standard and Clean Development Mechanism (CDM), are designing frameworks to facilitate digital reporting, building on the methodologies developed with World Bank (ESMAP) support. Gold Standard recently approved an amended methodology, co-developed with MECS and ClimateCare[3], for certifying CO2 emissions for renewable energy modern cooking appliances. This new methodology uses smart data on usage to improve and simplify emission measurement and reporting requirements. It should help clean cooking companies to benefit from the current strength in the carbon credit market. The joint decision at COP26 to phase out fossil fuels and inefficient fossil fuel subsidies indicates that a further critical discussion of which clean cooking fuels could, and should, be included in these approaches is necessary. This also entails an evaluation of current strategic



SEVERAL MODERN ENERGY COMPANIES ARE NOW DEMONSTRATING THE POTENTIAL FOR SCALE AND A MUCH HIGHER LEVEL OF TECHNICAL SOPHISTICATION.

3. *https://mecs.org.uk/gold-standard-announces-public-consultation-for-a-new-mecs-climatecare-developed-methodology-for-electrical-and-metered-cooking-appliances/*

approaches, for example, with regard to LPG, which will be the subject of an upcoming review to be published by MECS.

Smart data can also be used to streamline impact measurements and reporting in other areas, such as health, gender, livelihoods and environment and so reduce the cost of company reporting. This raises the possibility of promoting new sources of income for clean cooking providers. Some recent pioneering work has seen the piloting of a development impact bond (DIB) in the clean cooking sector, which explores how this approach could work in practice. A major obstacle to donors supporting impact payments has been the administrative costs of measuring and demonstrating impacts, especially for health. Intelligent project design, developing more data on project results and employing proxies that can be measured using smart data should offer opportunities in the future to lower these costs, whilst rigorously demonstrating impacts.

There is also a growing interest in RBF as a tool to promote clean cooking in more challenging environments. Important programmes are being implemented – or are under development – such as the World Bank's Clean Cooking Fund, various EnDev-led projects and the Beyond the Grid Africa Fund. Meanwhile, some larger energy access RBF programmes have started, including clean cooking components, alongside solar home systems and mini-grids – KOSAP (Kenya) and BRILHO (Mozambique) are notable examples. Smart data can also play a big role in RBF design going forward. Historically, RBF programmes have provided payments conditional on appliance sales, with little tracking of actual usage of the appliance. To be effective, the RBF needs to lead to sustained adoption of the appliance and the usage needs to be tracked. Surveys on usage can partially correct this shortcoming and provide useful qualitative user information, but there is still a risk of recollection bias. With modern energy cooking appliances, the utilisation of the appliances can be measured by smart data technology, allowing RBF payments to be based on more reliable actual usage information.

One major challenge that some fast-growing clean cooking companies face is how to fund their receivables

Photo: Jon Leary/MECS

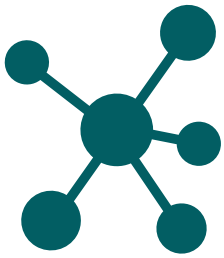
(both trade and carbon credits) against a relatively small equity capital base. Successive rounds of capital raising to fund organic growth are one approach to solving this problem. However, sourcing equity funding is challenging, especially for companies in developing markets/ countries. Some more creative funding solutions, such as special purpose vehicle (SPV) structures, are being used by companies to promote scaling. However, the challenge of providing equity finance to the sector is still present. A further challenge is how to manage currency risk arising from product sales in currencies prone to depreciation, as is the case in many developing countries.

Recently, the diversity of clean cooking funders has increased. Currently, at least 10 active impact investors operate in the market, with many coming from within the energy sector. The last five years have also seen debt funding made by investment funds, foundations and crowdfunding platforms. Despite this progress, many challenges remain for funders. There are still relatively few proven business models for clean cooking technologies that have demonstrated financial sustainability at scale, although this picture is improving with the advent of more sophisticated companies and products. However, the investible pipeline of companies remains small, with most attention still focused on a handful of names.

The sector is complex and solutions to promote uptake require a wide range of initiatives, many of which are beyond the scope of this report. Many factors influence the uptake of MEC technologies. These include user and community needs and perceptions (cooking and taste experience, ease of use, consumer awareness, geographical distance from customers), affordability (upfront cost of stoves, operating costs of stoves, consumer finance) and the industry structure (physical infrastructure, access to fuels or electricity, industry organisation, maturity of companies). Other relevant factors are the enabling environment (policies on end-user subsidies, government organisation and support to the sector, fiscal incentives) and energy pricing / fuel cost (cost of fuels or electricity, cost of competing fuels).

Most companies surveyed for this report expressed a strong interest in receiving Technical Assistance (TA), particularly for fundraising. Many needed support in other areas as a precursor to fundraising such as business and financial models. Many were also interested in getting support on research and development (R&D), piloting and market-related activities. Other TA areas prioritised by companies included treasury management and governance, partnership building and monitoring and evaluation.

The lack of data on the cooking market, companies and customers is seen as a major obstacle to attracting capital and larger corporate private sector operators into the clean cooking sector. Another challenge is the lack of widely accepted and standardised sector impact metrics, for example, in the areas of health, environment or gender equality. The Clean Cooking Alliance (CCA) publishes the Clean Cooking Industry Snapshot annually and this provides useful data on the sector. However, further progress is needed, with some initiatives already underway.



PROMOTE EFFORTS TO LINK CLEAN COOKING WITH WIDER ENERGY PROGRAMMES OF LARGE MDBS AND OTHER DFIS AND CONNECT THESE EFFORTS WITH THE DEVELOPMENT OF INTEGRATED ENERGY PLANS OF NATIONAL GOVERNMENTS.

Photo: Visual-stories Micheile/Unsplash

Recommendations

In this report, we have identified several potential interventions by donors and other financiers to scale-up the clean cooking sector. Our main recommendations are listed below:

1. Promote efforts to link clean cooking with wider energy programmes of large MDBs and other DFIs and connect these efforts with the development of integrated energy plans of national governments. Leverage the large-scale investment in electrification to promote clean cooking and undertake more research on financing options associated with this approach.
2. Provide R&D grant funding to encourage further technology and business innovation. Provide funding for the scale-up of successful businesses at different stages of company development.
3. Promote innovative financing solutions to address the problems of fast-growing companies facing capital constraints. Support early-stage patient equity funding, equity crowdfunding campaigns and equity de-risking instruments.
4. Offer concessionary, first loss capital on a limited and targeted basis to catalyse commercial debt investments, for example, through support for debt funds.
5. Support the design of RBF clean cooking programmes that address the specific challenges of the focus markets.
6. Support the development and integration of smart data and impact measurement solutions for clean cooking in order to reduce the cost of reporting and facilitate access to carbon credits and RBF.
7. Support innovative funding mechanisms such as DIBs which promote SDG impacts, especially on health and gender equality.
8. Support the development of standardised impact metrics for different clean cooking technologies.
9. Support utilities and mini-grid developers to pilot and scale-up electric cooking services and help existing clean cooking companies to diversify into electric cooking.
10. Incentivise appliance manufacturers to develop products targeted at the bottom of the pyramid, in particular DC- and battery-supported electric cooking products. Bridge initial cost–viability gaps in new or challenging markets by offering grants, social impact investments and RBF tied to SDGs outcomes.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2. INTRODUCTION

2.1 OBJECTIVES

The four main objectives of this report are:

1. To map the current funding landscape for clean cooking and identify the opportunities and challenges for scaling up the sector in developing countries. The report focuses on modern energy cooking (MEC) services (modern fuels including electricity) and the integration of clean cooking into wider energy access funding initiatives.
2. To understand the technical assistance (TA) requirements of companies that want to engage with clean cooking and to develop recommendations for potential TA interventions by funders and programme implementers.
3. To understand the data requirements of clean cooking funders, the role of standardised key performance indicators (KPIs) and impact metrics and the data gaps that need to be filled.
4. To make recommendations for potential interventions: (i) to fund and de-risk an energy access sector that is inclusive of cooking needs and supports the scale-up of modern energy cooking services, which includes addressing the TA needs of companies; and (ii) to fill the data gaps for funders and other stakeholders.

In general, clean cooking needs to be far more fully integrated within wider energy access planning. To date, it has been treated as its own sector, whereas, within the MECS programme, we believe that, as we move forward towards the deadlines for achievement of the SDGs and Net Zero Carbon, there will be an increasing need to utilise modern energy infrastructure, if we are to achieve clean cooking within sustainable pathways. To this end, we must increasingly conceive of cooking needs as part of the whole, not as their own sector. The data set utilised for this report considers cooking as its own sector almost set apart from the more comprehensive energy system. However, a new report intended to be published next year will present further MECS Research on the rapidly changing dynamics of the wider energy access financing landscape.

2.2 STRUCTURE OF REPORT

The report is divided into one main section and three subsidiary sections:

1. Overview of the funding landscape – This main section reviews the business models in the clean cooking 'sector', the size and composition of the current funding market, the typical growth curve and associated funding needs of companies, the different types of funders and evolving funding models, the challenges around financing and the barriers to scale-up and, finally, some profiles of companies and funders.
2. TA needs of companies – This section presents the main types of TA, the TA priorities of clean cooking companies, the TA offered in the market today and the gaps in the current TA offering.
3. Data requirements of funders – This section evaluates the market, enterprise and customer data required by funders, the development of standardised KPIs and impact metrics and the steps needed to attract new investments into the sector.
4. Recommendations – This section recommends interventions to address the clean cooking funding gaps and help scale up the sector, to provide TA to organisations and to fill the data gaps of funders.

Photo: Jon Leary/MECS

Photo: Jon Leary/MECS

3. METHODOLOGY

3.1 INTRODUCTION

The report explores the views of both clean cooking companies and funders through the evaluation of primary and secondary data, specifically:

- Two online questionnaires, one for clean cooking companies (with 40 respondents) and one for capital providers (with 28 respondents);
- Calls and interviews with nine clean cooking companies and 11 capital providers;
- Secondary research, including company and funder websites, and various online reports.

The cooking companies and funders participating in the questionnaire are listed in Annex 1 to this report.

3.2 FEATURES OF MODERN ENERGY COOKING

As this report is specifically focused on modern energy cooking (MEC), this section briefly presents the key elements of these technologies.

The Clean Cooking Alliance (CCA) has published voluntary performance targets to benchmark the performance of cookstoves – see Table 1 below. There are five indicators covered by the targets: thermal efficiency, fine particulate matter emissions, carbon monoxide emissions, safety and durability. For each indicator, lab test results are rated along six tiers (0: lowest performing, to 5: highest-performing). Tier 0 represents performance typical of open fires and the simplest cookstoves.

Table 1: Voluntary Performance Targets – Default Values (Source: CCA)[4]

Tier	Thermal Efficiency (%)	Carbon Monoxide Emissions	2017	2018	2019
5	≥50	≤3.0	≤5	≥95	<10
4	≥40	≤4.4	≤62	≥86	<15
3	≥30	≤7.2	≤218	≥77	<20
2	≥20	≤11.5	≤481	≥68	<25
1	≥10	≤18.3	≤1031	≥60	<35
0	<10	>18.3	>1031	<60	>35

'Modern' energy cooking solutions refer to those cooking technologies that are Tier 4 or above. These include biomass gasifier stoves, LPG solutions, ethanol solutions, biogas solutions, and solar and e-cooking. 'Improved' cooking solutions refer to those that are Tier 3 or below. These include advanced biomass and improved charcoal technologies. Clean Cooking is considered in the report as being practically synonymous with MEC as it is defined to involve fuel-stove combinations that achieve emissions performance measurements of Tier 4 or higher.

With the advent of highly energy-efficient modern cooking appliances, the developmental clean cooking landscape is changing dramatically. Historically, the sector was dominated by NGOs and small local producers promoting improved cookstoves (ICS) using biomass. The growing levels of electricity access and the greater efficiency and performance of appliances have made electricity an increasingly competitive solution. This, in turn, has drawn in the involvement of companies, such as mini-grid developers and solar home system (SHS) companies, as well as companies focused only on appliances. Some of the large electric utilities in East Africa (especially those with surplus power) are actively studying strategies to promote clean cooking as an additional revenue source. Other companies are finding cost-effective solutions using modern technology with other fuel sources, such as those mentioned above.

Photo: MECS

Energy-efficient modern cooking appliances.

4. *https://cleancookingalliance.org/news/10-16-2018-voluntary-performance-targets/*

Another notable feature of the transition towards clean cooking (especially, but not only via MEC) is its strong potential to advance SDG outcomes. These include, in particular, positive health impacts from a reduction in particulate emissions, climate-change mitigation and resilience effects, gender, environmental and livelihood impacts. These create opportunities for MEC projects to benefit from different forms of grant funding, in particular, carbon credit schemes and RBF.

3.3 CLEAN COOKING COMPANIES' QUESTIONNAIRE

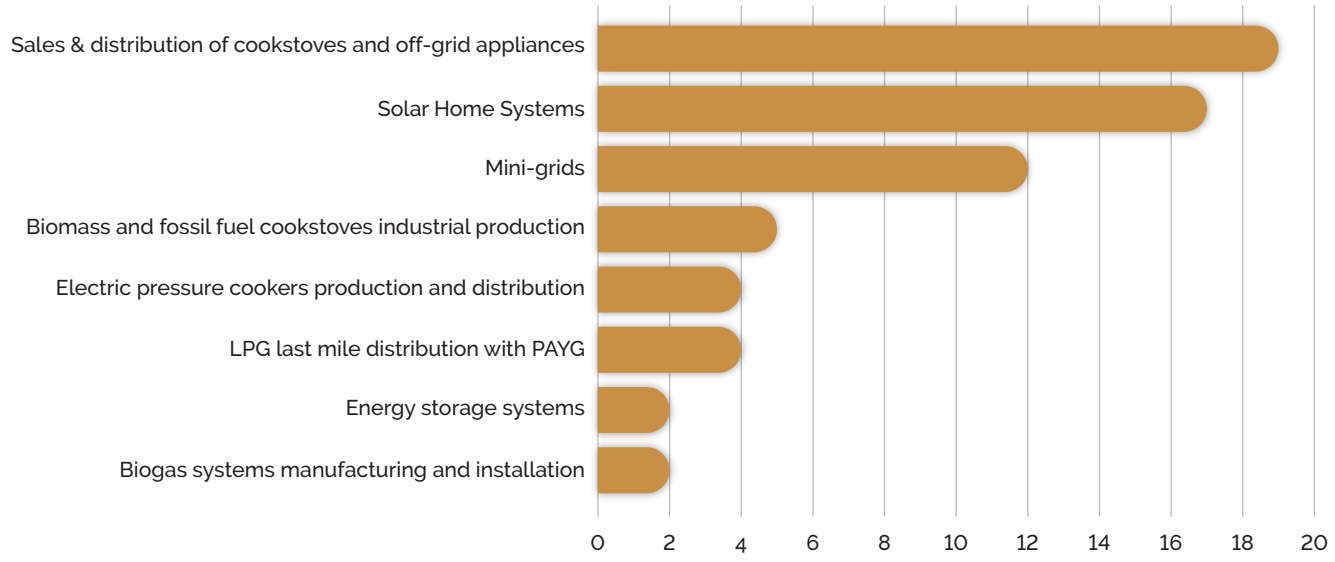
The report includes primary research based on analysis of the results of two questionnaires – one for 'clean cooking' companies and one for funders. The questionnaire for clean cooking companies explored capital raising challenges and the TA needs of different types of 'clean cooking' companies. The 40 respondents covered a wide range of businesses, including manufacturers and distributors. They included companies with wider commercial interests (such as SHS and mini-grid developers) and businesses focused solely on cookstoves. Figure 1 provides a breakdown of the respondents by industry sector.

The geographical selection of the respondents shows a slight bias for companies active in Africa (22) with eight companies having projects in South Asia, five in both, Africa and Asia, and another five companies having a broader geographical reach.

The companies selected for the survey were at different stages of development – three were at the seed stage, 17 were in early-stage growth, 19 were in late-stage growth and one respondent, an NGO, was a mature organisation. The classification of stages of development is defined in Section 4.5 of this report.

With regard to their business models, nearly all respondents claimed to target households at the 'bottom of the pyramid' (BoP), with half also focusing on middle-income households. Almost one-third of the respondents claimed to just target the BoP market.

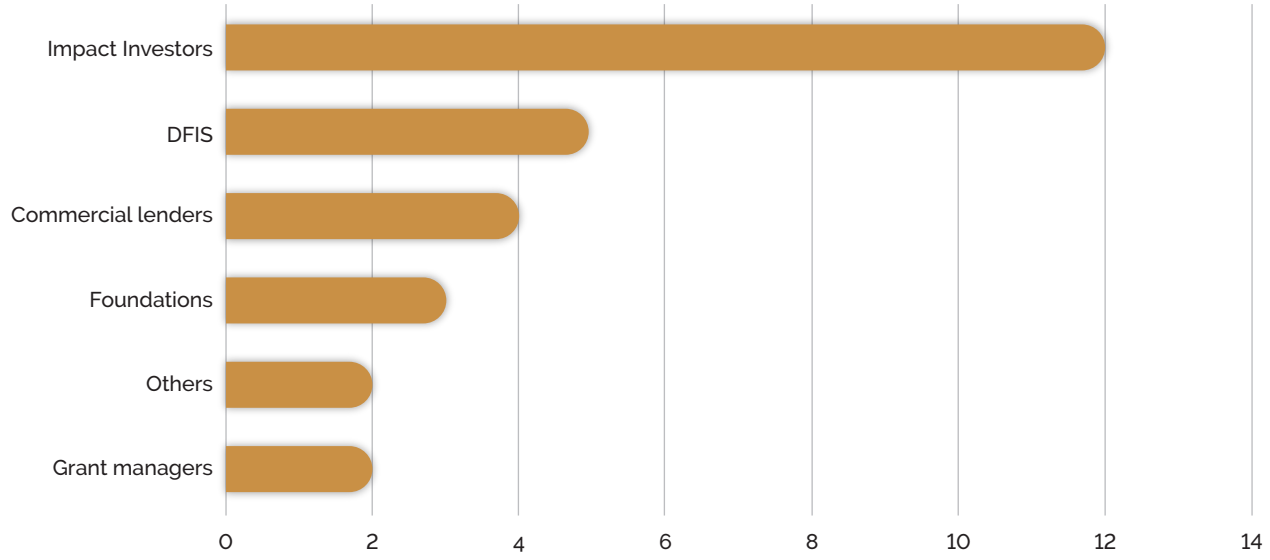
Figure 1: Number of Respondents by Industry Sector in Companies' Questionnaire (ranked by number of responses)



3.4 CLEAN COOKING FUNDERS' QUESTIONNAIRE

The second questionnaire looked at different investment approaches and data requirements of clean cooking funders. The 28 respondents came from a wide range of institutions, including impact investors, development finance institutions, foundations, commercial lenders, and grant managers – see Figure 2 for a breakdown.

Figure 2: Number of Respondents by Funder Category in Funders' Questionnaire (ranked by number of responses)



THE 40 RESPONDENTS COVERED A WIDE RANGE OF BUSINESSES, INCLUDING MANUFACTURERS AND DISTRIBUTORS.

4. OVERVIEW OF THE CLEAN COOKING FUNDING LANDSCAPE

4.1 INTRODUCTION

The financing and operational landscape for clean cooking has evolved significantly over the last few years. Most cooking companies have historically used the 'tool-only' business model, which is based on sales of cookstoves alone. More recently, 'tool & fuel' business models have emerged for selling appliances and related fuel that aim to make the cooking needs of low-income households cost-effective. There is also a question of how to conceive of, and document, electric cooking within this relationship between tools and fuels. Utilities can be conceived of as a third 'fuel and tool'; where the company is overwhelmingly focused on the fuel, and the tool (cooking appliance) becomes one further opportunity to promote revenue. In all types of models, pay-as-you-go (PAYGO) technologies have emerged (as is discussed further in the report in this series on appliance finance).

Despite significant gains during the last ten years in access to electricity, particularly in developing Asia, e-cooking, until recently, had been treated as a 'tool only' model, i.e., for companies supplying hotplates, induction stoves, slow cookers, electric pressure cookers and task-specific devices, such as kettles. Innovations in energy-efficient electric cooking appliances, such as electric pressure cookers and induction cookers, are paving the way for an increased uptake of these solutions among consumers. While off-grid e-cooking business models are still in their development phase, given their level of complexity and challenges (affordability, electricity supply, rural outreach), there are signs that this will change rapidly over the next five years. Larger utilities are increasingly looking at clean cooking solutions to incorporate into their businesses. These companies clearly represent an important opportunity to promote MEC going forward. For example, the Kenya Power and Lighting Company (KPLC) has had a 'pika na power' (meaning cooking with electricity) cooking awareness programme for the last four years. Therefore, should KPLC be counted as part of the cooking finance landscape and, if so, how and when should this occur?

This situation means it has been challenging to determine the most appropriate scope to use for this landscape report. In fact, the surveys used in this report have included mini-grid and SHS companies (as well as appliance companies), but have excluded major utilities and large fuel groups; quite apart from consideration of enabling infrastructure, such as electrification investment.

Whichever stage of development the businesses surveyed are in, access to finance remains a key constraint for companies engaged in clean cooking. Figure 3 shows the main investment criteria used by company funders. The three most important funding criteria for the funders surveyed are: the experience and commitment of the management team; the impact metrics tracked by the funder; and, whether the company is on the path to positive cash flow.

Figure 3: Main Investment Criteria by Funders (ranked by number of responses)

4.2 SIZE OF THE FUNDING MARKET

Clean cooking investment has not risen meaningfully over the last five years. It remains a long way below the levels needed to promote a rapid transition to clean cooking. Financial commitments to clean cooking still represent just a very small fraction of the estimated funds required to achieve universal clean cooking access by 2030.

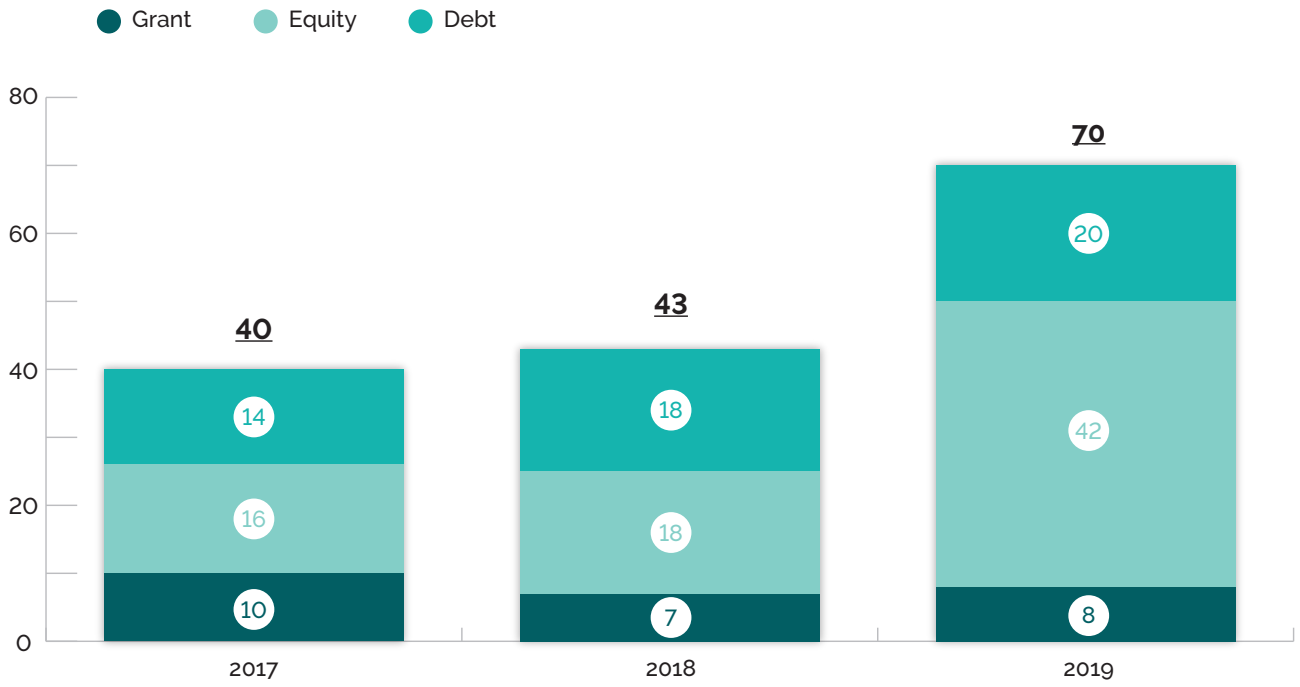
According to a CCA survey conducted for their Clean Cooking Industry Snapshot Report, the total funding raised for clean cooking businesses for 51 companies they surveyed was USD 70 million in 2019.

While the absolute investment numbers are very low, during the last five years the funding level has started to rise modestly and to transition from grant-based funding to more commercial financing. The diversity of clean cooking investors has also increased with investment funds, family offices, foundations and commercial lenders all now active in the sector.

Given the relative immaturity of the 'cooking sector', most corporate funding so far has concentrated on a handful of scalable modern cooking businesses. Figure 4 shows how overall capital increased in the period 2017 to 2019 for the CCA surveyed group.

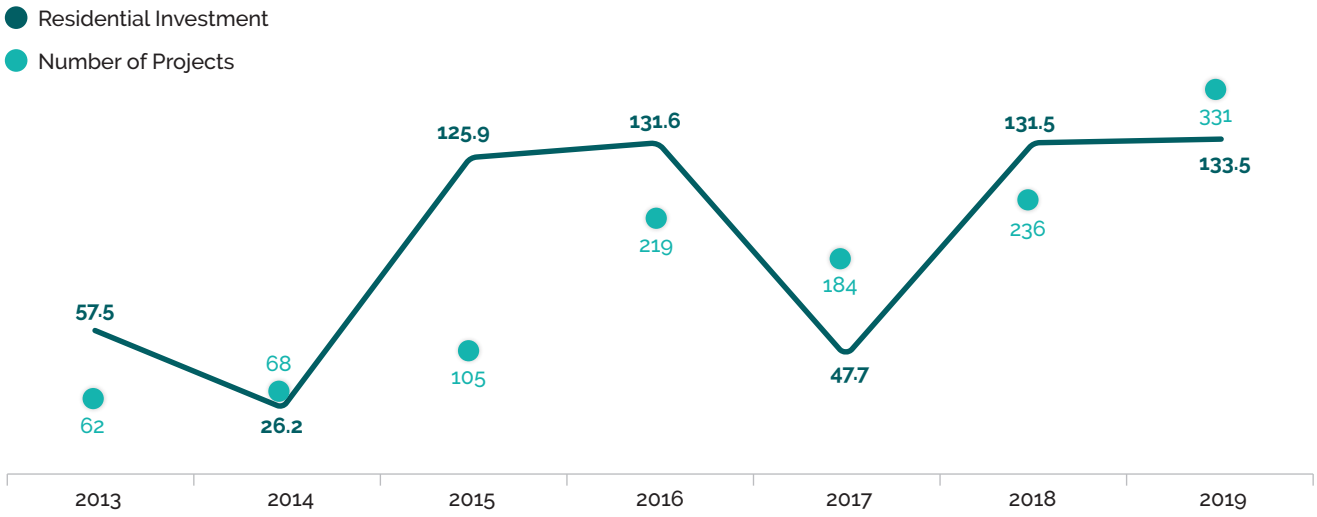
CLEAN COOKING INVESTMENT HAS NOT RISEN MEANINGFULLY OVER THE LAST FIVE YEARS. IT REMAINS A LONG WAY BELOW THE LEVELS NEEDED TO PROMOTE A RAPID TRANSITION TO CLEAN COOKING

Figure 4: Investment Flows in Clean Cooking by Instrument Type (2017 – 2019)[5]



Recent Sustainable Energy for All (SEforALL) analysis estimates that annual commitments to the High Impact Countries (HICs) on which their analysis focuses stagnated at around USD 130 million annually between 2015 and 2019 (except in 2017, when they actually fell) as shown in Figure 5.

Figure 5: Total Commitments for Residential Clean Cooking in HICs (USD million)[6]

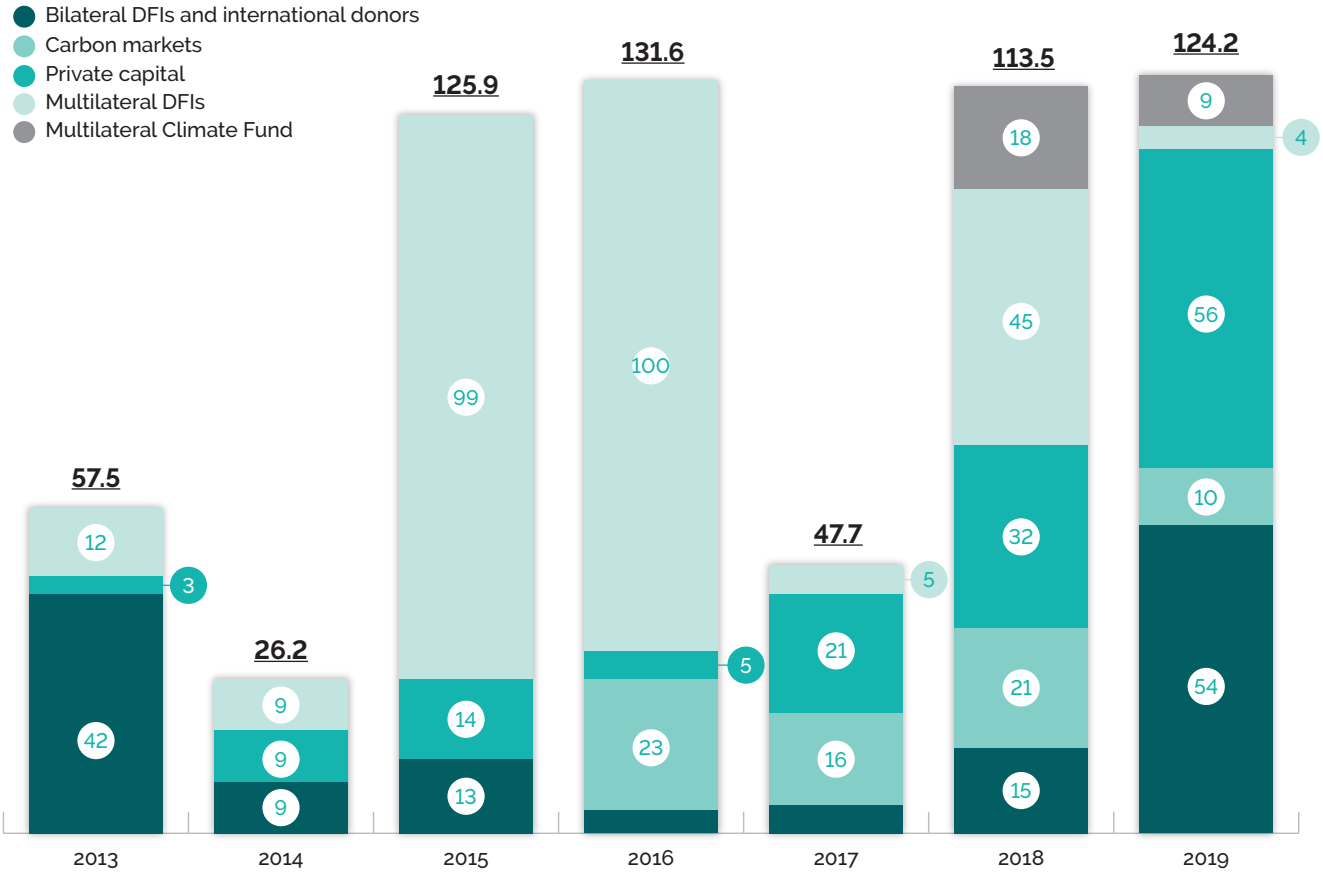


5. Source: "2021 Clean Cooking Industry Snapshot" (CCA) – *https://cleancooking.org/reports-and-tools/2021-industry-snapshot-report/* Note: The figure is based on tracking data of 51 companies for each year between 2017 and 2019. The data relies on self-reporting by the companies and has been supplemented with publicly available investment data
6. Source: SEforALL – Energising Finance, 2021; Note: Carbon finance estimates from the UNFCCC and Gold Standard were only included for 2016-2019

The SEforALL analysis of its HIC group also shows the increasing importance of private sector funding. Whereas clean cooking was very largely financed through public capital between 2013 and 2016, from 2017 onwards, private sources of capital played an increasing role, as shown in Figure 6 below. Private finance commitments almost doubled in 2019 to around 42 per cent (USD 56 million) of total commitments. This came from a range of institutional investors, impact investors, venture capital and private equity. SEforALL noted that private finance was heavily concentrated both geographically – with very large commitments directed to Kenya alone – and by technology, with LPG comprising around 55 per cent of total commitments, followed by ICS (19 per cent), and ethanol stoves (18 per cent).

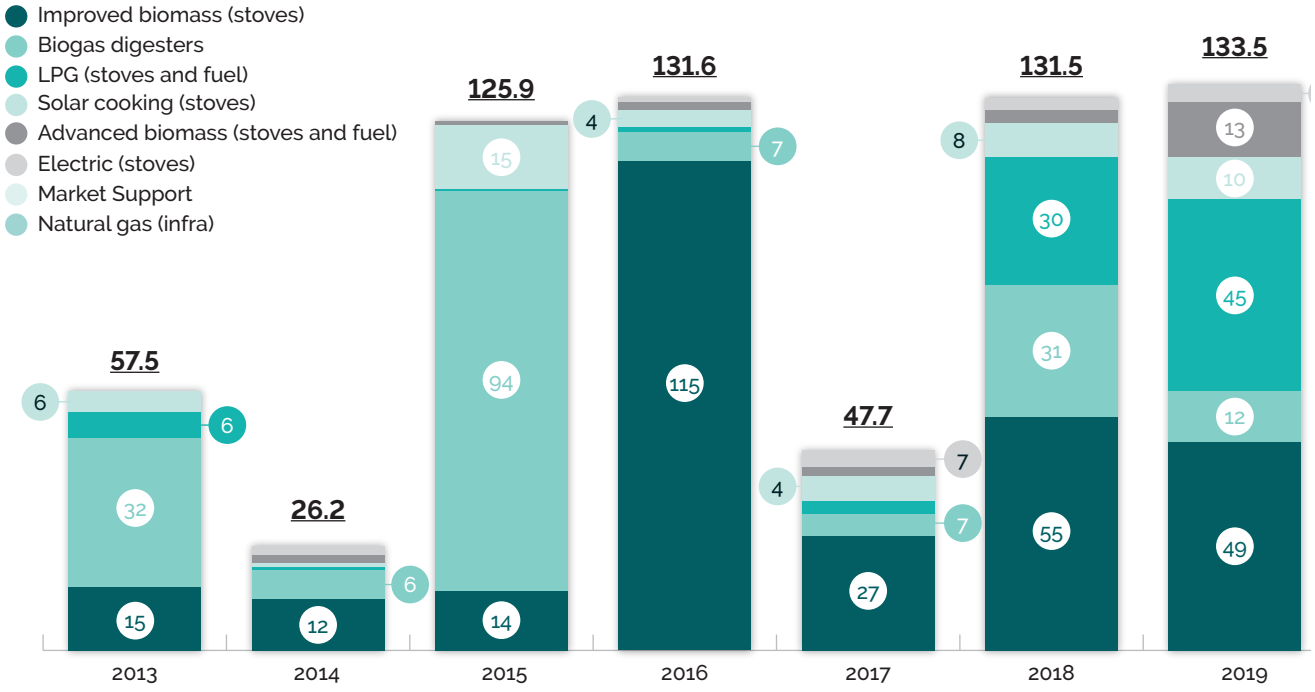
The SEforALL analysis set out in Figure 7 shows that ICS technologies continued to receive the most finance overall, with 36 per cent (USD 49 million) of total tracked finance commitments. Although ICS stoves, in general, were less advanced than the other fuels and technologies, their greater affordability made them appear a more viable option. Lower investments in biogas digesters – from USD 31 million in 2018 to USD 12 million in 2019 – was attributed to a downturn in certain large-scale public finance projects. Interestingly, electric and solar cooking still received very low levels of investment in 2019. Again, this shows how recently much of the technical innovation has occurred in the sector. It also raises some issues with the tracking of financing of basic electrical appliances used for cooking, for example, kettles and rice cookers.

Figure 6: Clean Cooking Commitments in HICs, by source and financial institution (USD)[7]



7. Source: SEforALL – Energising Finance, 2021: *https://www.seforall.org/data-and-evidence/energizing-finance-series*

Figure 7: Clean Cooking Commitments in HICs, by Technology (USD million)[8]



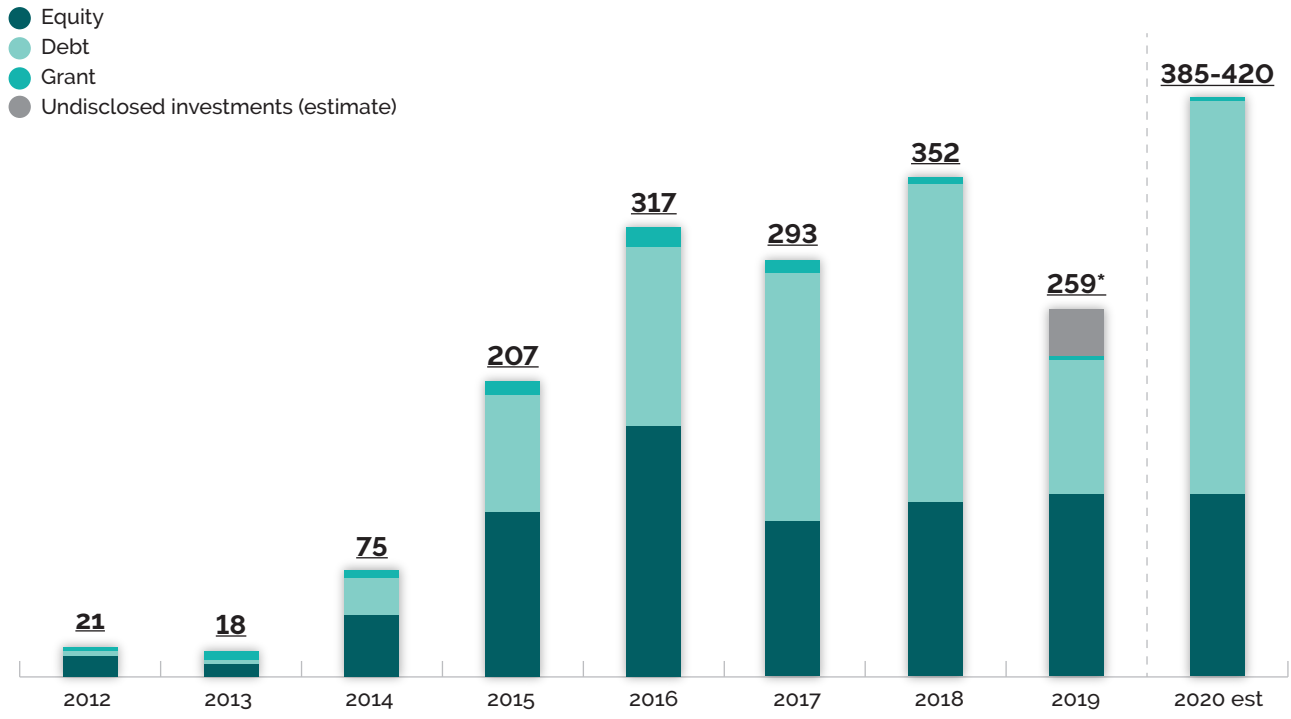
4.3 SYNERGIES WITH ENERGY ACCESS

While the SEforALL analysis demonstrates that investment into clean cooking companies per se has been very small, by contrast, the electricity access off-grid sector attracted more than $1.5 billion of investment in the period from 2012 to 2019 (this, of course, is itself substantially lower than the amount devoted to investment in grid-based electricity), with growth in the early years driven by equity. Debt became more significant in the later years as financiers became more comfortable with the risks – see Figure 8.

IN SIMPLE TERMS, THE VOLUMES OF FUNDING FLOWING INTO ELECTRICITY (THE FUEL OF 'FUEL AND TOOL') ARE OF A DIFFERENT ORDER OF MAGNITUDE TO THOSE PRESENTED AS GOING INTO THE CLEAN COOKING SECTOR.

8. Source: SEforALL Energizing Finance: Understanding the Landscape 2021. *https://www.seforall.org/publications/energizing-finance-understanding-the-landscape-2021*

Figure 8: Capital Invested ($ million) in the Off-Grid Sector by Financial Instrument (2012 – 2019, 2020 estimate)[9]

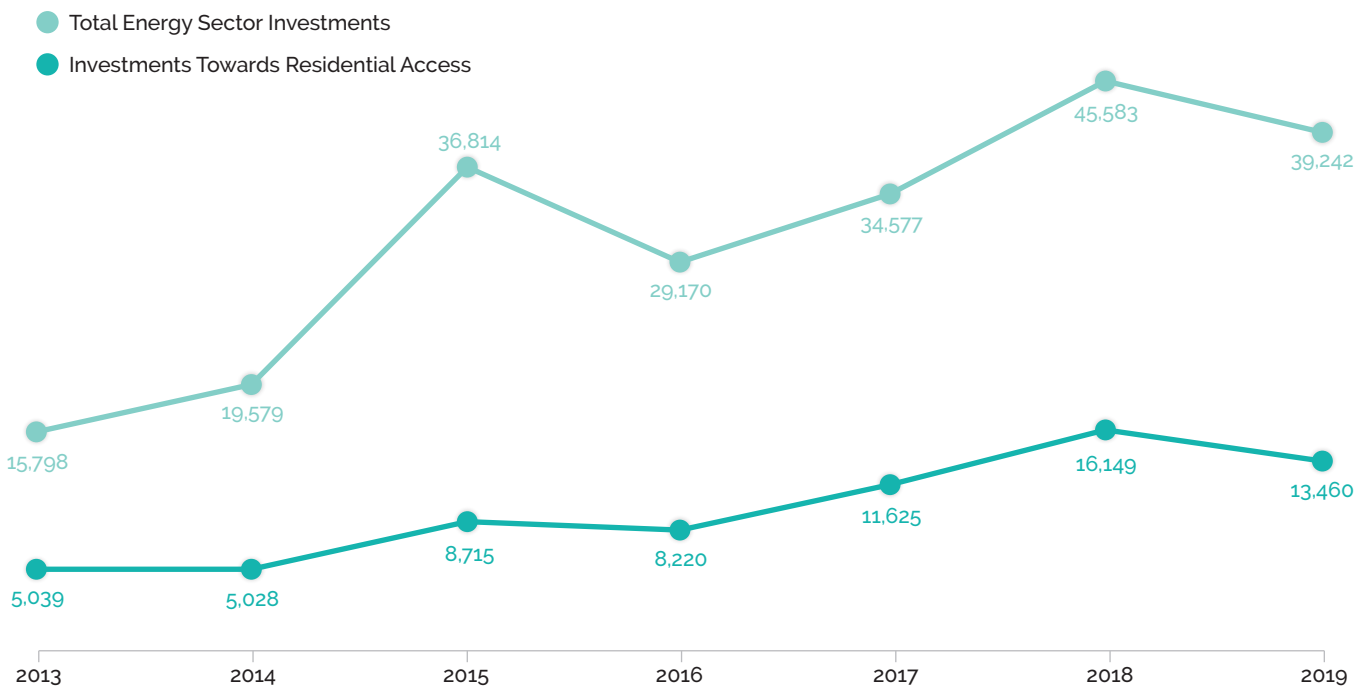


According to SEforALL, as set out in Figure 9, total finance for electricity access in the tracked high-impact countries (HICs) declined moderately in 2019 (USD 39.2 billion) from USD 43.6 billion in 2018. Of the USD 39.2 billion in 2019, an estimated USD 13.5 billion, or approximately one-third of finance commitments, benefitted residential customers. This amount is less than one-third of the USD 41 billion estimated annual investment needed to attain universal access to electricity by 2030 (IEA 2021)[10] and represents a 17 per cent decline from 2018. Even so, it can be seen that, in simple terms, the volumes of funding flowing into electricity (the fuel of 'fuel and tool') are of a different order of magnitude to those presented in Figure 5 going into the clean cooking sector. It illustrates vividly the advantages of linking clean cooking into the broader energy agendas and, particularly, for electric cooking.

However, even these billions are only those for improving energy access. All countries have a core modern energy infrastructure, which, in itself, sees significant investment. World Energy Investment reports from the IEA 2016 to 2019 show over USD 400bn was invested in electrical networks in SSA, SE Asia and India. While some of this was fossil fuel based generation, IRENA reports that the trend for renewables across the continents (a slightly different grouping than the HIC of the energising finance report) is likely to see an upward trajectory, especially with the reducing costs of renewable energy. Table 2 shows that Sub-Saharan Africa (SSA) and Southeast Asia are both expected to nearly triple their generating capacity by 2030 under the business-as-usual scenario and could increase their renewable energy capacity fivefold under a transition scenario. This investment in infrastructure effectively provides a 'platform' that could be used with energy-efficient appliances for cooking.

9. Source: SEforALL Energizing Finance: Understanding the Landscape 2021. *https://www.seforall.org/publications/energizing-finance-understanding-the-landscape-2021*
10. *https://www.iea.org/*

Figure 9: Finance to Electricity in HICs (2013-19, USD million)[11]



IRENA REPORTS THAT THE TREND FOR RENEWABLES ACROSS THE CONTINENTS (A SLIGHTLY DIFFERENT GROUPING THAN THE HIC OF THE ENERGISING FINANCE REPORT) IS LIKELY TO SEE AN UPWARD TRAJECTORY, ESPECIALLY WITH THE REDUCING COSTS OF RENEWABLE ENERGY

11. Source: SEforALL Energizing Finance: Understanding the Landscape 2021. *https://www.seforall.org/publications/energizing-finance-understanding-the-landscape-2021*

Table 2: Renewable Installed Capacity (Source IRENA 2020)[12]

	Renewable Installed Capacity (GW)		
	2017	2030 (PES)	2030 (TES)
East Asia	718	2439	3479
Southeast Asia	51	126	256
Rest of Asia	187	557	730
EU	440	620	798
North America	342	528	1135
Sub-Saharan Africa	34	120	178

Renewable = bioenergy, hydropower, solar PV, wind
PES = Planned Energy Scenario
TES = Transforming Energy Scenario

In addition to the direct investment in electrical infrastructure, most of the countries under discussion also have significant investment in providing fossil fuels for their transport infrastructure, which underpins an ability to pivot to LPG for cooking. There is much debate about the subsidies that fossil fuels currently receive, particularly in the context of a net-zero carbon world. According to the IMF, under-pricing of fossil fuels remains pervasive and substantial. They calculate, for the world as a whole, this could touch $5.9 trillion.[13] While most of this is in industrialised countries, China ($1.4 trillion) and India ($209 billion) are part of this global norm. At COP26, fossil fuel was specifically named as a carbon source that needed to be regulated. This raises the question of what the impacts of subsidy reduction or removal might be. In India, for example, several schemes have been put in place to subsidise LPG more directly to encourage a transition from biomass to LPG, particularly for the poorer segments of society. Until recently, this was said to be costing the government between $3 to $7 billion per year (reduced in 2020 and, possibly, further in 2021). In Indonesia, subsidies are also in place to encourage transition and cost in the order of $3 billion.

12. Source: IRENA 2020. *https://www.irena.org/publications/2020/Mar/Renewable-Capacity-Statistics-2020*
13. *https://www.imf.org/-/media/Files/Publications/WP/2021/English/wpiea2021236-print-pdf.ashx*

Photo: KOKO networks

These 'transition' subsidies should be counted as an investment in clean cooking. However, the main focus should be on the wider infrastructural investment that sets the scene for clean cooking use. An African example of large-scale investment in fuel infrastructure is the company Oryx Energies; one of Africa's largest and longest-established independent providers of oil and gas products and services. Oryx have a presence in 17 African countries through its 24 affiliates with two Lubricants plants. Oryx provide a basic company-wide infrastructure that enables them in Tanzania to circulate 2.6 million LPG cylinders and have 48 service stations.[14]

This brief discussion of the wider fuel issues relevant to MEC illustrates three points:

- Volumes of funding flowing into electricity and fossil fuel networks (the fuel of 'fuel and tool') are of a different order of magnitude to those presented in Figure 5 as going into the 'clean cooking sector.
- Existing research on financing barely considers these infrastructural investments. Yet, as clean cooking pivots to MEC, the presence of these fuel supplies will be essential.
- Future investment in infrastructure will not be dependent on a political commitment to clean cooking, but will be strongly influenced by a mixture of corporate profit-making drivers, political decisions made to support a modern economy and the growing influence of Climate Change mitigation on the energy access sector, including increased use of commercially viable renewable energy.

These are themes that will be developed in considerably more detail in a second financial landscape report currently under development by MECS.

4.4 CORPORATE FUNDING IN CLEAN COOKING

Returning to the core data set, Table 3 illustrates several significant recent corporate fundings within the clean cooking sector. These investments have increased over the last few years, albeit they have remained at very low levels. Most were equity investments in modern fuel companies, but there were also several debt transactions. The list is not complete as several transactions were kept confidential and so, not listed, e.g., KOKO Networks funding.

14. *https://oryxenergies.com/*

Table 3: Major Private Sector Financings in Clean Cooking 2018-20[15]

Company	Amount raised	Year	Investor type	Name of investors
KopaGas	N/A	2018	Private investment funds – equity	Acumen
PayGo Energy	$3.5 million	2018	N/A	N/A
SmartGas – Envirofit	$1.5 million	2018	Private investment funds – equity	ENGIE RDE
			DFI	FMO
			Foundation	Others
Sistema.bio	$12 million	2019	Foundation	Shell Foundation
			Private investment funds – equity	ENGIE RDE Fund, DILA Capital, ElectriFI, Endeavor Catalyst, EcoEnterprise Fund
			Private investment funds – debt	Triodos, AlphaMundi, Lendahand
ATEC International	$1.6 million	2019	Private investment funds – equity	ENGIE RDE, IIX Growth Fund
			Foundation	Phitrust Asia, Foundation Ensemble
KopaGas	$25 million	2020	Private investment funds – equity	Circle Gas
African Clean Energy	€1 million	2020	Private investment funds – debt	Oikocredit
Total	**Approx. $44.5 million**			

Table 3 does not include capital flowing into smaller, less well-established companies. In general, this report focuses on more developed corporate cooking activity, given their better availability of information.

4.5 FINANCING THE S-CURVE

The capital structure and the financing requirements of clean cooking companies are strongly influenced by their business model. The 'tool-only' business models are employed by manufacturers/ assemblers of ICS, EPC and some biogas companies. These involve only the manufacturing and sale of the cooking hardware, either for cash or on credit and without a fuel contract. The main capital requirement of these 'tool-only' companies is usually working capital for inventory and receivables. They may also need CAPEX for manufacturing, if they are not solely focused on distribution, but, unlike tool and fuel groups, no CAPEX is needed for fuel infrastructure.

The 'tool & fuel' business models employed by many LPG, Ethanol, and some Biomass companies involve selling

15. Source: Energy 4 Impact Research

their cooking hardware at a low cost along with fuel purchase contracts. The 'tool & fuel' companies typically aim to recover the cost of the stoves through margins on the sale of the cooking fuel over several years (at least three years, but potentially much longer). The fuel may be sold on a demand basis or through regular payments, for example, every month. The profitability of these companies depends on reaching a certain scale of fuel usage, which, in turn, is a function of the sale of stoves.

'Tool & fuel' companies have significant requirements for working capital and also CAPEX for distributing the fuel. This has to be seen within the infrastructural discussions initiated above. To reduce their CAPEX, some companies have formed strategic partnerships with larger fuel companies. The fuel companies handle fuel production, storage and logistics. A notable exception is ECS, which has its own manufacturing facility for pellets in Zambia. Most of the other modern fuel companies leverage existing fuel distribution networks. For instance, KOKO Network's fuel distribution is run through its own dispensing units, but is built on the existing liquid fuel distribution infrastructure owned and operated by Vivo Energy in Kenya. KopaGas purchases wholesale LPG from Oryx Energies; one of Africa's largest private sector players in LPG. Profiles of Circle Gas, KOKO Networks and ECS can be found in Section 5 of this report.

As discussed in the previous section, 'Fuel and tool' approaches focus on the added value of the energy demand from the cooking to enhance bottom-line revenue. Utility led models, whereby the utility offers energy-efficient appliances as part of a package, potentially converts a tool-only provision of electric pressure cookers to a 'fuel and tool' model, where the utility makes its margins on the fuel, not the tool.

Another important difference is in the cost of the stoves/appliances. Lower tier improved biomass stoves can be purchased for as little as $2-$10 in Sub-Saharan Africa (SSA), but they offer limited efficiency improvements and less durability. Higher-tier modern fuel appliances are higher cost, but reduce ongoing fuel expenditure. Electric hotplates are relatively inexpensive (typically $10-$30), but have relatively high electricity running costs as they are less efficient. Efficient electric appliances are more expensive, with basic EPCs typically retailing for $50-$100.[16]

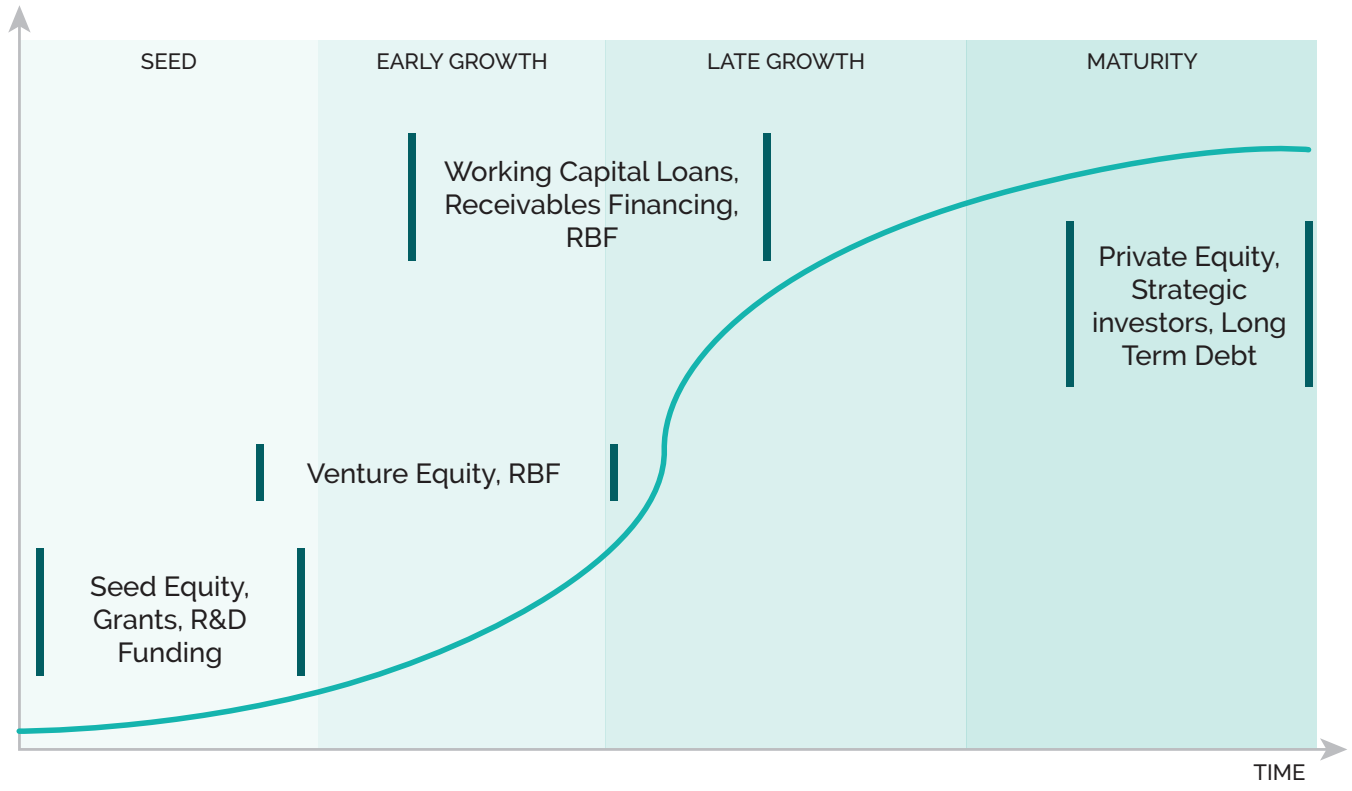
16. For an overview of appliance pricing see: *https://mecs.org.uk/wp-content/uploads/2021/07/Clean-Cooking-Financing-Appliances-for-End-Users.pdf*

Photo: Benjamin Dada/Unsplash

The higher upfront cost of most modern stoves creates affordability challenges for certain end-user groups, especially lower-income households. Clean cooking companies have responded to this challenge by avoiding approaching the poorest customers and/or by selling the stoves at cost (or as a loss leader) and on credit. PAYGO LPG and ethanol companies, for example, typically target households with a monthly fuel spending of at least $16, while PAYGO biomass companies target households with monthly spending of at least $6. By comparison, BoP customers are defined as earning $2.50 or less a month. The PEC stove switching programme in Ecuador linked credit facilities to acquire the induction stove with repayments linked to their utility bill, and this was linked to 80kWh per month of free electricity.

Compared to the off-grid energy sector, clean cooking companies do not yet perform well in many countries in terms of reaching BoP customers and recognise that subsidies of one kind or another are needed to reach this segment.[17]

Figure 10: Financing the S-Curve[18]



Irrespective of the business model, the life cycle of most companies typically follows the S-curve shown in Figure 10. The four main stages in the company life cycle – seed, early growth, late growth and maturity – are described in more detail below. The capital requirements are similar for the 'tool-only' and 'tool & fuel' business models, until they reach the late-growth stage. Most of the commercial capital providers surveyed said they were interested primarily in investing in early or late growth-stage companies (46% respondents), followed by mature companies (39%) and then seed companies (29%).

17. *https://mecs.org.uk/wp-content/uploads/2021/07/Clean-Cooking-Financing-Appliances-for-End-Users.pdf*
18. Source: Energy 4 Impact Research

Seed Stage: To date, clean cooking companies typically finance their early start-up investments through a combination of seed equity and grants. The initial equity is sourced primarily from the founders, who may also contribute by taking little or no salary.

Many companies incur substantial expenses in developing their cookstoves and related technologies, such as mobile payment integration, remote monitoring and control and 'last-mile' fuel delivery mechanisms. Grant funding to support technology development, proof of concept and piloting is especially important at this stage. The technology investments are quickly followed by the capital required to develop the business. Most of the capital at this stage is spent on piloting products, starting to build a customer base and resolving initial operating problems and challenges.

At the end of the seed phase, a clean cooking company may have a limited customer base, basic technology assets, an initial distribution strategy and a partial management team in place. They may have identified a positive unit economics model, without which any scale-up is futile.

Early Growth Stage: In the early growth stage, the companies start expanding their core management and operations team to build in-house capabilities in finance, information systems, technology, sales and marketing.

During this stage, the companies may face significant hurdles from issues related to technology scale-up and upgrades, expansion of the distribution network and operation of hardware, the supply chain, the consumer credit process and the recruitment of a larger workforce or agent network. If these challenges can be resolved, the company is well-placed to build a resilient operational business.

In this stage, companies that are ready to scale up start attracting commercial equity capital from a very limited pool of venture capital investors, private investment funds and concessionary impact investors. While the venture capitalists tend to have higher commercial return expectations and more appetite for risk, concessional capital providers or impact investors, such as foundations, may offer patient equity or low-cost loans.

At the end of the early-growth phase, a company may have 5,000 to 10,000 customers or more, strong IP-protected technology assets with continuous upgrades, a successful distribution strategy and a full management team in place.

In the 'fuel and tool' model, the addition of a clean cooking product or service to an established utility, mini-grid, SHS provider or fuel distribution company, could be seen as effectively leveraging existing assets at an early stage of company growth. For instance, adding energy-efficient appliances as a product to be acquired through a utility (such as in Ecuador) means that the new team dealing with the rollout may already have credit facilities, an agent network and a customer base within the corporate company. They may still have to identify the supply chains and address teething trouble persuading customers to pick up the added-value products and services. However, as a department or part of a larger corporation, they rarely have to start building a customer base from scratch. Their access to finance is often about persuading the Board or trustees or the directors to approve a 'special project', rather than undertake all the actions associated with a 'seed stage'. As the sector moves towards modern energy solutions, this type of business model is going to become increasingly important to the sector.

Late Growth Stage: During this stage, the company's growth accelerates and its cost structure is driven by the number of customers purchasing products and fuel on a recurrent basis. For 'tool and fuel' and 'fuel and tool', the higher and denser the customer base, the lower the cost of service per customer. The need for investments comes from geographic expansion into new markets and new products and customer experience improvements in existing markets. The capital structure for each fuel technology moves to a stable state that supports sustainable growth. It is likely to include a solid equity base, short-term revolving debt and working capital facilities to finance inventory and term loans to finance end-users. While concessional capital and RBF financing are available, most of the capital inflows are likely to come from commercial capital providers.

Photo: Lukas Blazek/Unsplash

Maturity Stage: In the maturity stage, companies have achieved profitability on a sustainable basis. They have optimised their capital structure in terms of financial leverage to bring appropriate returns to equity investors. There is likely to be a consensus around certain business models with the market dominated by a few players in each technology. The market is also likely to unbundle, with technology providers, last-mile distributors, cooking fuel manufacturers, cookstove manufacturers and others starting to offer niche products and services. The financing landscape is likely also to be characterised by occasional large equity raises involving strategic and private equity investors and long-term debt transactions involving commercial lenders.

For many 'fuel and tool' models, the organisation expanding their activity is already at a mature stage. Unlike the off-grid space, the grid space is dominated by utilities and fossil fuel distributors. These are large corporations that are mostly listed on share exchanges. Raising finance for new products and services within this space may involve the allocation of internal resources, rather than more cumbersome external funding.

4.6 TYPES OF FUNDERS

Recently, the diversity of funders in the clean cooking sector has increased significantly to include commercial investors and concessionary capital providers. Table 4 lists the main types of funders, the funding instruments they use and some of their special features.

Table 4: Types of Capital Provider[19]

Type of capital provider	Examples in clean cooking	Financial instruments	Special
Development agencies; Public funders	FCDO/UKAid Sida, Netherlands Development Corporation, US Aid/DIV, MECS	Energy access programmes which include clean cooking R&D and corporate grant programmes RBF programmes Blended finance programmes e.g., EEP	Support for socio-economic development through donor programmes Support may be tied or untied Do not typically make direct investments in companies, but some exceptions e.g., DIV
Development financing institutions (DFIs) or development banks	World Bank, AfDB, FMO (Netherlands), CDC (UK), UNCDF, Nordic Development Fund	Results-based grants e.g. World Bank's Clean Cooking Fund Indirect loans or grants in debt or equity funds Technical assistance	Historically not focused on direct loans for clean cooking companies – ticket sizes too small, unproven business model. Includes multilaterals (multi country) and bilaterals (single country)
Private foundations	Osprey Foundation Shell Foundation	Can be very flexible. Grants, e.g. for institution building and policy making or risk tolerant equity Early-stage debt to high-risk companies First loss and other subordinated debt	Non-profit or charitable trust with specific development objectives Funded by corporates or individuals/ families Remit of corporate foundation sometimes completely different to underlying business of corporate Payouts may be grant or Programme-related Investments (equity or loans)
Impact investors / private investment funds	Equity funds: Acumen Energy Access Ventures, Novastar Ventures Global Partnerships ENGIE Rassembleurs IIX Growth Fund AHL Venture Partners Factor E Gaia Impact Fund Persistent Energy Debt investors and funds: SIMA, Oikocredit, AlphaMundi Triodos	Equity and debt generating both financial return and socio-economic impact	Some funds are linked to strategic investors / large corporates e.g., ENGIE Rassembleurs Some funds are more prepared to lead funding rounds and bring in other investors e.g., Novastar
Crowdfunding	Peer-to-peer lending platforms: Lendahand Trine bettervest Crowd Credit (Japan) Energise Africa (potential investor) Venture debt platforms: Kiva Equity platforms: CrowdCube (potential investor) Various reward or donation platforms	Loans for SMEs at different stages of development Loans for micro enterprises Donations and rewards	Most investments to date have been in alternative fuel companies e.g., Sistema.bio or companies that distribute solar home systems as well as stoves e.g., Vitalite, ECS, Bidhaa Sasa. Potential source of bridge funding for RBF products Potential for equity crowdfunding on platforms, such as Crowd Cube

19. Source: Energy 4 ImpactResearch

As Table 4 demonstrates, a wide range of financing institutions are involved with clean cooking, albeit that this usually represents only a very small part of their overall activities. Profiles on the cooking-related activities of some of the organisations with a significant sectoral focus have been set out in Section 6. These include The Clean Cooking Alliance (CCA), Acumen, Shell Foundation (SF) and MECS.

Governmental institutions have played a key role in supporting different financial initiatives, often using instruments, such as RBF, other upfront grants and TA programmes. Direct dealing with companies is less common, although USAID's Digital Innovation Ventures (DIV) platform has done this. DIV is an innovation funding programme that tests and scales innovative technologies, solutions and business models to tackle global development challenges. DIV is structured as a rolling programme, accepting applications continuously from any sector and any country with a USAID presence. DIV provides flexible, tiered grant funding to test new ideas, take strategic risks, build evidence of what works and advance the best solutions. The amount of funding varies from up to $200,000 for a proof of concept to $5 million for scaling. Their grants to clean cooking have included those in Table 5.

Table 5: DIV Grantees in Clean Cooking Sector (Source: USAID)[20]

Grantee	Year	Type of company	Grant amount
PayGo Energy	2017	PAYGO LPG distributor	$ 150,000
BURN	2017	Improved cookstove manufacturer	$ 1,210,000
BioLite	2013	Fan-assisted biomass stove manufacturer	$ 1,000,000
Eco-fuel Africa	2015	Waste to clean cooking technology	$ 1,100,000
Carbon Roots	2013	Biochar technology company	$ 100,000
Potential Energy	2012	Improved cookstove marketing and distribution	$ 1,500,000

The Mobile for Development Utilities (M4DU) programme is backed by FCDO (formerly DFID) and USAID and aims to test and scale the use of mobile technology to improve or increase access to energy, including clean cooking services to the underserved. Launched in June 2013, the M4DU Innovation Fund has awarded grants to 50 organisations in various sectors across four continents, reaching almost five million beneficiaries. Their clean cooking grantees are shown in Table 6.

GOVERNMENTAL INSTITUTIONS HAVE PLAYED A KEY ROLE IN SUPPORTING DIFFERENT FINANCIAL INITIATIVES, OFTEN USING INSTRUMENTS, SUCH AS RBF, OTHER UPFRONT GRANTS AND TA PROGRAMMES.

20. *https://www.usaid.gov/news-information/fact-sheets/usaid-announces-cutting-edge-innovations*

Table 6: M4DU Grantees in Clean Cooking Sector (Source: GSMA)[21]

Grantee	Year	Project
KopaGas	2015	Design low-cost meter for LPG Canisters
KopaGas	2018	Validate operational assumption to strengthen PAYG business model
SimGas	2018	Install and demonstrate remote monitoring and control through smart meter technology

Several Foundations have been active in the clean cooking sector, usually as part of a wider mandate, for example, with the Shell Foundation (see Section 5 below). The Osprey Foundation is a US-based private foundation established in 2003 which has given a special focus to clean cooking, alongside clean water, sanitation and hygiene. They support market-based approaches that advance the use of cleaner cookstoves in poor communities, particularly in SSA. Osprey supports research into customer cooking needs and behaviours and funds companies that make clean cooking products that are affordable, convenient, beneficial and

21.. *https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2019/03/Mobile-for-Development-Utilities-Annual-Report-2019-Intelligent-Utilities-for-All.pdf*

Photo: Adeolu Eletu/Unsplash

attractive to low-income customers.[22] Osprey is also the pioneer impact payment provider for the Cardano-managed Development Impact Bond (DIB).

Several impact funds have started to invest in the clean cooking sector. For example, Acumen is actively involved as set out in Section 6.2. Other funds are starting to look at the sector as part of a wider energy focus. One example is ENGIE Rassembleurs, which is the venture capital arm of ENGIE, a French multinational energy utility. It promotes access to sustainable and relevant energy solutions, including clean cooking through direct investments in private enterprises. It is a strong proponent of technology-enabled PAYGO solutions that improve the affordability of clean cooking solutions. ENGIE Rassembleurs' investee companies include: Sistema.bio, SmartGas and ATEC International.

4.7 MULTILATERAL DEVELOPMENT BANKS (MDBS) AND OTHER DEVELOPMENT FINANCE INSTITUTIONS (DFIS)

MDBs and other DFIs have tended to invest in the clean cooking sector through intermediaries, rather than making direct financings. For example, FMO manages the EUR 102 million Access to Energy Fund[23], which provides early and late-stage equity and loans in clean energy projects in SSA, including clean cooking. AfDB is arranging to be the anchor investor in the proposed Spark+ Africa Fund. One notable exception is The World Bank, which has launched the Clean Cooking RBF fund to support World Bank operations, rather than working through intermediaries.

It appears that most MDBs and other DFIs have tended to ignore the clean cooking sector in their mainstream operations, as ICS projects did not correspond to the larger investment profiles they normally target.

MDBs and DFIs play a highly significant role within the energy access sector as providers of financial resources, sources of technical support and assistance and as influencers on the direction of bilateral funds. The advent of modern energy cooking initiatives now offers a much greater opportunity for them to engage their clean energy and energy access programmes with major potential benefits for the sector.

There should be multiple opportunities for MDB and DFI engagement. A large MDB typically has various teams covering different areas that are potentially relevant to clean cooking. For example, MDBs might have separate teams working independently of each other covering such areas as mini-grid/SHS companies, the provision of finance to consumers (through their lines of credit), early-stage innovation through impact funds, large-scale public sector investment and individual grant funding programmes focused on specific objectives and sectors (e.g. the AfDB's Sustainable Energy Fund for Africa). These usually operate through separate departments and instruments. Typically, a large MDB might work through Public Sector teams (focusing on long term concessional loans to governments), Private Sector teams focusing on medium and long term non-concessional loans to private companies, lines of credit to financial institutions and often impact equity investment and separate grant units. Each of these different areas of activity provides particular opportunities to support clean cooking.

On the consumer funding side, it seems feasible that clean cooking could be accommodated under existing green energy lines of credit structures, as many MDB lines of credit cover both clean energy 'and its uses'. Typically, MDBs are keen to see their credit lines fully utilised. Thus, the new highly developmental opportunities associated with modern energy cooking should be attractive to them.

4.8 'TRADITIONAL' FUNDING SOLUTIONS

This section looks at the standard financial instruments used in the clean cooking sector, namely: upfront TA grants, equity and debt. As Figure 11 shows, most of the funds raised to date by the respondents came from grants and commercial equity.

22. See: *http://www.ospreyfdn.org/cookstoves https://static1.squarespace.com/static/573f7af62eeb81d00cc62fea/t/5cc09ebd53450af-47f3a34d6/1556127423164/Cleaner+Cooking+4.16.19.pdf*
23. *https://ndcpartnership.org/funding-and-initiatives-navigator/access-energy-fund*

4.9 GRANTS

Historically, most of the funding for the clean cooking sector came in the form of grants paid upfront and linked to agreed milestones. While some grant agreements require matching contributions from the beneficiary and contain clauses for full or partial reimbursement of the grant, if agreed milestones are not met, the risk of non-performance rests on the grantor. Due to this, some grantors have evolved their programme design to be an incentive results-based structure. There is a strong case for continuing upfront grant support to clean cooking companies for research and development, testing and pilots of new technologies and business models. These activities are high-risk, have uncertain outcomes and suffer because other sources of funding are generally not available.

4.10 EQUITY

Equity investment is one of the biggest funding challenges to the scale-up of the clean cooking sector. While debt typically comes in from the mid-stage of a company's development, when sufficient de-risking has already happened, companies still need equity to test different business approaches and carry out riskier activities before scale-up. Equity capital is also required to build the specialist human resource capacity of a business. The majority of the commercial capital that has come into the sector over the last five years has been equity. There are some signs that these investments may increase.

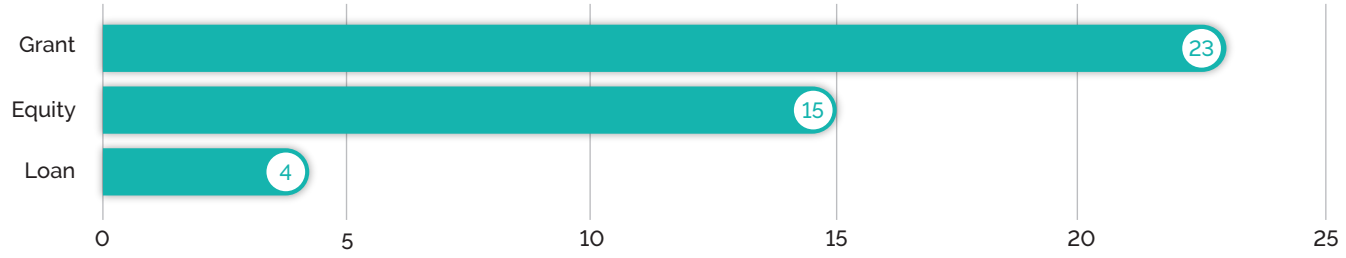
Most equity funds that have invested or are considering investing in clean cooking come from the energy access and PAYGO SHS sector. These investors see a parallel between the business models of clean cooking and PAYGO SHS. Both often involve the credit-based sale of hardware, which is remotely controlled and monitored by GSM technology, with payments collected through mobile money. They also often have similar target customers, distribution strategies and impact goals. The research suggests that some investment funds involved in energy access are actively considering entering the clean cooking market.

4.11 DEBT

Until recently, the majority of the capital going into the clean cooking sector has been in the form of grants and equity. Many clean cooking companies sell their stoves on credit and, hence, require debt to finance their inventory and the receivables linked to the sale of the stoves. Some growth companies that have managed to raise debt have done so despite having negative cash flows and a small asset base (a similar trend exists in the SHS market).

There have been relatively few debt transactions in the sector and very limited data on those transactions, reflecting the historic lack of product sophistication, profitability and maturity of companies in the sector. Most of the debt has come from foundations (e.g. Osprey Foundation), peer-to-peer lending platforms (e.g. Lendahand, Trine) and specialised off-grid lenders, such as SIMA. In many cases, the loans have been to PAYGO SHS companies that also sell stoves (e.g. Vitalite) or cooking companies that also sell PAYGO SHS (e.g. EcoZoom, ECS). In the case of the latter, the loans are usually sized off the sales of the SHS, rather than the stoves.[25] There have been some cases of loan defaults (e.g. New Light Africa, who sold LPG stoves, as well as SHS) and SimGas.

Figure 11: Type of Funding Raised to Date by Clean Cooking Companies (ranked by number of responses)[24]



24. Source: Energy 4 Impact companies' survey
25. SunFunder reported that they do not formally lend to cooking companies, but can lend to SHS companies that sell stoves

Photo: steward maswenenng/Unsplash

Photo: Jon Leary/MECS

There is a real shortage of clean cooking-focused debt providers. Encouragingly, Enabling Qapital, a Swiss impact asset manager, in collaboration with CCA, is planning to launch the Spark+ Africa Fund. This is a sector-focused fund that includes impact investors, such as DFIs and foundations, as well as commercial investors including pension funds, family offices and banks. Spark+ is a $50-70m fund investing $1-5m through debt and quasi-equity instruments, with a more limited ability to make equity investments. Spark+ will invest in companies across the clean cooking value chain, including off-grid solar companies, MFIs and others who play a role in access to clean cooking. The fund has an on-the-ground team, an investment strategy that fits the current maturity of the sector and a three-tranche blended capital structure that has mobilized highly commercial institutional investors, such as pension funds and private banks, to invest in the sector. Spark+ was designed to apply lessons learned from earlier efforts, including the Clean Cooking Working Capital Fund pilot in 2015 that was managed by Deutsche Bank's Global Social Finance Group. That fund had failed to scale up because Deutsche Bank made a strategic decision to prioritize more mature sectors.

In addition to fund-related efforts, some mid-stage growth companies have managed to close successful debt transactions, including KOKO Networks (with commercial banks), Sistema. bio (with Triodos, AlphaMundi and Lendahand) and African Clean Energy (with Oikocredit).

One problem that many clean cooking companies face is how to fund their receivables from fast-growing sales against their relatively small equity capital. Receivables have two very different profiles: those arising from trade receivables and those coming from carbon credits. Conventional strategies for dealing with this issue come from successive increases in capital to fund organic growth and support conventional debt funding with acceptable leverage for lenders. An obvious challenge to pursuing this approach is the availability of equity capital to support company balance sheet growth. A patient equity approach is frequently required in the case of tight profit margins and/or potentially challenging exit opportunities.

Opportunities to manage the capital adequacy challenge may arise from

more creative funding solutions, such as securitisation. Some interesting precedents have been established by SHS companies facing similar challenges using Special Purpose Vehicles (SPVs) to fund sales. Several clean cooking companies are considering this format as a way to solve the problem of rapid growth against a limited capital base, and some such transactions have been made. One interesting recent SPV structured funding transaction has been provided by bettervest to BURN. However, these structures are not straightforward to set up and operate, especially in an emerging market environment where, in most cases, they still require adequate equity protection for lenders. Despite these challenges, some significant progress is evident by several pioneering companies and funders.

Another future approach may arise from factoring solutions, whereby financing companies buy receivables directly from clean cooking companies. Suitable ongoing collection arrangements would be established through contracting with the cooking company.

The vast majority of clean cooking appliances are still sold today for cash and the amount of consumer credit available for clean cooking appliances remains relatively low. Most payment plans involve a small down payment, followed by monthly instalments over a period of 6 to 36 months.

One of the most promising new developments in clean cooking, with the potential to scale up the sector, is the emergence of automated PAYGO models. These are similar to those that transformed the off-grid solar market in the last five years. The PAYGO technology removes or reduces the upfront price barrier of the cooking kit by allowing end-users to pay a small or zero deposit, followed by affordable instalments over time.

Many of the more recently emerging leading clean cooking companies have developed PAYGO solutions. These cover a wide range of appliances, including EPCs, induction stoves, LPG cooking kits, biomass gasifiers, biodigesters and solar-biomass hybrid energy systems. PAYGO is most often used to describe off-grid energy provision as in SHS or, more recently, gas refills. Utility-led models (grid and mini-grid providers), of course, can recover a credit facility through their monthly utility bills and, in that sense, can also be characterised as PAYGO[26].

Most companies use their PAYGO model for end-users (the so-called business-to-consumer or B2C model). The PAYGO model typically includes many of the features below:

- The distributor rents or sells consumers a clean cooking kit.
- Payments can be made on a daily, weekly or monthly basis using mobile money, cash dispensing machines or other means.
- Customer payments are tracked. The cooking kit can be remotely enabled or disabled, if a customer tops up or falls behind on their payments. The distributor usually has the right to repossess a device, if a customer defaults on their payments.
- In some cases, the cooking device can be remotely managed and fuel or electricity usage can be tracked by smart meters. For modern fuel businesses, arrangements can be made to dispatch refills to customers before they run out.
- Some PAYGO providers do not use smart meters to track fuel usage because of their high cost. Instead, they use pre-existing metered PAYGO technologies.
- Customer service can be supported through the use of customer relationship management (CRM) software.

4.12 CROWDFUNDING AND P2P BUSINESS LENDING

The crowdfunding market for energy access companies has grown from $3.4 million in 2015 to approximately $50 million in 2019. Most of the growth has come from social-impact-oriented peer-to-peer (P2P) business lending platforms in Europe, including the UK and Japan. Some transactions have been done for clean cooking companies also, with a clear scope for growth in the future. Crowdfunding, as a potential funding source for clean cooking, is covered in more detail in another report in this series.

26. The challenge of having to cut someone off from their electricity because of non-payment of bills is a concern that is holding back some experimentation in this arena.

Photo: Jon Leary/MECS

Clean cooking organisations raised nearly $8 million through crowdfunding between January 2014 to September 2020. This compares to $159 million of energy access crowdfunding investments over the same period and a total investment of $153 million in clean cooking between 2017 and 2019[27].

Two of the most active crowdfunding platforms for clean cooking are Kiva (direct lending for early-stage companies and micro-lending through partners) and bettervest (debt for growth companies).

Most companies use P2P business lending platforms to raise working capital and finance accounts receivables. However, some, such as BURN Manufacturing, have borrowed for capital expenditure; in their case to purchase raw materials for stove production in Kenya. As clean cooking companies begin to sell stoves on a PAYGO basis, the quality of receivables will become an important component of the due diligence process.

Occasionally, crowdfunding loans have been used as a bridge to results-based grants (e.g., ECS Zambia) and the receipt of carbon credits (e.g., Greenway Appliances and BURN).[28]

4.13 RESULTS-BASED FINANCE

As mentioned in Section 3.2, clean cooking has long been recognized to have a significant positive impact potential for a range of the UN's Sustainable Development Goal (SDGs). Figure 12 illustrates the ten SDGs involved, while the five most relevant SDGs concerned are: SDG 1 (Poverty and Decent Work), SDG 3 (Health), SDG 5 (Gender Equality), SDG 7 (Affordable and Clean Energy) and SDG 13 (Climate Action). Most impact funders seek to measure the impact of their investments tracked against these SDGs.

Figure 12: SDGs for Clean Cooking[29]

Clean cooking is part of basic services necessary to lead healthy and productive life and saves house holds time and money.

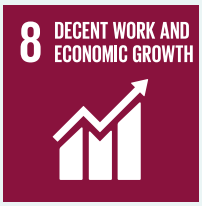
Efficient cookstoves reduce the amount of fuel needed to cook, thus reducing the burden on families who would otherwise have to collect it, buy it, or trade their food for it.

Reducing smoke emissions from cooking decreases the burden of disease associated with household air pollution and improves well-being. especially for women and children.

Children, particularly girls, are often kept out of school so that they can contribute to household tasks, like cooking and collecting fuel.

Unpaid work, including collecting fuel and cooking, remain a major cause of gender inequality.

Clean cooking is essential to addressing energy poverty and ensuring sustainable energy security for billions of people.



Energy access enables enhanced productivity and inclusive economic growth. The clean cooking sector offers many job opportunities.

Clean cooking addresses household and ambient air pollution, resource efficiency, and climate vulnerability.

Up to 25% of black carbon emissions come from burning solid fuels for household energy needs. Clean cook ing solutions address the most basic needs of the poor, while also delivering climate benefits.

Up to 34% of woodfuel harvested is unsustainable, contributing to forest degradation, deforestation, and climate change.

RBF mechanisms increasingly have become the instrument of choice for public financing interventions in clean cooking aimed at achieving SDG impacts. RBF mechanisms provide capital to private companies upon the delivery of pre-agreed results (e.g. sales of stoves), which are subject to independent verification. In this way, the risk of non-performance rests with the private sector.[30]

27. Source: 2021 Clean Cooking Industry Snapshot (Clean Cooking Alliance, March 2021)
28. For more details see: Energy 4 Impact and MECS (2021). Clean Cooking: Financing Appliances for End Users. Report 2 of the Financing Clean Cooking Series.
29. *Source: Clean Cooking Alliance*
30. The potential for RBF as a tool for scaling up clean cooking has been examined in more detail in another paper in this series, with only a summary of some of the most important issues set out in this section. See: MECS and Energy 4 Impact (2021). *Clean Cooking: Results-Based Financing as a Potential Scale-up Tool for the Sector.*

Photo: Josh Appel/Unsplash

There are six key elements in a typical clean cooking RBF:

1. The first are the targets. Historically, RBFs often had output targets based purely on the number of cooking appliances sold, but, more recently, the question for impact measurement and incentivisation has acquired more prominence.
2. The second is eligibility. This defines the technologies, geographies and type of companies qualified to receive RBF. In the past, RBF programmes often focused on ICS, while the most recent RBF programmes are technology-neutral or even explicitly support modern energy cooking solutions.
3. The third is the bidding mechanism. Previously, RBF programmes often have adopted a fixed incentive per stove of up to 50 per cent of the price of the stove. However, many programmes now require companies to bid through reverse auctions to reduce the subsidies per unit of output.
4. The fourth element of an RBF is the incentive itself. Most RBF programmes today use a tiered structure. This has higher incentives for modern cooking technologies, under-served regions, low-income groups and cooking as a productive use.
5. The fifth element is the RBF programme manager, which can be a public body or a social enterprise.
6. Finally, the monitoring, reporting and verification (MRV) process is a key element of RBF programming. It is critical for the success of a programme as companies, as well as programme managers, rely on timely data collection and processing that is tied to the disbursement of funds. There is increasing interest in using remote monitoring and mobile money payments to reduce costs.

There are particular challenges that make RBFs in the clean cooking sector more challenging than other energy access markets. These challenges include: a wider range of available cooking technologies, fuel types and business models; currently, limited scope to track usage and payment remotely; and, a greater need for bridge funding, due to the capital constraints of the companies given the nascency of the market, especially with regard to modern energy cooking in many countries. It is also worth highlighting that RBF incentives for electricity access programmes usually cover a much higher percentage of the lifetime cost of a SHS than a cookstove. This is because the running costs of a SHS are lower.

Historically, clean cooking often has been promoted distinct from electricity access initiatives. Many energy access funding interventions do not consider cooking in their planning and design, even though it can contribute to their impact targets. The same applies to investors and lenders who have chosen to focus on more scalable energy access markets, such as SHS, rather than clean cooking. Things are starting to change. Some RBF donor programmes, e.g., KOSAP (Kenya) and BRILHO (Mozambique), include significant targets for clean cooking. Endev has focussed its RBF on improved cookstoves in the past, but now is diversifying into e-cooking and other modern cooking solutions.

4.14 CARBON CREDITS

Carbon credits have been an important source of funding to clean cooking companies, despite some exceptional volatility in their prices over the years. In the past two years, carbon credit prices for clean cooking projects have risen from around $3-4 per tonne CO2e certified emission reduction to around $6-9 per tonne today. Some parties expect the price could rise further. These levels are very attractive to clean cooking companies as they can demonstrate emission reductions of around 3-5 tonnes CO2e per annum by shifting to a higher-tier cooking technology.[31]

31. See: *https://www.mdpi.com/1996-1073/14/15/4559/htm*

Photo: Circle Gas

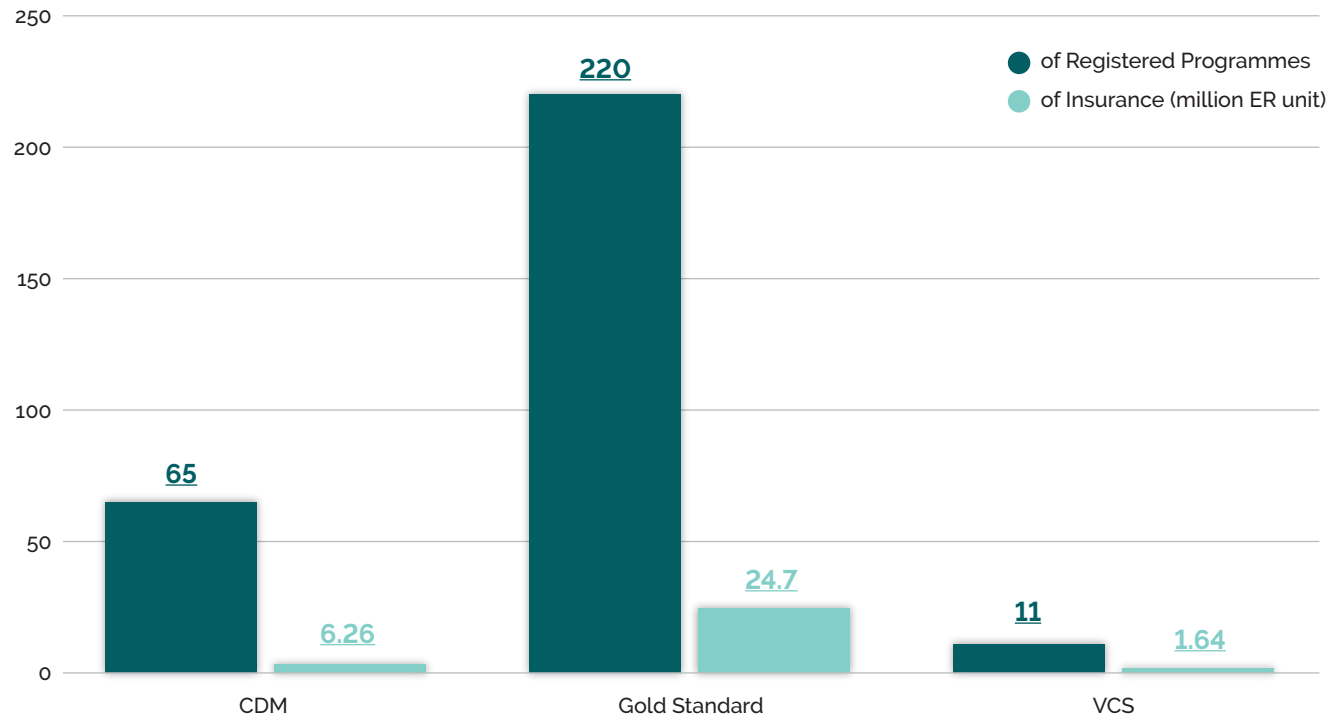
The 2015 Paris Agreement established the principles for a new approach to replace the Clean Development Mechanism (CDM) regime of the Kyoto Protocol. The Paris Rulebook is still being drawn up. A key part will be the rules to cover the International Transfer of Mitigation Outcomes between countries. Therefore, Compliance Carbon markets are presently in transition until the Paris Agreement mechanisms become operational.

In contrast to the standstill in the main Compliance Market, the Voluntary Carbon markets have been active with stronger prices being achieved in recent months. Gold Standard (GS) and Verified Carbon Standard (VCS) are the main other certification agencies that have issued offsets for clean and efficient cooking projects.

Currently, there is no market for trading emission reduction credits, almost all sales are done 'over the counter' on a bilateral basis resulting in a wide range of prices. The price depends on the type of underlying project and, in particular, its other associated SDG impacts, the standard used, the location, the age of the credit and the volume being purchased, amongst other factors.

Figure 13 shows the number and volume of clean cooking programmes and projects registered or certified under each platform as of 1st December 2019. At this date, 220 cookstove projects had been certified under the GS. This accounted for 29 per cent of total registered GS projects and 24.7 million Verified Emission Reductions (VERs) had been issued for these projects. A total of 65 cookstove programmes had been registered under the CDM. These were 20 per cent of their total and achieved issuance totalling 6.26 million Certified Emission Reductions (CERs). Eleven cookstove projects were registered under the Verified Carbon Standard (VCS) for which 1.64 million Verified Carbon Units (VCUs) were issued.

Figure 13: Cookstove Programme Volumes by Registry[32]



32. Source World Bank /Ci-Dev: *https://ci-dev.org/sites/cidev/files/2020-11/CI-DEV_FRACTION%20OF%20NONRENEWABLE%20BIOMASS_R2.pdf*
33. An Emissions Reduction Purchase Agreement is a form of agreement used between the buyer and seller of carbon credits

One reason for the popularity of the GS VERs is believed to be its well-developed methodologies for certifying other non-carbon SDG impacts. This allows higher prices to be achieved for offsets.

To date, nearly all these transactions were based on improved cookstove solutions, rather than emerging ('fuel switch') business models. They have usually led to households moving from three stone/open-fire wood stoves to improved cookstoves. This obviously simply reflected the technology available at the time.

Carbon Credit schemes clearly offer very good opportunities for grant funding for clean cooking companies, due to the large emission savings associated with eliminating biomass cooking. In October 2021, GS made public a revised methodology for calculating emission reductions for electric and other renewable energy-related metered clean cooking appliances. The previous certification procedures were complex, less statistically reliable and presented a barrier to entry, particularly for smaller players. It is hoped that the new approach will allow for a more efficient process for calculating emission reductions and, thus, achieve cost savings, especially for monitoring /reporting/ verification (MRV).

With new clean cooking business models and technologies emerging, carbon credit programmes should focus increasingly on modern energy cooking providers with a reliable and technology-enabled means to measure, monitor and demonstrate the continued usage of the stove – thereby, confirming the 'fuel switch'. It will be beneficial also for NGOs and humanitarian organisations that will be required to meet more challenging environments.

Much pioneering work has been done in the field of carbon credits by The Carbon Initiative for Development (Ci-Dev). This is a World Bank trust fund that provides performance-based payments to clean energy enterprises after the verification of results is achieved in the form of Certified Emission Reductions (CERs). Ci-Dev finances between $3-15 million per company through Emission Reduction Purchase Agreements or ERPAs.[33] These agreements provide for the delivery of CERs at pre-agreed prices over a period of five to seven years.

Photo: Scott Evans/unsplash

Another pioneering group is BIX (Base of the Pyramid Impact Exchange). This is an innovative investment vehicle cmanaged by the Cardano Development group, with support from Shell Foundation. BIX provides medium-term working capital loans to clean cooking companies linked to carbon credits arising from sales of stoves to BoP households in SSA. Formed in 2013, BIX currently has funds under management from strategic investors, such as FMO, a European family office, IFC, the Shell Foundation and Calvert Investments. BIX has provided loans to SimGas (Kenya) and BioLite (Uganda and Kenya) and C-Quest Capital (Nigeria, Zambia and Malawi).

Carbon credits have had a problematic past with extreme price volatility and uncertainty over the reliability of the methodologies and processes. However, the recent strength in the markets is widely expected to continue, based on the high priorities associated with climate change. As a result, carbon credits have the potential to transform the clean cooking sector by improving company profitability, by subsidising the price of the cookstove hardware and making clean cooking affordable to millions of households.

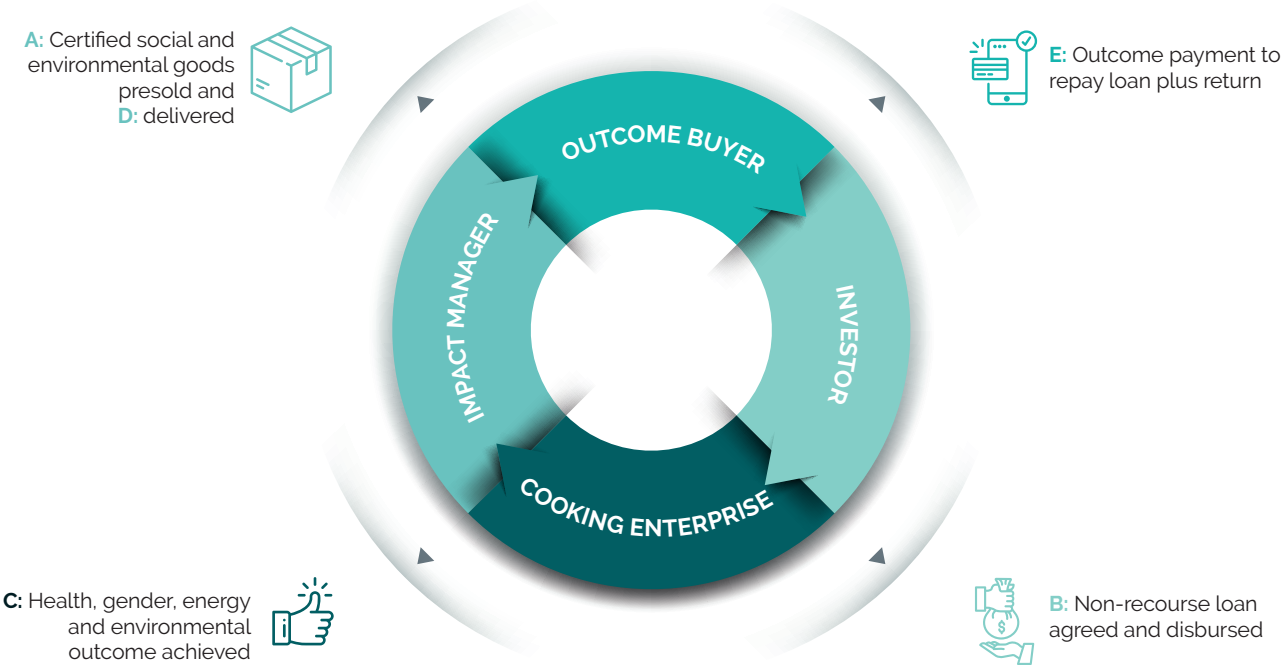
4.15 DEVELOPMENT IMPACT BONDS

Development Impact Bonds (DIB), outcome funds or outcome purchase programmes are an innovative solution to channelling donor funding to projects for verified SDG outcomes.

A pioneering pilot transaction in the clean cooking sector has been the Clean DIB managed by Cardano Development/ Frontier Capital that closed the bridge funding for its first transaction in 2021. Figure 14 shows how this DIB works in more detail.

The Impact Bond manager (Cardano) arranges to certify the impact of a project on particular SDGs of interest to donors, such as health (SDG 3), gender (SDG 5), clean energy (SDG 7), decent work (SDG 8) and the climate (SDG 13) through, for example, the Gold Standard certification process. As for other GS certifications, all gathered and monitored data is verified by an independent accredited auditor before the Gold Standard Certified SDG Impacts are issued.

Figure 14: The Clean DIB[34]



34. Source: Cardano Development

Photo: Kyle Glenn/Unsplash

In the case of the Cardano pilot, the measurement, certification and sale of the health and gender impacts were a first of its kind globally. The health impacts are expressed in Avoided Disability Adjusted Life Years (ADALYs) – a measure of the number of years that would have been lost due to ill-health, disability or early death, due to the inhalation of indoor pollution from cooking on open fires. These ADALYs are assigned serial numbers on the Gold Standard Registry. For gender, the DIB used Gold Standard certified SDG 5 Impact Statements that quantify the number of quality hours (QH) added to women's time – the time spent on productive activities, education or leisure, instead of the time spent gathering wood and tending to open fire. Price setting for these impacts was done based on the best available sources and in close consultation with the impact buyer.

To develop the model, Cardano undertook a pilot that secured a USD 0.5 million off-take contract for health and gender impacts. The cooking enterprise for the DIB pilot was the Kenyan operations of Sistema.bio (a company that sells prefabricated biodigesters producing biogas that can be used for cooking with a fertilizer by-product). The impact buyer was Osprey Foundation, with the loan being provided by BIX Capital. The impact certification programme was managed by Cardano Development and South Pole. The instrument has been supported by IFC, Shell Foundation and MECS. Health data was gathered by Berkeley Air Monitoring Group. Baker McKenzie was the legal counsel (acting pro bono).

The loan and grant funding will allow the company to scale up in a flexible way and sell more stoves to new customers to generate the projected health and gender benefits (the outcomes). The pilot will track and report on the impacts to demonstrate the viability of this form of results-based finance. Following significant progress during the pilot stage, plans are being made to scale up the initiative.

DIBs can potentially monetise clean cooking externalities, such as improved health, gender impacts, livelihood and environmental benefits and so could provide an additional revenue source for companies and other project managers. Although DIBs are still at a very early stage, they represent a promising alternative approach to channelling grant funding into clean cooking projects.

4.16 BARRIERS TO FUNDING AND SCALE-UP – THE COMPANIES' VIEW

Returning to our questionnaire survey, the main barrier to the scale-up of clean cooking was identified as customer affordability, with three out of four respondents to the companies' survey highlighting this as an issue. Other barriers highlighted by the respondents included: access to finance, both at the corporate and end-user level, (raised by 28 of the 40 respondents), lack of public funding (24 respondents) and lack of viable business models (20 respondents), as Figure 15 below illustrates.

Affordability covers both the ability and willingness to pay. Many potential customers are unable to afford the upfront cost of a stove and fuel cylinder (if relevant), as well as the ongoing cost of fuel or electricity. As a result, most cooking companies avoid targeting the very poorest customers.

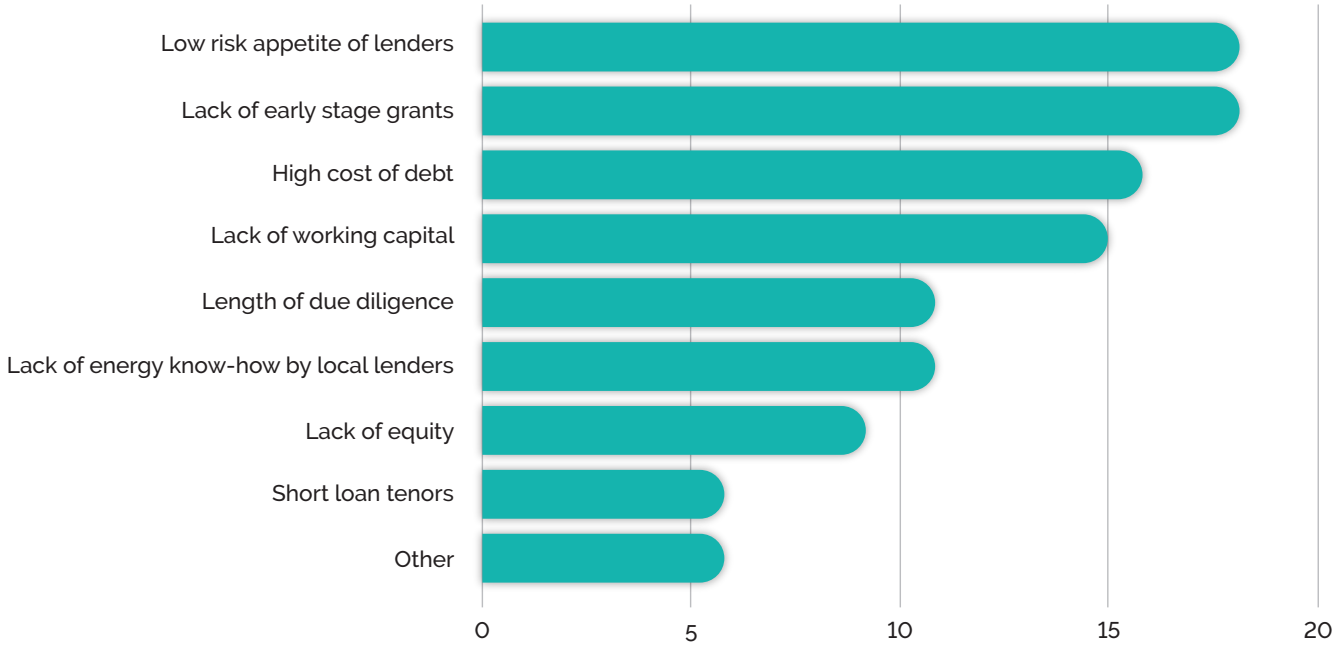
Customers are likely to be more willing to pay for stoves if they see value in the clean cooking solution when compared to traditional cooking methods. This partly depends on the user experience and willingness to change traditional behaviours, e.g., whether they are prepared to change how they cook, whether the cooking experience is easier, and how the cooked food tastes. It also depends on the aspirational goals of customers. Meanwhile, clean cooking companies are running marketing strategies to raise awareness of the benefits of clean cooking. Many clean cooking companies focus on urban and peri-urban markets where modern cooking solutions can be competitive with charcoal and kerosene alternatives.

Figure 15: Barriers to the Scale-up of Clean Cooking in Developing Countries (ranked by number of responses)[35]

35. Source: Energy 4 Impact Research

As discussed earlier in this report, fundraising is a major challenge for clean cooking companies. However, no single issue on fundraising was raised by more than half of the survey respondents. Many companies complained about what they saw as the low-risk appetite of lenders and the high cost of debt, plus the general lack of early-stage grants and working capital, as illustrated in Figure 16. These issues are hardly surprising, given the scarcity of proven and scalable business models and the weak financial position of many companies in the sector. Some companies claimed they were turned down by investors because they were not of sufficient scale and were not present in enough countries. Several companies complained about the problems of under-capitalisation, which meant they could not raise debt and so had to go through a lengthy equity raise instead. The complexity and length of financial procedures are also a concern.

Figure 16: Barriers to Clean Cooking Fundraising in Developing Countries (ranked by number of responses)[36]



4.17 BARRIERS TO FUNDING AND SCALE-UP – THE FUNDERS' VIEW

Overview

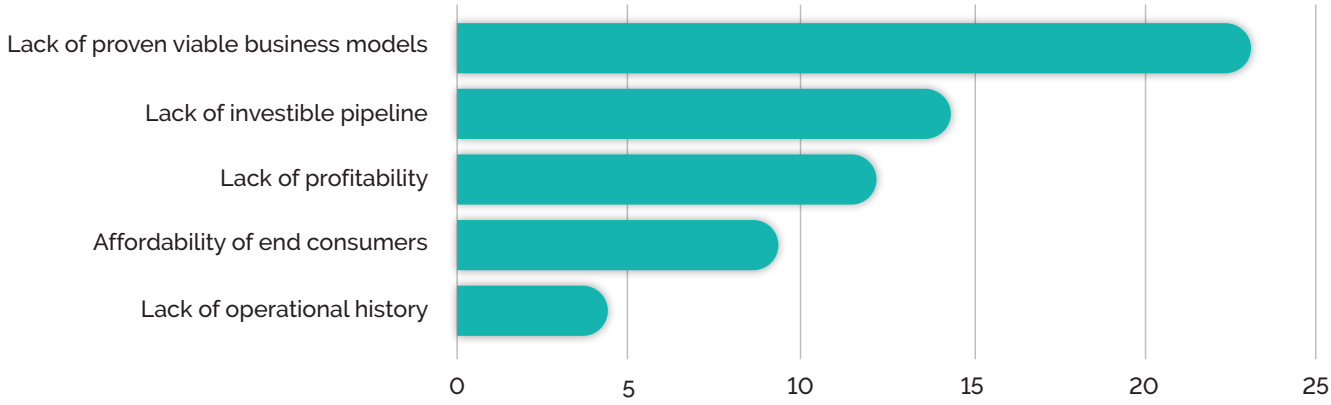
The four main barriers to the scale-up of the clean cooking sector, according to our funders' survey, are as follows:

1. Lack of viable business models
2. Lack of investible pipeline
3. Lack of profitability
4. Customer affordability and willingness to pay

36. Source: Energy 4 Impact Research

These are shown in Figure 17 and described in more detail below:

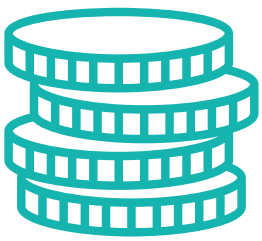
Figure 17: Main Investment Barriers for Funders (ranked by number of responses)[37]



Lack of Viable Business Models

Four out of five of the capital providers who participated in the survey identified a lack of viable and proven business models as one of the top three factors hindering investments in the clean cooking sector. There may be three main reasons for this:

1. Almost no improved cookstove company that has scaled and sold thousands of stoves has built a successful and profitable business. This is due to the low price point of the products, the limited improvements in the incumbent's cooking experience and a failure to build an aspirational cooking solution to stimulate demand. Many investors still look at the sector through this lens. Even those interested in the 'tool & fuel' model or the 'fuel and tool' model require more evidence on the business viability of modern cooking solutions.
2. Second, investors require evidence that the unit economics are positive and the business model is on the path towards profitability. However, most clean cooking companies cannot demonstrate this because their 'tool and fuel' business model is tied to the number of customers paying for fuel and most companies have less than 5,000 active customers.
3. Third, many companies are still striving to identify the right combination of fuel technology (LPG, ethanol, biomass), payment methods (mobile money, cash, in-kind), distribution model (company-owned shops, resellers, agents), target customer segment (low-income, middle-income), target geography (urban, peri-urban, rural), payment plans for stoves (12-36 months) and partnerships (in-house fuel production, imports).



AFFORDABILITY WAS LISTED AS THE NUMBER ONE BARRIER TO THE GROWTH OF THE SECTOR BY CLEAN COOKING COMPANIES.

Lack of Investible Pipeline

Investors are generally more willing to devote time and resources to new sectors when they know there is an investible pipeline. The due diligence process for corporate investments can take six to nine months (for equity) and two to four months (for debt), so the costs involved are not insignificant. Investors prefer that the learning curve for a new sector can be spread across several potential

37. Source: Energy 4 Impact Research

investments, rather than relying on a single transaction that might not proceed.

An investible pipeline is one where there are a large number of high-quality companies seeking capital are on a path towards profitability and are not financially over-leveraged. Unlike the PAYGO Solar sector (which has at least 50 organised companies, big and small, with relatively proven business models spread across Africa, Asia and the Americas), the clean cooking sector to date is highly concentrated in a handful of players in each fuel technology and market. Currently, there are perhaps about 10-20 companies that could be considered investible and scalable and many of these are focused on just one core market today.

Lack of Profitability
Very few clean cooking companies operating in developing countries have reached sufficient scale to be financially sustainable; although more may have positive unit economics and be on the way to profitability. There is little public data on the financial performance of these privately-owned cooking companies, except for some management accounts published in conjunction with crowdfunding campaigns.

The 'tool & fuel' business models appear to be promising, but they still face significant challenges. These businesses typically sell stoves to customers on credit (say over 12-36 months), while the fuel is pre-paid (either monthly or on-demand) and are linked to a long-term contract (e.g., three years or longer). The companies look to make their margin on the sale of fuel. This is more complex than simply selling appliances.

Affordability
Affordability was listed as the number one barrier to the growth of the sector by clean cooking companies. It was also highlighted as a major issue by funders.

Lack of Data and Standardised KPIs and Impact Metrics
Another major barrier to the growth of investment in the sector is the lack of market, enterprise and consumer level data, as well as standardised KPIs and impact metrics for evaluating companies. This is discussed in detail in Section 8.

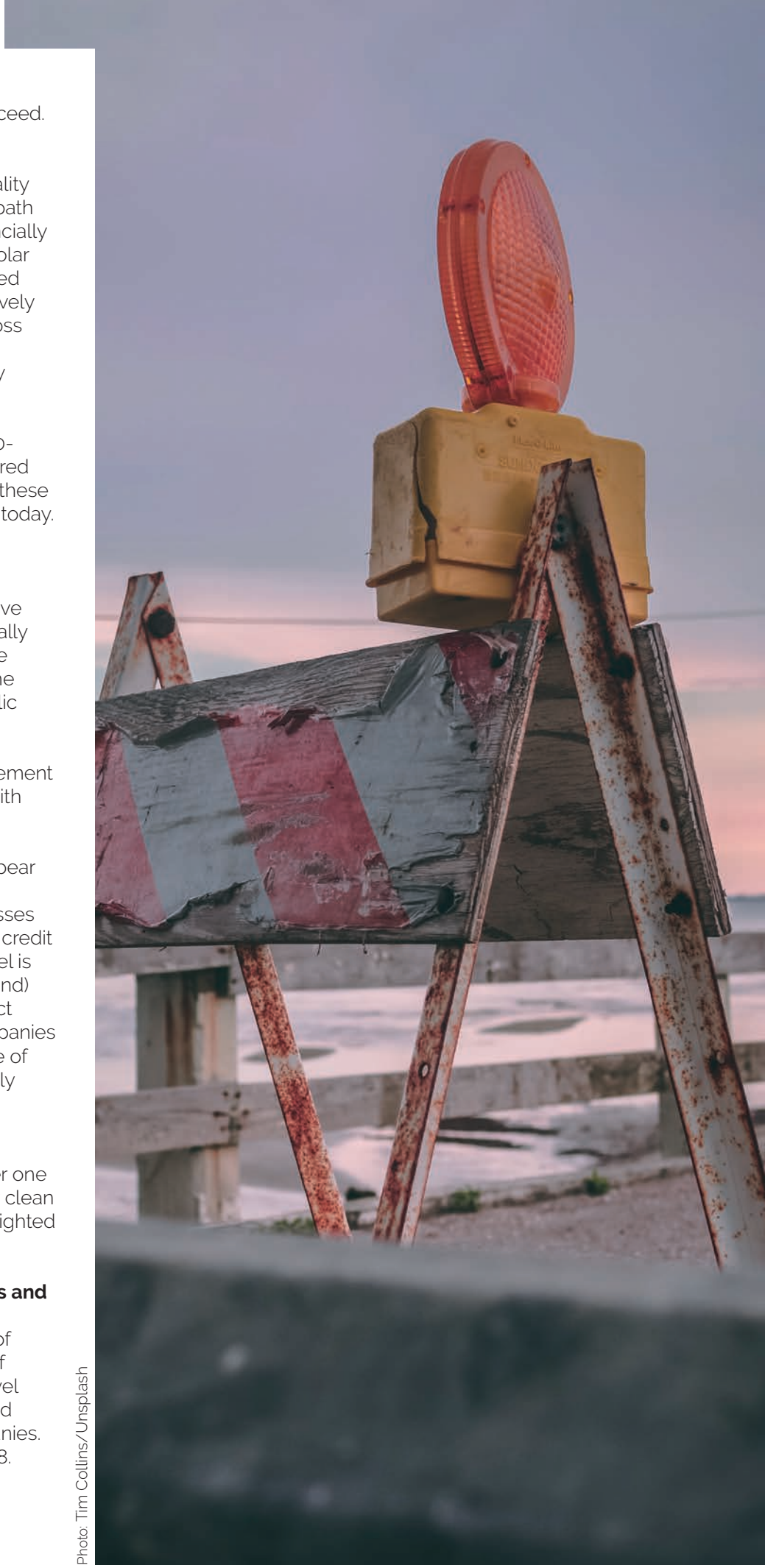


Photo: Tim Collins/Unsplash

5. PROFILES OF COMPANIES

This section presents profiles of five selected clean cooking businesses that have started to scale. The profiles show how the movement towards modern energy appliances is advancing and how some companies are developing much greater levels of technical sophistication, compared to the traditional lower-tier ICS models. To illustrate this trend, several pioneering groups that use different fuel sources and business models have been profiled. These include: Circle Gas (LPG), Koko Networks (Ethanol), BURN Manufacturing (Electric-EPCs, LPG, ICS), Emerging Cooking Solutions (biomass gasification) and ATEC International (Biodigesters and Electric Induction).

5.1 CIRCLE GAS – PROMOTING ACCESS TO CLEAN ENERGY

Circle Gas aims to transform the lives of low-income households in Kenya and Tanzania that use harmful and polluting charcoal and paraffin for their daily cooking needs by providing access to clean and affordable LPG.

In January 2020, Circle Gas acquired from Kopagas its KopaTech proprietary LPG SmartMeter technology and advanced manufacturing capabilities in China in a transaction worth $25 million. The Kopatech developed smart meter is central to the service now offered by Circle Gas companies. The meter controls the release of gas to customers until their balance, which is tracked digitally, runs out. It can be topped up using electronic payments and the meter also reports gas consumption back to Circle Gas, which is then used to support billing and the scheduling of delivery of replacement cylinders.

KopaTech itself was founded in 2014 with grants from donors, including GSMA, DFID and MIT D-Lab. These grants were critical for developing and piloting the technology. KopaTech's other early investors included: Acumen, Saisan, Hooge Raedt Social Venture and D-Prize. Circle Gas is in the process of completing the acquisition of KopaGas itself, which had over 5,000 customers in Dar es Salaam as of August 2021.

With the acquisition of Kopatech technology, Circle Gas was able to expand the operations of its Kenyan subsidiary, M-Gas. M-Gas launched its Kenyan PAYGO in January 2020 with a pilot in Mukuru-Kwa-Njenga, Nairobi. This offered the developing world's first truly pay-as-you-go LPG solution at scale. As of the end of August 2021, M-Gas was serving over 70,000 households across Nairobi and increasing its rate of expansion.

M-Gas provides a complete cooking solution consisting of a two-burner gas cooker and a 13kg LPG cylinder fitted with a high-tech SmartMeter in a customer's home. There is no upfront fee and customers pay for the gas on a need basis through the M-PESA mobile payment system. This starts from as little as KShs.1, which is 'transferred' to the SmartMeter via Safaricom's Narrowband 'Internet-of-Things' technology.

Circle Gas' investors now notably include the Kenyan telecom operator Safaricom. M-Gas also has a wide-reaching strategic operating agreement with Safaricom to support and accelerate the growth of its business in Kenya.

Circle Gas has made it easier for customers to track their gas usage, thereby allowing them to manage the use of their cooking fuel more effectively. The technology also ensures that customers do not run out of gas. These attributes have helped make Circle Gas and its subsidiaries the largest PAYGO clean cooking business in East Africa.

The company places a strong emphasis on its role in promoting UN Sustainable Development Goals, especially for energy access, poverty reduction, health, gender and the climate.

5.2 KOKO NETWORKS – FAST GROWING BIOETHANOL FUEL AND HARDWARE GROUP

KOKO Networks is a venture-backed technology company operating in East Africa and India. They deliver liquid bioethanol cooking fuel in partnership with the local downstream fuels industry to cover a range of distribution, dispensing and end-use appliance technologies. The company chose a liquid fuel because of the infrastructure cost advantages

compared to alternatives, coupled with the existence of dedicated distribution and storage infrastructure at scale in challenging markets. Bioethanol became the fuel of choice, mainly because the company believes that it offers significant quality of life improvements to users (e.g. clean burning nature, low emissions and ease of use). KOKO's pioneering innovations have allowed it to distribute this fuel competitively compared with less clean alternatives.

KOKO has developed a unique and scalable fuel delivery model that has focused initially on Nairobi. KOKO retails liquid bioethanol through 700 fuel ATMs, or 'KOKO Points'. These are located inside corner stores within a short walking distance of target households. Customers draw the fuel into reusable KOKO-branded fuel bottles and, once at home, they connect the bottles to a KOKO-designed twin-hob stove that has an airlock to prevent spillage and recover vapour. The KOKO Points are refilled by a fleet of 'smart micro-tankers'. These are, essentially, IoT-enabled small fuel trucks operated through a partnership with Vivo Energy, the London-listed fuel company that owns and operates a Shell-branded fuels distribution infrastructure across Africa. These vehicles are designed for narrow, potholed city streets. Once refilled at selected Shell-branded petrol stations, they carry out last-mile fuel distribution close to the consumer.

Underpinning KOKO's clean fuel network is a software platform that enables the company to dispatch drivers and track fuel levels across the city in real-time. All the fuel ATMs are cloud-connected and customers simply need to top up their KOKO accounts with mobile money before any fuel is dispensed. The system fits with the 'small and often' spending pattern of most Kenyan households.

KOKO decided to launch in Nairobi for several reasons. First, the level of disposable income is higher than many other African cities. Bioethanol can compete with alternative fuels, due to a

Photo: Koko Networks

reasonable amount of locally produced fuel and the presence of a major international port (Mombasa). Secondly, the Kenyan government was willing to implement the policy changes necessary to authorise ethanol as a cooking fuel and write the necessary standards. Thirdly, there was an abundance of technology and engineering talent necessary to build a team to go through multi-year research and development cycles. Finally, Kenyan consumers were known to be open to trying out new technologies, as evidenced by their rapid adoption of mobile phones and the success of Safaricom's M-PESA mobile payment system.

The success of KOKO's business model depends on two critical elements. First, they leverage the existing liquid fuel distribution infrastructure of a fuel major, enabling their supply partners to add a profitable new line of business to their downstream infrastructure. At the same time, KOKO concentrates its efforts on the logistical challenge of the safe and efficient last-mile distribution of bioethanol, while managing shopkeeper and customer relationships. By removing the need for centralised bottling and single-use plastic bottles, KOKO believes that its technology-enabled distribution model is cheaper than traditional bottling approaches to bioethanol cooking. Second, proximity to the customer is critical for the new fuel to be competitive against conveniently available market incumbents (kerosene and charcoal). By focusing on affordability, accessibility and convenience, KOKO claims it can retail its fuel in Nairobi at a significant discount to the cost of charcoal.

The partnership with Vivo Energy Kenya ensures reliable supply. This is in line with international safety standards, while KOKO mass manufactures its next-generation cookstoves at a wholly-owned factory in India. The cost efficiencies of this, combined with the use of carbon finance to provide material customer discounts, means the KOKO Cooker is currently sold

Photo: KOKO networks

at less than $20 in Nairobi, with plans to expand country-wide from later this year.

KOKO also offers an attractive layaway scheme, whereby customers pay only a small deposit upfront and continue making small payments flexibly towards the cost of the cooker. Apart from the deposit, there is no minimum payment amount or time limit for making the payments. Customers collect their KOKO cooker kits on completion of payment, with no interest fees charged, regardless of whether they buy either outright or through instalments. This removes the need for KOKO to offer consumer credit.

KOKO is exploring new lines of business outside clean cooking. This includes: digital retail, financial services, media content and connectivity. For example, KOKO Point screens could open up an appealing new advertising channel for brands seeking to reach mass-market consumers and, just as customers buy the KOKO's cookstove via a KOKO Point, consumers in the future could use the same system to acquire products from other brands delivered by the company to the agent shop. KOKO believes this model of e-commerce encourages online retailers to make use of existing and trusted local shops and, thus, is well-suited to emerging markets.

KOKO's funding model is very different to other cooking companies. It has not relied on public funding, concessional capital or funding from impact investors. Over the last five years, KOKO has raised privately tens of millions of dollars in more commercial capital, primarily from family offices, high net worth individuals and venture capital firms.

5.3 BURN MANUFACTURING – LEADING THE MOVE TO EPCS

BURN Manufacturing was established in 2011 following a decision to set up a manufacturing facility for clean cookstoves in Nairobi. BURN was able to overcome several challenges to create a state-of-the-art manufacturing facility with investment and other support from General Electric, Acumen Fund, United States Overseas Private Investment Corporation (OPIC), the Global Alliance for Clean Cookstoves and The Energy and Environment Partnership Programme (EEP).

BURN Manufacturing has grown to be the largest manufacturer of clean cookstoves in East Africa and one of the largest in the World. It has developed a wide range of improved and modern energy cookstoves for both household and institutional uses under its Jikokoa and other brands. With its local operations, BURN was able to get rapid feedback from customers, quickly re-design its products and create new generations of increasingly sophisticated products.

Although improved cookstoves represent by far the largest part of BURN's current operations, it intends to shift its focus heavily towards modern energy appliances going forward. To this end, BURN has recently developed an electric pressure cooker (EPC) and a Liquefied Petroleum Gas (LPG) stove, as well as a range of hybrid electric biomass stoves that burn agricultural waste to add to its product range.

BURN's new trademarked ECOA EPC is customized to be especially suited for Kenyan and other African households. It has several smart features, including smart metering to track usage and related cost to consumers, as well as devices to remotely lock and unlock the appliance in a similar way to most SHS systems. The appliance comes together with helpful advice and support, including different recipes.

The company estimates that its EPC is a revolutionary new electric cooking technology that can deliver a very large cost reduction compared to charcoal for cooking traditional foods, while reducing cooking time by up to 50 per cent. Their EPCs cook food in a sealed pressure vessel, heated electrically and controlled through automatic sensors. This cooks food faster, due to the high pressure, and is very energy efficient, as heat loss is reduced during cooking. EPCs can be used to cook a wide range of dishes, due to their ability to steam, shallow fry, boil and bake. They are particularly efficient for many local African dishes that require a long-time simmering.

BURN also has introduced a double burner LPG household stove into its product range. It aims to provide a high quality locally produced product at a lower price than current imported models. BURN believes there is strong demand from PAYGO companies in the LPG sector for such a locally produced LPG stove.

The company has experienced consistently strong unit sales growth in recent years and is projecting annual sales of around 300,000 improved cookstoves in 2021. BURN sells products into a range of African countries with Kenya and the Horn of Africa being its current core focus. However, BURN has ambitious growth plans to convert several SSA countries where it already sells products into core countries of operation. From here it aims to spread sales into new SSA countries, so becoming the largest cooking appliance company on the African continent. Burn has worked with a wide range of distributors who are typically able to offer user-friendly arrangements, which may assist its expansion plans.

BURN's high investment levels and development costs unsurprisingly resulted in poor levels of profitability until quite recently. However, BURN has been net income, EBITDA and equity positive since 2018. Recent results have shown further improvement, even with a strong continuing investment programme. BURN is expected to benefit significantly from its extensive and active use of carbon credits based on the recent increases in carbon credit prices.

BURN has received a range of technical assistance and other grants from donors over the years. These have supported its growth, including its move into modern energy cooking. It has also attracted longer-term support from anchor investors, such as Acumen.

5.4 EMERGING COOKING SOLUTIONS – LEADING BIOMASS GASIFICATION STOVE USE

Emerging Cooking Solutions is a private company headquartered in Sweden, with operations in Zambia, Malawi and Mozambique. From its inception in 2012, Emerging Cooking Solutions (ECS) has focused on a switch to modern energy cooking, rather than relying only on improved cooking devices using the same fuel as before.

SupaMoto, the Zambian operation of ECS has around 80 staff and over 150 sales agents. It has been running a pellet manufacturing factory in the Copperbelt Province since 2013. This was upgraded recently to 15,000 tonnes per year capacity. It has sold pellets to around 15,000 household and distributed 100 institutional stoves (of which the majority are advanced stoves), as well as about 20,000 Pay-As-You-Go (PAYGO) Solar Home Systems.

The business model of ECS is to provide higher-quality products with a three-year warranty, allowing customers to move beyond low-tier cooking technologies. The company applies a 'Tool & Fuel' business model. By spreading the cost of the capital item over long payment periods and by selling the fuel significantly below the cost of charcoal, it believes its customers in Zambia are realising large savings on cooking costs, compared to traditional charcoal cookstoves.

Their customer feedback loop is built on years of selling both stoves and fuel. This has given the company a strong, field-based understanding of people's cooking, as well as their financing needs. From this, ECS, several years ago, drew certain conclusions:

1. PAYGO, with the ability to turn off the stove if not paid for, could be highly transformative in the clean cooking sector, as it has been for the off-grid solar sector.
2. The carbon market for clean cooking has several main shortcomings: low price, high setup costs, high brokerage fees and, for most companies, a long delay before payment. ECS believes that this can be resolved by incorporating 'hard' and real-time carbon offset data, so making carbon credits transformative to the sector.
3. Stove stacking (the use of other cooking devices) could be reduced or even eliminated through further improvements to the pellet stove performance. This would lead to additional pellet sales – ECS's higher-margin consumable. More specifically, ECS saw the need for a clean stove with both a larger heat range and a long maximum burning time of 2.5 hours to allow time-consuming meals to be cooked without the disruption of having to reload the fuel.

Building on this, ECS has now developed a proprietary IoT (Internet of Things) enabled technology platform. This has already been launched as a pilot with 800 stoves connected to the internet through a SIM card. ECS products now include:

- A new, completely redesigned generation of advanced biomass stoves ("4th Generation"), using sensors

and software control and innovative ceramic-based, low-cost material for the burning chamber, developed together with partners Zemission, Zenit Design and Sigma in Sweden. Based on recent test results at an ISO certified lab, the current version of the stove achieved 54% Thermal Efficiency, 3 hours extended water boiling test on one load of pellets, large turn-down ratio (low to high heat) and Tier-5 level emissions on 3 out of 4 measurements (a close Tier-5 on the last).

- GSM-based connection to the internet for the stoves, enabling PAYGO to be used. The integration with a Solaris/ PaygOps loan management platform for this purpose is up and running.
- Usage data sent back to ECS's server. This has enabled the development of "hard data" based carbon credits, based on Gold Standard's new "methodology for metered devices" where the actual fuel sales data (together with usage data) forms the basis of the Emission Reduction Claims, rather than random samples and self-reported data. The goal is to achieve more accurate and transparent claims, a higher price per unit, lower overhead costs and the shortening of the cashflow cycle of carbon credits from the current 1.5-2 years to a much more immediate credit.

Photo: EEP S&EA

ECS has been funded by a mixture of loans and grants from SIMA, Lendahand, Atradius, Trine, Beyond the Grid Fund, SIDA, EEP Africa, Nordic Climate Facility, USAid, UKaid, Clean Cooking Alliance and others, as well as by private equity.

ECS is working closely with most of the other advanced biomass cooking companies to set up a common platform to lower the threshold of entry for hard data-based carbon revenue for the sector. ECS is currently working on packaging its comprehensive combination of hardware, software, financing and carbon credits to different distributors as well. The aim is that access to these new technologies and tools can accelerate the uptake of advanced biomass cooking, with the objective of eventually making pellets a significant baseload fuel in fulfilling SDG 7.

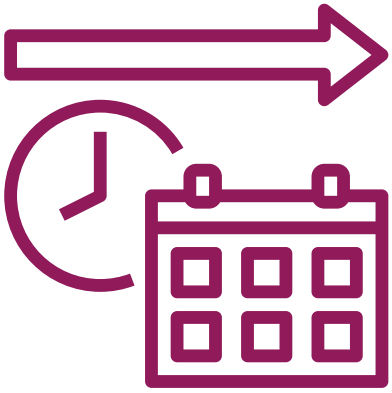
5.5 ATEC INTERNATIONAL – EXPANDING FROM BIODIGESTERS INTO INDUCTION ELECTRIC

ATEC International is a vertically-integrated social enterprise that manufactures, distributes and finances modern cooking solutions for BoP households in Cambodia and Bangladesh. Apart from these countries, ATEC has been conducting trials in five other countries. Their Biodigesters and eCook products are seen by customers as long-term, aspirational purchases, making them ideal for PAYGO sales.

ATEC originally started with scalable 'plug-and-play' biodigesters in Cambodia. In 2019, ATEC integrated PAYGO functionality into their biodigesters through a collaboration with Angaza, a PAYGO technology company. ATEC had previously sold the biodigesters for cash or through third party financing channels. The introduction of PAYGO led to a doubling in lead conversion rates and a significant increase in monthly sales volumes. Under the PAYGO scheme, customers who cannot afford the upfront cost of the biodigester can pay through monthly instalments. These are set so they can be paid for out from savings made by the customer from reduced purchases of gas and fertiliser sales.

Seeing the potential for PAYGO to disrupt the global clean cooking sector, ATEC designed and developed what it believes to be the world's first PAYGO-enabled electro-magnetic induction cooker, eCook. Based on its market and technical macro-analysis, ATEC predicts that electromagnetic induction will become the leading cooking solution globally by 2030, surpassing LPG.

ATEC has closed two equity rounds and is looking at further equity and debt financing over 2021 and 2022.



THEIR BIODIGESTERS AND ECOOK PRODUCTS ARE SEEN BY CUSTOMERS AS LONG-TERM, ASPIRATIONAL PURCHASES, MAKING THEM IDEAL FOR PAYGO SALES.

Photo: ATEC

6. PROFILES OF FUNDERS

This section presents profiles of four clean cooking funders that have been active in the sector. The profiles illustrate different approaches and initiatives for supporting clean cooking.

6.1 SHELL FOUNDATION

Shell Foundation (SF) is a UK-registered charity, founded by Shell in 2000, that creates and scales business solutions to enhance access to energy and transport services for low-income communities across Africa and Asia. SF primarily offers grant funding and technical assistance to social enterprises.

SF essentially follows a 'double bottom line'' approach for enterprises it supports. It provides early-stage financial and technical support to promote company financial performance. In so doing, it closely tracks the company's progress to financial sustainability through monthly and quarterly financial reporting, as well as monitoring business performance ratios. At the same time, SF works with its investee companies to promote progress towards SDG 7 by tracking key metrics specific to their business, such as the number of low-income customers served, environmental benefits (emission reductions), economic benefits, such as jobs created or livelihood improvements and social benefits, such as improved health.

SF has developed a high touch support model, which includes the following:

- Patient, flexible and risk-tolerant grant funding to demonstrate impact, scale and viability
- High touch day-to-day business support and strategic guidance
- Links to private and public sector partners and investors
- Tailored instruments to help partners build a track record to leverage second-stage finance

Promoting clean cooking is only one of several areas of focus for SF. SF has several priority areas for interventions including:

- Standalone energy solutions for households for basic needs, such as cooking, heating and lighting.
- Energy for smallholder farmers and rural enterprises to improve productivity and generate income.
- Integrated mini-grid- or utility-level services that meet all residential, community and business needs in off-grid areas.

However, SF has been focused on venture building in collaboration with major governmental agencies, such as FCDO (formerly DFID) and USAID for some time. SF played a leading role in the DFID funded Transforming Energy Access (TEA) programme. Consequently, SF has been an integral part of various clean cooking initiatives and has plans to increase its activities in the sector going forward.

SF clean cooking-related work includes the following initiatives:

- SF supported a research project conducted by The Nature Conservancy to better understand the charcoal supply chain in East Africa by studying sustainable economics, policy and investment to highlight market trends, the potential for substitution and economic modelling of sustainable production.
- In early 2010, SF along with the United Nations co-created the Clean Cooking Alliance to drive a cohesive vision for the sector. Since then, the Alliance has played a leading role in building awareness about the issue, developing standards and certifications and producing evidence to attract capital and innovation into the sector.
- SF supported Cardano Development for the creation of the world's first clean cooking Development Impact Bond, an innovative blended finance instrument to unlock impact financing for the sector.
- SF has supported Sistema.bio around broad R&D efforts to improve cookstove nozzle efficiency and identification of a replication strategy of their successful model, which has highlighted the advantages of biogas for productive utilization of waste in agricultural contexts.
- SF has worked closely with Envirofit supporting nine biomass cookstove pilots through a $30Mn + support

Photo: Ian Schneider/unsplash

programme that helped improve cookstove technology (biomass and LPG) and expand distribution in six key geographies. SF's recent support has focused on their SmartGasTM to resolve affordability, accessibility and illegal refilling of cylinders issues.

- SF funded the study of the real-world impact of Berkeley Air's Breathing Space Programme to help achieve a verifiable and significant long-term reduction in the incidence of indoor air pollution through clean cooking solutions.
- SF have also supported other investment funds and intermediaries with activities in the clean cooking space, including BIX Capital, Persistent Energy Capital and Factor E Ventures.
- SF are one of the funders for the Universal Energy Facility, which has major plans to promote the clean cooking agenda.
- SF recently made investments in PayGo Energy (LPG smart metering) and Burn (specifically focused on their electric pressure cooker business).

SF is interested in linking their climate ambition within their clean cooking work and, therefore, is keen to understand the innovations from a technology, business model and financing perspective within the cleanest cooking fuels, e.g., LPG, electricity, biogas and ethanol.

SF is using the lessons learnt from their work in the sector over the years to prioritise models to attract more financing. This is based on cooking fuels solutions that have the most robust supply infrastructure and strong customer demand and reliable alternative financing products, in terms of carbon credits and DIBs. Also, to seek digitization-based models that drive efficiency in supply chains and lever more effective subsidy programmes and develop greater insights on usage and payment information.

6.2 ACUMEN

Acumen invests 'patient capital', backed by philanthropic funding, in early-stage social enterprises in low-income and emerging markets. Its investments help to bridge the 'Pioneer Gap', where innovative companies often struggle to access funding. Unlike most other investors, which prefer to invest at later stages once commercial viability is proven and conditions for scaling are present, Acumen's philanthropic funding and commitment to fighting poverty allow it to take on more risk and come in at the crucial early stage when equity is hard to find. In addition to patient capital, Acumen has also created a series of returnable funds, which make follow-on investments in growth-stage companies and critical market infrastructure.

Since 2007, Acumen has invested a total of $31.1 million in 28 early-stage off-grid energy companies, including $13 million as part of its Pioneer Energy Investment Initiative, which was launched in 2017. Acumen's equity also comes with a suite of post-investment support and is designed to help companies grow to a stage where they can access other types of capital. In aggregate, Acumen energy investee companies have impacted over 134 million people and raised more than $340 million in capital in subsequent fundraising rounds.

In the clean cooking sector, Acumen made its first investment in 2015 with BURN Manufacturing. Since then, it has invested in four more companies (Biolite, Green Energy Biofuels, Grameen Greenway and KopaGas), as well as making follow-on investments in both BURN and Biolite. Acumen made its equity investment in KopaGas in 2018 following development grants from GSMA, DFID (FCDO) and MIT's D-Lab. This had enabled the company to develop its smart metering technology and complete a pilot with 100 households. Along with much-needed equity to fund their growth, Acumen provided KopaGas with strategic guidance, technical assistance and Lean Data surveys. This helped them incorporate customer feedback into their products and payment plans. In January 2020, Circle Gas acquired KopaGas. This allowed Acumen to exit its position, recycle its capital and pursue other opportunities in the sector. Such an early exit is rare in impact investing overall and almost unprecedented in the clean cooking sector.

Acumen has been actively collaborating with MECS since 2020 with a view to promoting the involvement of some of its portfolio companies in modern energy cooking and developing a broader knowledge of the issues facing the sector. Acumen has undertaken technical assistance engagements with five of its portfolio companies to better understand how their business models could support the advancement of EPCs, the type of capital needed and how best to manage risk while introducing funding into the sector. While it remains early in these engagements, some promising lessons are emerging, as follows:

- Potential demand is high for modern cooking solutions. Users and prospective users are excited by the possibility of clean, smoke-free cooking. In marketing demonstrations in West Africa, users showed more interest in electric pressure cookers than appliances, such as televisions or freezers.
- Durability, reliability, cooking speed and ease of use are priorities for users. Consumers state that they are willing to pay a premium for high-quality solutions where products are durable and intuitive to operate.
- Consumer financing that allows customers to pay small amounts over time is highly valued. As shown by the PAYGO solar sector, the ability to pay for (and eventually own) an asset over time unlocks customer demand. Customers have responded positively when companies offer cookstoves with longer-term payment options.
- EPCs can play a crucial role in stimulating rural energy demand. Average consumption for mini-grid and rural on-grid customers in Sub-Saharan Africa is low. By shifting energy usage to an electric solution, EPCs can help increase household consumption of electricity while saving users money and making rural electrification models more financially viable.

Some of the notable challenges arising from the pilots were as follows:

- Affordability remains a barrier to wider uptake. Although generic EPCs and LPG cookstoves can be obtained for cheaper prices, high-quality models currently cost over $100. This is prohibitively expensive for lower-income consumers. Consumer

Photo: on Leary/MECS

financing can reduce that burden, but only up to a point. In the short-term, results-based financing, end-user subsidies, and carbon finance can bridge the affordability gap and help promote uptake. In the long term, affordability needs to come from economies of scale, which governments can encourage through enabling policies.

- Consumer finance is a double-edged sword that must be handled with care. PAYGO is extremely important, but is an entirely separate competency from cookstove manufacture and distribution. Companies need to learn lessons from the PAYGO sector and partner with competent organisations where possible.
- Partnerships between product companies and energy service providers are needed to unlock scale. Utilities and mini-grid companies have little experience in distributing or financing products. Innovative partnerships at the nexus of e-cooking, solar home system (SHS) and mini-grid business models are necessary for these solutions to scale.

Acumen sees a role for a mix of different types of capital to fuel the growth of clean cooking companies. Grants are required to bridge the affordability gap, to support R&D for new products that meet affordability requirements, to capitalise investments in technical capacity-building and to enable policy experimentation and development. Climate finance instruments, such as D-RECS and carbon credits, can play a potentially catalytic role in driving affordability.

Cookstove companies will always be capital-intensive. Therefore, debt to finance working capital is essential for scale. As consumer finance for cookstoves builds momentum, longer-term receivables will create greater foreign exchange (FX) pressure on companies in financing local currency sales in euros or dollars. There remains a huge unmet need for local debt, de-risking mechanisms, lenders who are willing to absorb or hedge FX risk and off-balance sheet facilities that enable companies to recycle their capital efficiently.

In general, Acumen believes that the clean cooking sector faces similar barriers to those faced by other nascent social venture sectors. At present, there are few investors in a limited number of companies that have not yet achieved significant market traction. Few exits have been made, limiting liquidity and dampening enthusiasm from potential new investors. However, modern cooking is changing the landscape. The promise of both LPG and electric cooking, which has activated mini-grid and PAYGO

companies to enter this space, opens up new opportunities for consumer finance models with the potential to scale and successfully attract the capital needed to scale modern cooking.

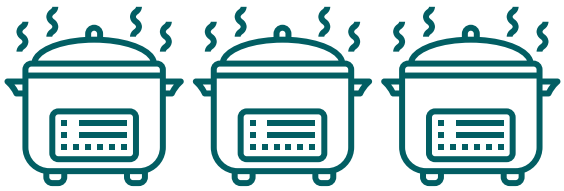
6.3 CLEAN COOKING ALLIANCE – COOKING INDUSTRY CATALYST

The Cooking Industry Catalyst (CIC) is a global industry development programme launched by CCA in January 2020. This enhanced and consolidated its various enterprise funding and technical assistance programmes over the preceding seven to eight years. The CIC was developed to demonstrate the viability of commercially attractive and scalable business models to deliver high-impact clean cooking solutions through interventions aimed at businesses, markets and consumers.

The programme presently has three components:

- Venture Catalyst
- Market Catalyst
- Demand Catalyst

The Venture Catalyst (VC) aims to build an investment-ready pipeline of cooking companies through venture-level interventions. It has multi-year funding from the Dutch Ministry of Foreign Affairs, NORAD, Shell International and some smaller funders.



THE VENTURE CATALYST (VC) AIMS TO BUILD AN INVESTMENT-READY PIPELINE OF COOKING COMPANIES THROUGH VENTURE-LEVEL INTERVENTIONS.

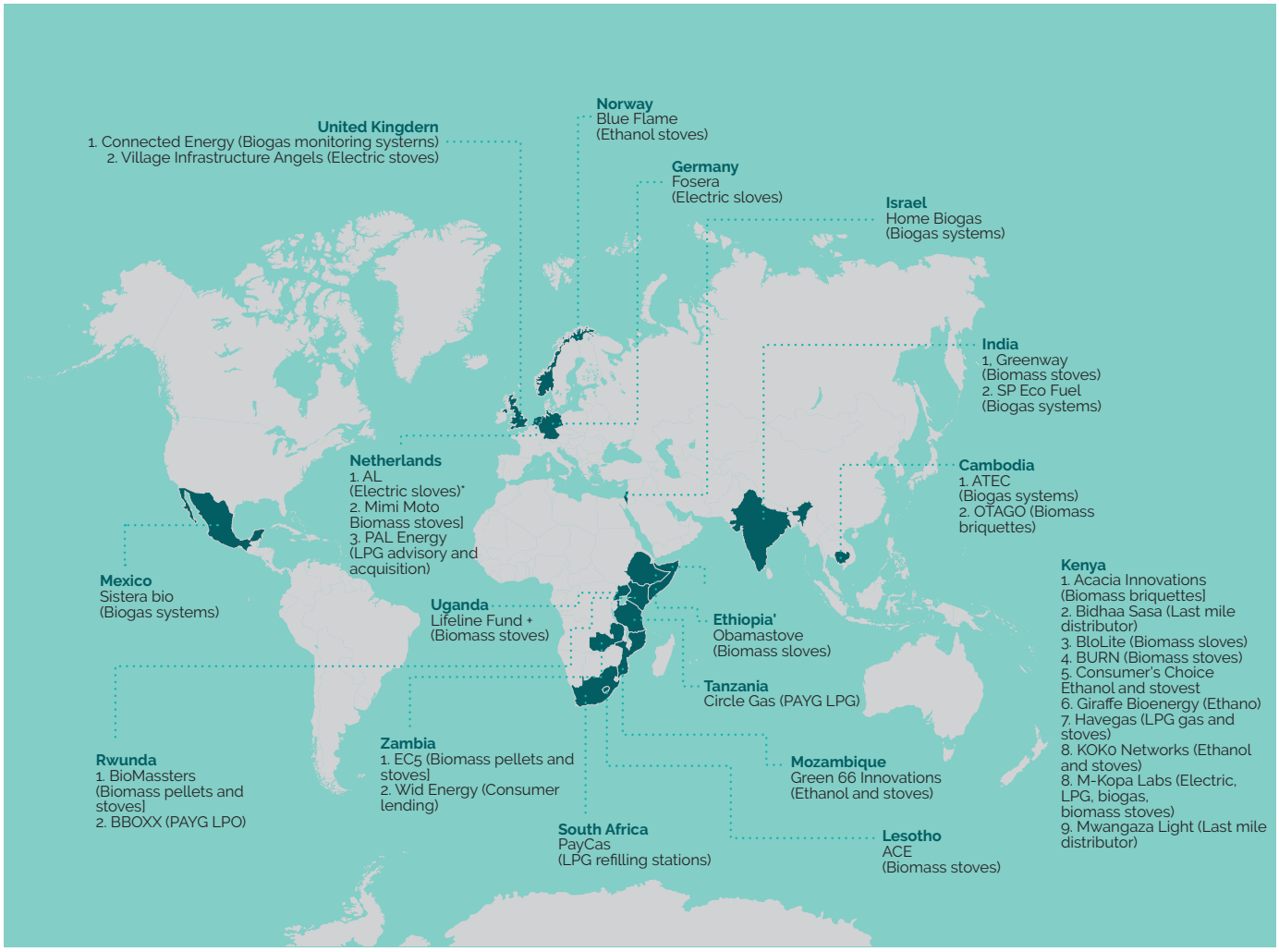
The CCA has selected an initial cohort of 33 companies for the VC as presented in Figure 18. These companies operate mainly in Africa and cover all technologies i.e. fuel distributors (biofuel, LPG and biogas); fuel producers (pellet, ethanol and char-briquettes); and stove manufacturers (ethanol, gas, electric and biomass). E-cooking companies supported by the VC include Village Infrastructure Angels (UK), IXL (Netherlands) and Fosera (Germany). The VC is also supporting many other companies looking at e-cooking, such as BURN and MKopa Labs. The portfolio includes multi-product last-mile distributors, micro-finance institutions and distributed energy services companies. Many VC portfolio companies integrate industrial-scale manufacturing, digital technologies, mobile money and consumer financing.

As mentioned previously, CCA has supported the development of the Spark+ Africa Fund that plans to offer debt and quasi-equity (and in limited cases equity) capital to companies throughout the clean cooking value chain. The fund's pipeline includes many companies being supported by the CIC and was designed by the same team responsible for designing the CIC. While the fund is one of the various investors interested in the sector, it represents the first and only sector-specialized investment fund. Therefore, it is likely to become a financing partner to many companies being supported by the VC.

Under the VC programme, companies benefit from a broad range of support services to establish their commercial viability, enhance their investment readiness and facilitate access to growth capital. These include:

- Financial and transaction advisory
- Strategy and business development
- Operations and human resources
- Tax, legal and governance
- Government relations and policy advocacy
- Social and environmental impact

Figure 18: Venture Catalyst Portfolio Companies[38]



The Market Catalyst (MC) focuses on market-level interventions that improve the enabling environment for companies and catalyse investment. To achieve these goals, the MC will carry out market intelligence, develop policy briefs and other targeted tools, host events and roundtables and design targeted engagements to support investors and policymakers.

The Demand Catalyst focuses on understanding consumers and driving demand through consumer-level interventions. This component supports consumer-facing awareness raising and behaviour change campaigns, collaboration with partners to integrate clean cooking messages into complementary initiatives and the provision of marketing assistance to companies. While these activities seek to increase demand for the entire product category, they are informed by and aligned with, the target markets and product and service offerings of the VC portfolio companies.

38. Source: *https://www.cleancookingalliance.org/cooking-industry-catalyst/venture-catalyst/index.html*

Photo: Jon Leary/MECS

6.4 MECS CHALLENGE FUND

Modern Energy Cooking Services (MECS) is a UKAID (FCDO) funded programme dedicated to accelerating the transition to modern energy cooking services. MECS was launched in October 2018 with a £40 million funding envelope. The five-year programme combines creating a stronger evidence base for transitions to modern energy cooking services with promoting socio-economic and technological innovations that will drive the transition forward.

Whilst MECS is primarily a research programme and not a provider of capital, it has been recognised that there is an opportunity for some small-scale investments to be made that could provide significant opportunities to engage in active learning, as well as providing valuable early-stage funding to different clean cooking initiatives. Therefore, a £7 million Challenge Fund exists as part of the programme to provide early-stage research funding to stimulate innovations. This includes modern energy cooking technology and systems, as well as support to enable the advancement of technology-based cooking energy products, processes and services in low-income countries.

MECS involvement in accelerating the transition to modern energy cooking services spans a wide range of interventions from the developers of innovations looking for initial funding through to financing well-established companies to support their expansion into new products and markets.

Apart from technical innovation, funds are often required to allow a company to move from the proof of concept to product prototyping and development. Generally, research funds are available that can help to demonstrate the technical feasibility of a concept, but support for translating the proof of concept to a working prototype is more limited. Often public funding agencies cannot justify the development of a prototype, since it is seen as a commercial activity. Meanwhile, private funders hold back, due to the high technical risk and the lack of a proven business case at this stage. Other funders (impact investors and venture capitalists) are generally only interested when a prototype has been developed and demonstrated. The MECS Challenge Funds for basic research and prototyping activities are focused on addressing these shortfalls.

Photo: Jon Leary/MECS

The Challenge Fund has been run as a series of competitions, each with its own focus and objectives. The competitions have been open to companies of all sizes, types (including academia and other organisations) and locations to support research projects that could lead to enabling safe and efficient modern energy cooking systems.

MECS has run five Challenges to date. These are presented in Table 7. Two have been run in-house. These aimed to provide early-stage research across a range of research fields (TRIID) and an EPC outreach programme (ECO) to understand the issues of scaling up EPC use from the user's perspective. An additional three competitions have been run in conjunction with Energy for Access focussing on Low Energy Appliances and EPCs, in particular.

CHALLENGE FUND EXISTS AS PART OF THE PROGRAMME TO PROVIDE EARLY-STAGE RESEARCH FUNDING TO STIMULATE INNOVATIONS.

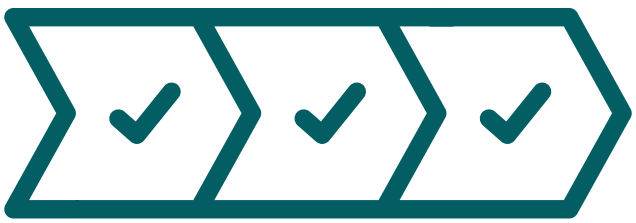
Table 7: MECS challenge-fund projects

Title of Fund	Number of Funded Projects	Project Duration	Source	Fund Value
LEIA	6	12-24 months	*https://mecs.org.uk/challenge-fund/past-funds/leia/*	£800,000
TRIID	22	6 Months	*https://mecs.org.uk/challenge-fund/past-funds/triid/*	£660,000
ECO	12	12 months	*https://mecs.org.uk/challenge-fund/past-funds/mecs-eco-challenge-fund/*	£830,000
LEIA R&D programme	6	7-18 months	*https://mecs.org.uk/challenge-fund/past-funds/energy-for-access/*	£780,000
Global LEAP	39 EPCs submitted	Usability and Value test conducted	Ran as a competition	2 x $100,000 prize for winners

The focus of the calls has changed over time and with the collection of data. Initially, TRIID focused on a number of core issues. Much of the work was research producing baseline data to develop future calls. From the creation of the call to the closure of projects, much had already changed in both the market and from a policy perspective. To address this, Electric Cooking Outreach (ECO) looked at expanding the reach of EPCs and establishing knowledge across nine African and Asian countries. The cooking of different foods and an understanding of users' requirements were the main aims here. Much of this work is still ongoing, but it has already provided some valuable insights.

To address the balance and focus more on technology, MECS/LEIA funded the first AC Electric Pressure Cooker Global LEAP Award designed for households with reliable grid connections. The further focus on EPCs followed research by MECS and others. This identified EPCs as the most energy-efficient electric cooking appliance available, with the biggest energy savings on the most energy-intensive dishes, such as heavy foods (foods that typically require boiling for more than an hour). From 39 entrants, a cash prize of $100,000 was awarded to the winner of the Best User Experience and the Best Value EPC categories.

Initial results have shown that demand for modern cooking solutions is high, but reliability and supply chain issues remain



INITIAL RESULTS HAVE SHOWN THAT DEMAND FOR MODERN COOKING SOLUTIONS IS HIGH, BUT RELIABILITY AND SUPPLY CHAIN ISSUES REMAIN THE BIGGEST CHALLENGES.

Photo: MECS/Jon Leary Myanmar kitchen labs

the biggest challenges. There is some distrust with regard to energy costs. So, having an energy monitor connected to the appliance offers security with regard to expenditure and confirms savings on dishes cooked. Work is continuing in rural areas where SHS are utilized and making an accessible DC EPC is still underway. Moving forward, an understanding of how eating habits are changing and the impact of pre-cooked food will be priorities to provide a further understanding of the benefits of modern energy cooking services and access to electricity.

MECS has also provided technical assistance funding to promote market initiatives that offer a strong potential to support the overall sector. MECS has been working with Climate Care to negotiate a revised methodology for calculating carbon emission reductions for electric and other metered clean cooking appliances with a leading certification agency – Gold Standard. MECS has also been supporting the work of Frontier Finance Solutions / Cardano Development for a Development Impact Bond in the clean cooking sector.[39] MECS has also been cooperating with Acumen, as outlined more in Section 5.2 above and with Energy 4 Impact in consultancy assignments culminating in the publication of the Financing Clean Cooking series of reports.

39. See: *https://mecs.org.uk/gold-standard-announces-public-consultation-for-a-new-mecs-climatecare-developed-methodology-for-electrical-and-metered-cooking-appliances/*

7. TECHNICAL ASSISTANCE NEEDS OF COMPANIES

7.1 INTRODUCTION

The survey results which are presented in this section have shown, in general, a strong interest by clean cooking companies for technical assistance (TA) support to complement their financing requirements, as well as their priorities for interventions.

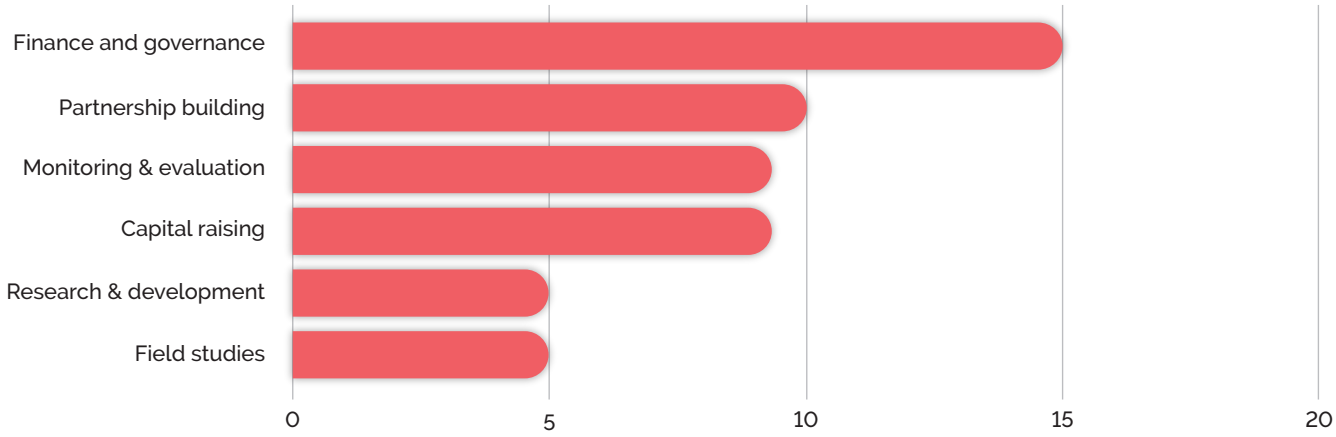
7.2 AREAS OF TA

A wide range of TA activities might be required by companies. The actual TA required can vary, depending on the skills and experience of the company, the stage of their development and the sector of the market in which they operate. The main types of TA can be summarised as follows:

- **Strategy, business model development and financial modelling** – Areas of interest include: market entry analysis, marketing and sales and value delivery (including manufacturing, supply chain and logistics).
- **Fundraising** – Many companies require support for fundraising. Key questions include: use of funds, a clear costed budget, identifying and introductions to potential funders, preparing a suitable presentation and financial model, help preparing the transaction, addressing due diligence questions and negotiations with funders.
- **Finance management and risk analysis** – This includes tax, treasury, insurance, budgeting, processes and controls, accounting and auditing. Another important topic is financial resilience and restructuring, particularly since the arrival of COVID-19. With the move to PAYGO, credit management is also an important issue.
- **Access to specialists** – This covers many areas including legal and regulatory, technical, engineering, product development, IT and mentorship.
- **Partnering** – Finding suitable partners is critical for a company's growth. Some of the more important partnerships for clean cooking are likely to involve distribution and routes to market, plus related payment systems and remote monitoring.
- **Human resources** – Recruitment and talent management is important for many companies. One of the biggest challenges facing the sector is finding good and reliable financial management and sales teams.
- **Performance monitoring and environmental, social and governance compliance** – Companies frequently require support to meet the reporting requirements of different institutions and to manage environment, social and governance (ESG) issues effectively.

Figure 19 summarises the post-investment TA provided by those funders who responded to our survey. Over 70 per cent support finance and governance, with around half assisting on partnership building, monitoring and evaluation and capital raising.

Figure 19: Post Investment TA Provided by Funders (ranked by number of responses)[40]



7.3 PROVIDERS OF TA

There are five main types of TA providers operating in the clean cooking sector:

- **Limited, ad hoc support to companies** – this is the approach currently used by most providers
- **Dedicated clean cooking TA programmes** – a notable example of this type would be the Cooking Industry Catalyst established by CCA. This provides both TA and funding to companies, as well as advice to policymakers and financiers, as outlined earlier in the report.
- **Broader energy access TA programmes** that offer services to clean cooking companies or energy access companies interested in clean cooking, e.g., GET.invest, Green MiniGrid Help Desk and PFAN.
- **Post investment support** provided by funders to their grantees, investees or borrowers. This TA can be provided by donor programmes, e.g., EEP provides business development support to ECS and other clean cooking grantees; Shell Foundation, Acumen, and Persistent Energy Capital provide similar support to their grantees and investees.
- **TA provided by equipment suppliers to distributors**, e.g., Greenlight Planet has provided TA to ECS.

7.4 TA NEEDS

Clean cooking companies have a strong interest in receiving TA and broader information through an online portal. Based on the survey, the number one TA requirement for companies is capital raising[41], with 80 per cent of companies saying this was a priority. Other important areas of support include: partnership and network building, business model development, impact measurement and market entry analysis – see Figure 20 below. Over 75 per cent of companies would like TA on the ground, as well as desktop support.

40. Source: Energy 4 Impact Research
41. This typically includes assistance on business models, financial modelling, pitch decks, investor introductions and support in negotiations and due diligence

Figure 20: TA Priorities of Companies (ranked by number of responses)

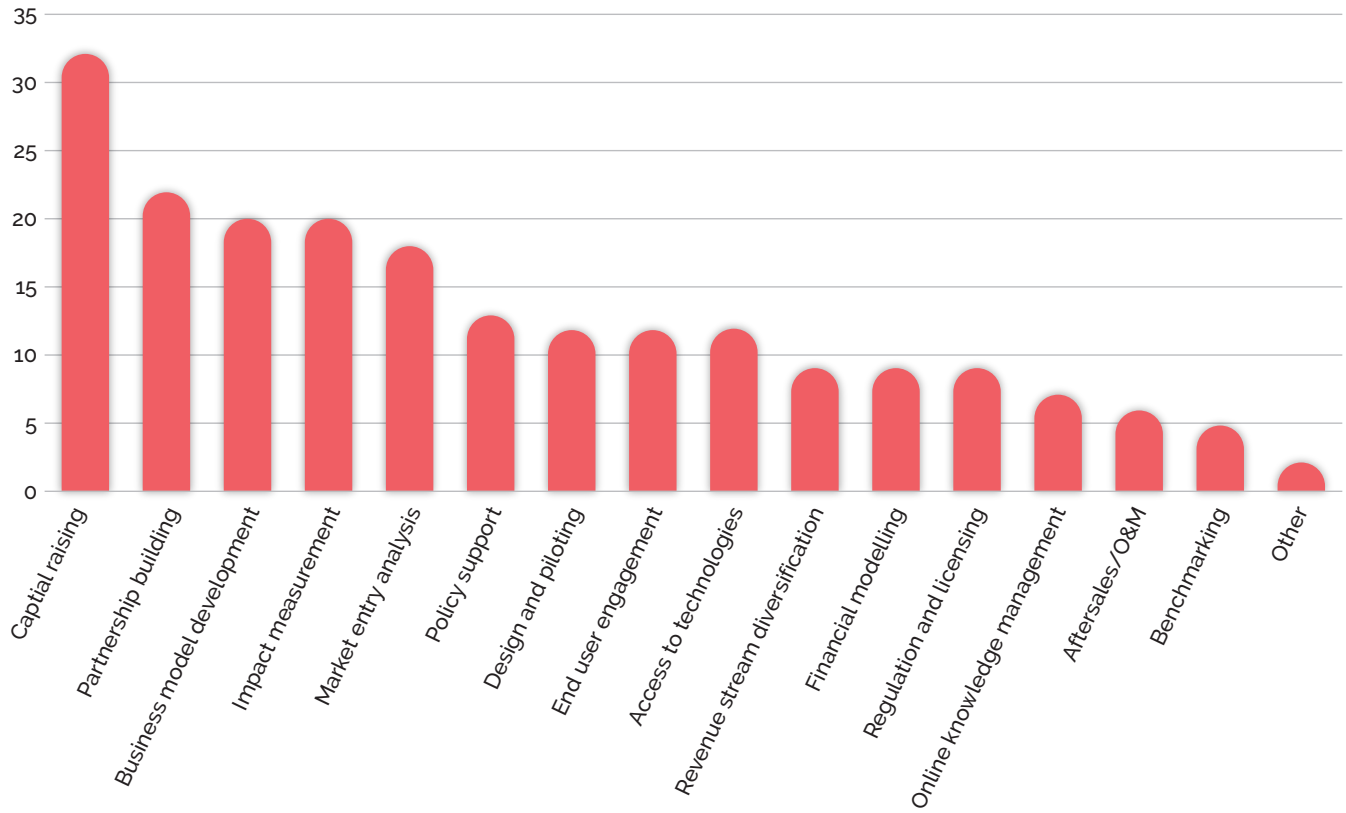
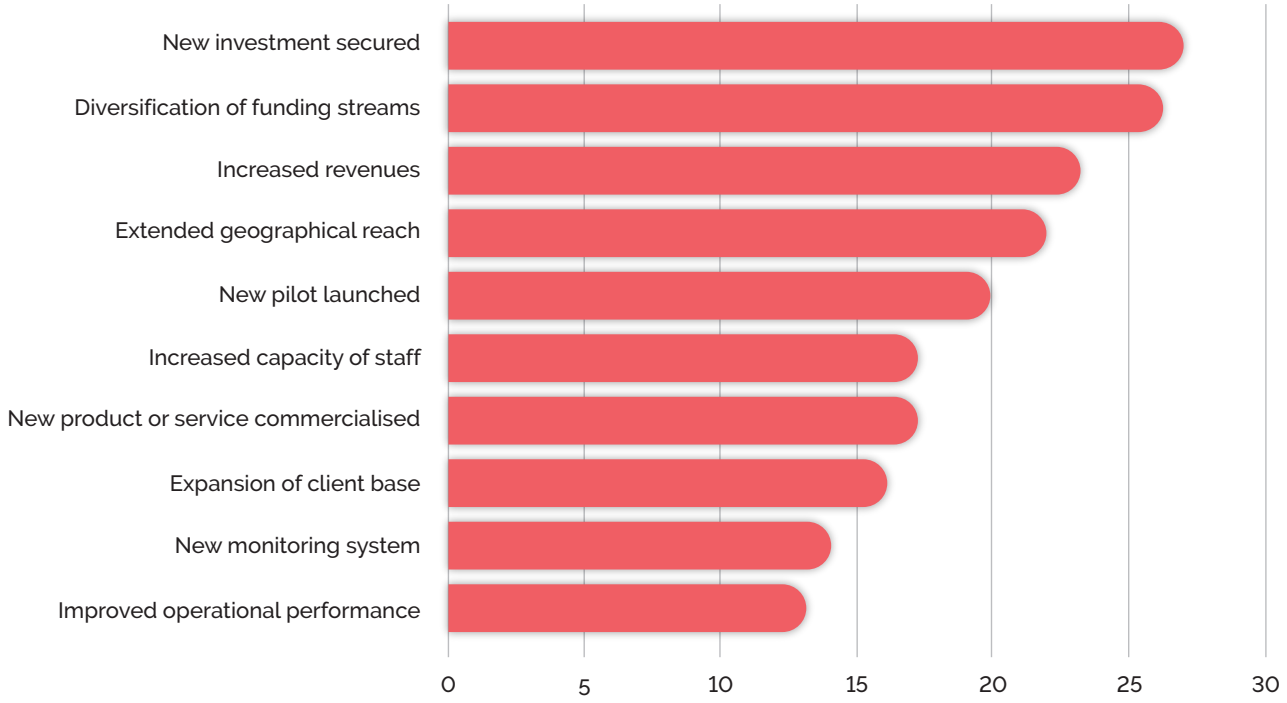


Figure 21: Preferred Outcomes of TA for Companies (ranked by number of responses)[42]



42. Source: Energy 4 Impact Research

The survey also asked companies what they would like as an outcome of the TA – see Figure 21. The top three objectives were securing new investment, diversifying funding streams and increasing revenues.

Other more generic areas of TA (i.e. not clean-cooking specific) were not covered in the survey, but are still important for companies. These include financial management, human resources, leadership and governance.

In Table 7, TA requirements of companies are broken down based on their stage of development (seed, early growth and late growth) and their expected outputs or outcomes. While all companies requested TA on capital raising to diversify their funding sources, the actual TA required is more nuanced. Seed companies were interested primarily in support to develop their business model and impact measurement. Early growth companies expressed strong interest in impact measurement and policy and regulation, while late growth companies were keen on building partnerships and developing operational plans (e.g., for marketing and procurement) in order to source scale-up capital. The late growth companies were also interested in running more pilots to test new business models and technologies.

Table 8: Key TA Requirements Based on Development Stage of Company[43]

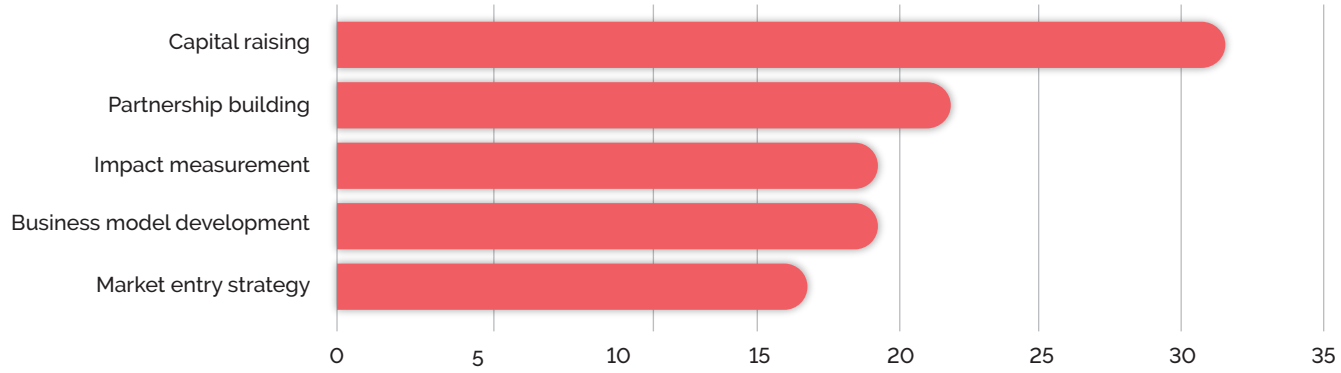
Stage	Required support	Expected outputs	Expected outcomes
Seed	• Capital raising • Business model development • Impact measurement	• Business plan • Financial model	• Diversification of funding streams • New investment secured • New pilot launched
Early Growth	• Capital raising • Impact measurement • Policy and regulation	• Capital raising strategy • Pitch deck • Introduction to investors • Performance monitoring system	• Diversification of funding streams • Extended geographical reach • Improved customer offering (service/technology) • Improved reporting • Increased capacity • Increased revenues
Late Growth	• Capital raising • Access to partnerships and networks • Access to technologies	• Capital raising strategy • Business plan • Financial model • Pitch deck • Introduction to investors • Marketing plan • Procurement plan	• Scale-up investment secured • Diversification of funding streams • Pilots to test new technologies and business models • Increased capacity • Increased revenues

EARLY GROWTH COMPANIES EXPRESSED STRONG INTEREST IN IMPACT MEASUREMENT AND POLICY AND REGULATION,

43. Source: Energy 4 Impact Clean Cooking Companies' Survey

Figure 22 shows the TA priorities of clean cooking companies.

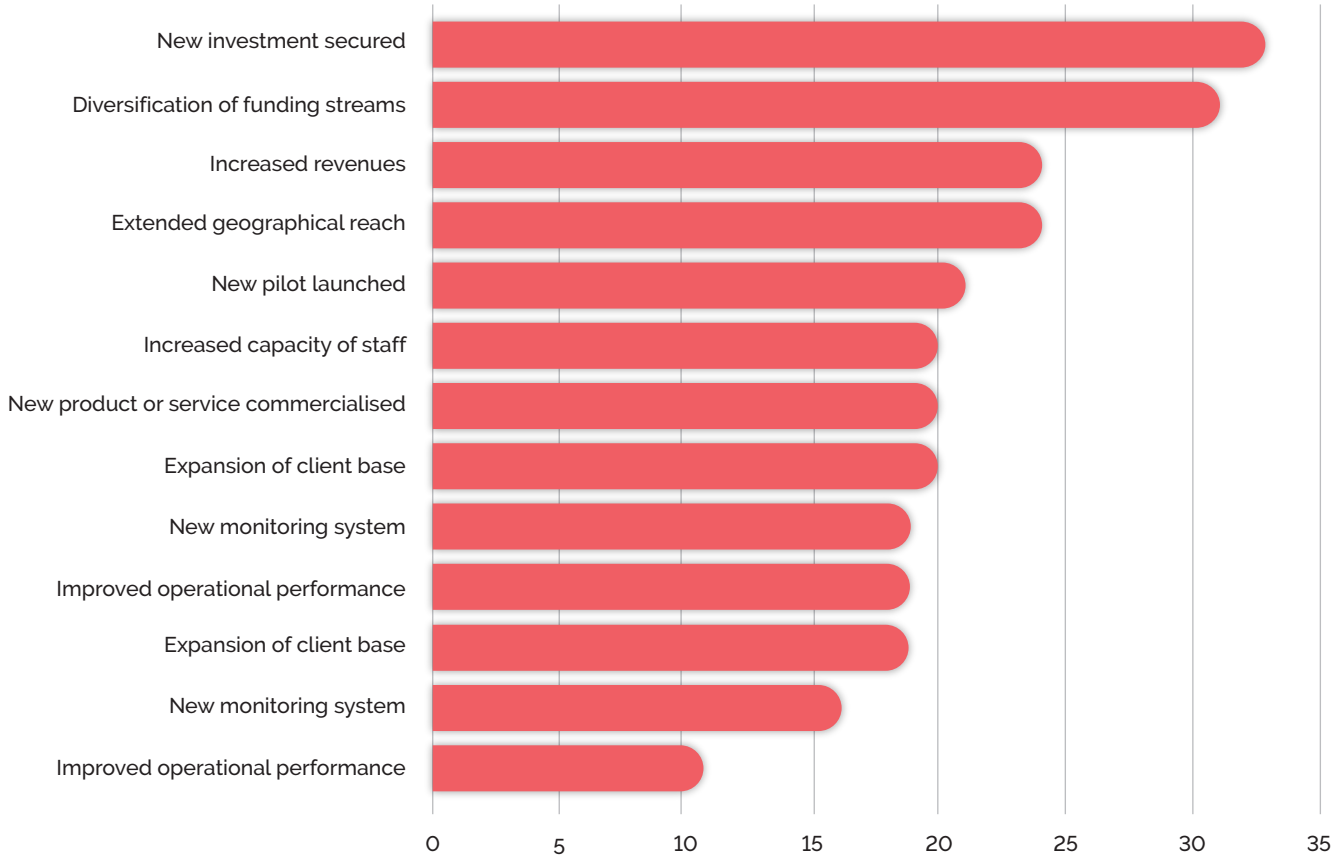
Figure 22: TA Requirement by Clean Cooking Companies (ranked by number of responses)[44]



44. Source: Energy 4 Impact Clean Cooking Companies' Survey

Photo: ATEC

Figure 23: Demand by Companies for Clean Cooking Online Portal Content (ranked by number of responses)[45]



Currently, only a small number of companies in the clean cooking sector have managed to raise much equity. One important area is to support CFOs for example:

- Financial accounting, controlling and reporting
- Basic financial planning, budgeting, forecasting, cash flow modelling and projections and financial management information systems.
- Fundraising

In addition to bespoke TA, companies expressed a strong interest in a clean cooking portal, with 90 per cent of survey respondents in favour. The content areas of most interest to companies were consumer profiling (particularly for BoP consumers), country reports, policy and regulation and business models – see Figure 23. These are roughly in line with the priorities of funders, although they have ranked their content priorities slightly differently.

7.5 CONCLUSIONS

The primary area of TA requested by clean cooking companies is capital raising. However, experience shows that many companies that ask for support on capital raising usually need support in other areas before that, especially support around business models.

Most TA providers prefer to support companies in more advanced stages of growth. However, it is essential not to ignore the seed and early growth clean cooking companies because they may be the source of the winning business models of the future.

The TA delivery method is also important. Providing one-off pieces of TA is useful, but not sufficient. What companies really need is a flexible TA service that responds to their changing needs over a period of years. Ideally, that TA should be accompanied by grant funding as well.

45. Source: Energy 4 Impact Clean Cooking Companies' Survey

8. DATA REQUIREMENTS OF COMPANIES AND FUNDERS

8.1 INTRODUCTION

This chapter looks at the clean cooking data needs of companies and funders and the importance of standardised KPIs and impact metrics.

8.2 OVERVIEW OF CLEAN COOKING DATA AVAILABLE

The lack of data – market data, enterprise data and customer data – remains one of the biggest obstacles to attracting capital in the clean cooking sector.[46] If reliable and consistent data is not available, funders are less able to define markets, develop investment strategies, and screen and close potential investments and need more time to conduct due diligence.

Information on the market has started to improve. For example, CCA published its first *Industry Snapshot* report in April 2019[47] and this insightful publication is now a regular occurrence. The SEforALL publication, *Energizing Finance*, covers clean cooking, as well as mini-grids, solar home systems and other renewable energy technologies[48].

46. Automated usage tracking/sensors could potentially play this role (e.g., the CCDP planned in Rwanda through SEForALL and Nexleaf)
47. *https://www.cleancookingalliance.org/resources/566.html*
48. See: *https://www.seforall.org/data-and-evidence/energizing-finance-series/energizing-finance-2020*

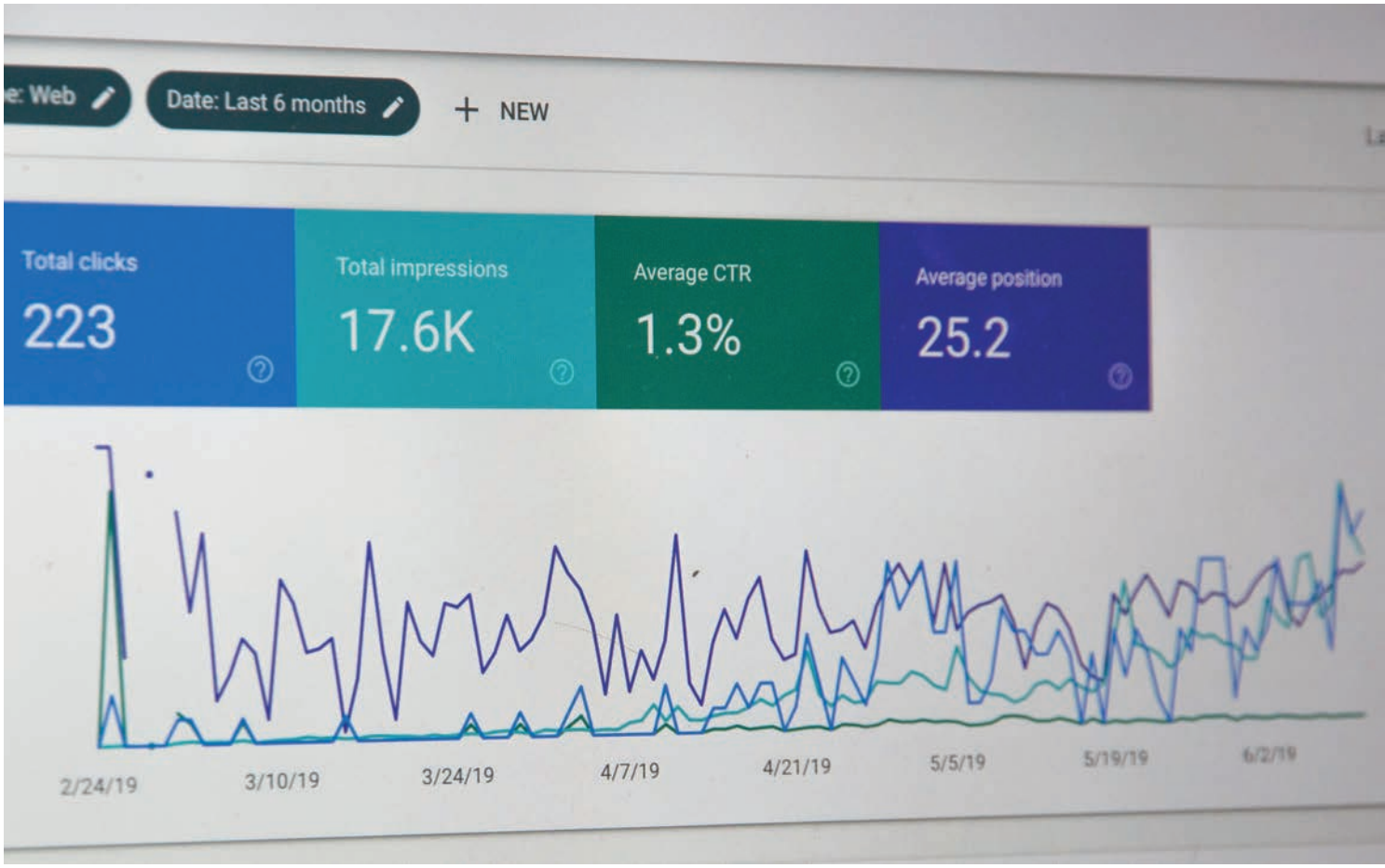


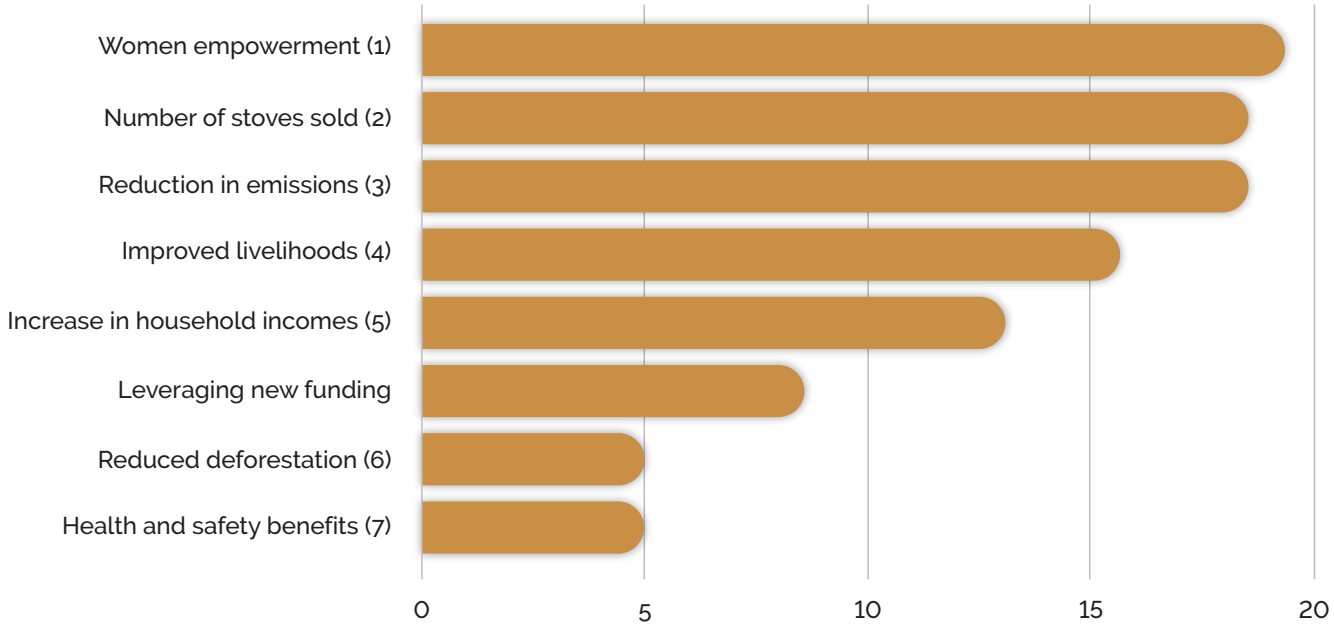
Photo: Stephen Phillips/unsplash

8.3 STANDARDISATION OF KPIS AND IMPACT METRICS

The single biggest data challenge is the lack of agreement on standardised KPIs and impact metrics tailored to different cooking technologies. There is also a need for a standardised approach to collecting, organising and sharing data and an agreement on how often this should happen. Other off-grid sectors, such as the PAYGO SHS market, are already doing this successfully, with the help of organisations, such as GOGLA. However, clean cooking has a larger number of business models and technologies than PAYGO SHS, so the challenge is greater.

It will take time for a set of standard metrics to be agreed on for clean cooking. In the meantime, it is important to recognise that different funders track the impact of clean cooking in different ways and to try to accommodate their needs. Figure 24 summarises the results of the funders' survey.

Figure 24: Impact Metrics Tracked by Funders (ranked by number of responses)[49]



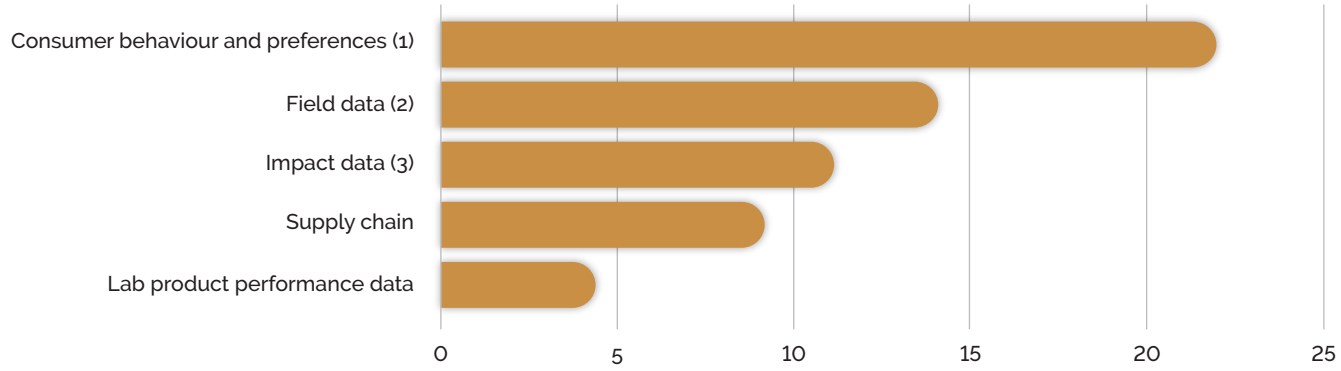
Notes:
1) Women in management, jobs created for women
2) Number of households purchasing clean cooking products
3) Tonnes of CO_2 and black carbon emissions avoided
4) Number of jobs created
5) Fuel savings, productive hours freed up for women
6) Tonnes of wood uncut
7) Averted Disability Adjusted Life Years (ADALYS) using WHO methodologies

8.4 DATA REQUIREMENTS OF FUNDERS

This section reveals the main data requirements of funders. Figure 25 shows that, by far, the number one priority for funders is data on consumers, i.e., their demand patterns and their ability and willingness to pay.

49. Source: Energy 4 Impact Clean Cooking Companies' Survey

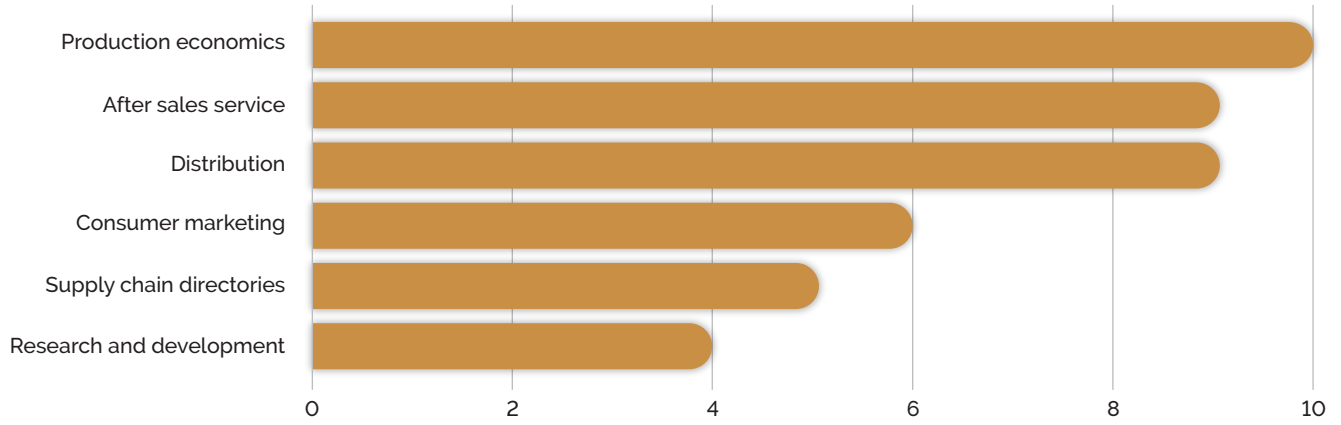
Figure 25: Demand by Funders for Market Data (ranked by number of responses)[50]



Notes
1) Demand patterns, ability and willingness to pay
2) Testing cooking products in real-life conditions
3) Livelihood, climate change and health and other impacts

Figure 26 looks at the supply chain data requirements from upstream production to downstream after-sales. This area is important, but still ranks well below information on consumers. The three areas of most interest to funders are unit production economics, after-sales service and distribution.

Figure 26: Demand by Funders for Supply Chain Data (ranked by number of responses)[51]



In Figure 27, the data requirements on policy, regulation and standards are presented. In line with the findings above, funders were primarily interested in learning more about consumer incentives, with nearly half of them saying this was a priority.

50. Source: Energy 4 Impact Clean Cooking Companies' Survey
51. Source: Energy 4 Impact Clean Cooking Companies' Survey

Figure 27: Demand by Funders for Data on Policy, Regulations and Standards (ranked by number of responses)[52]

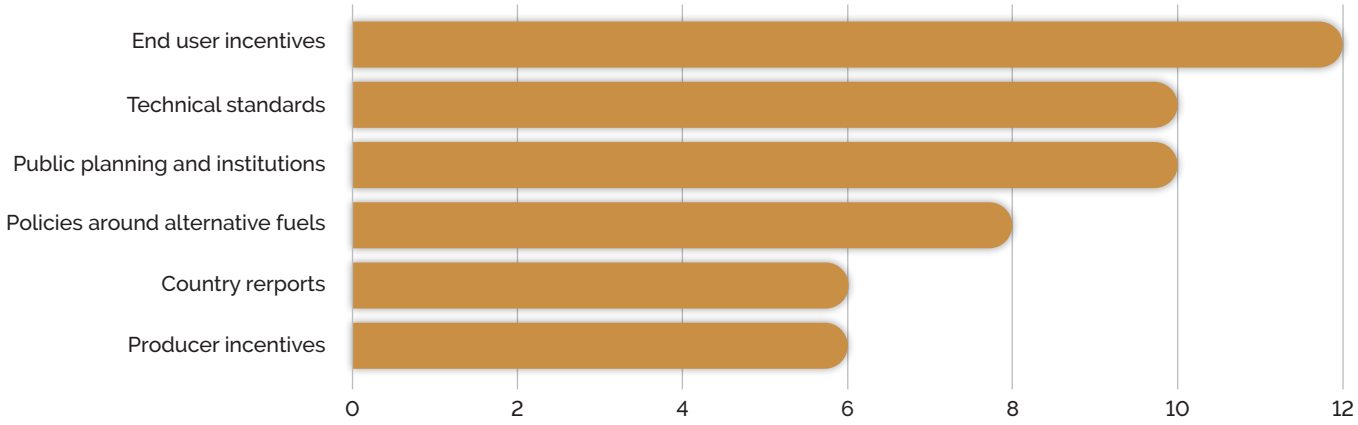
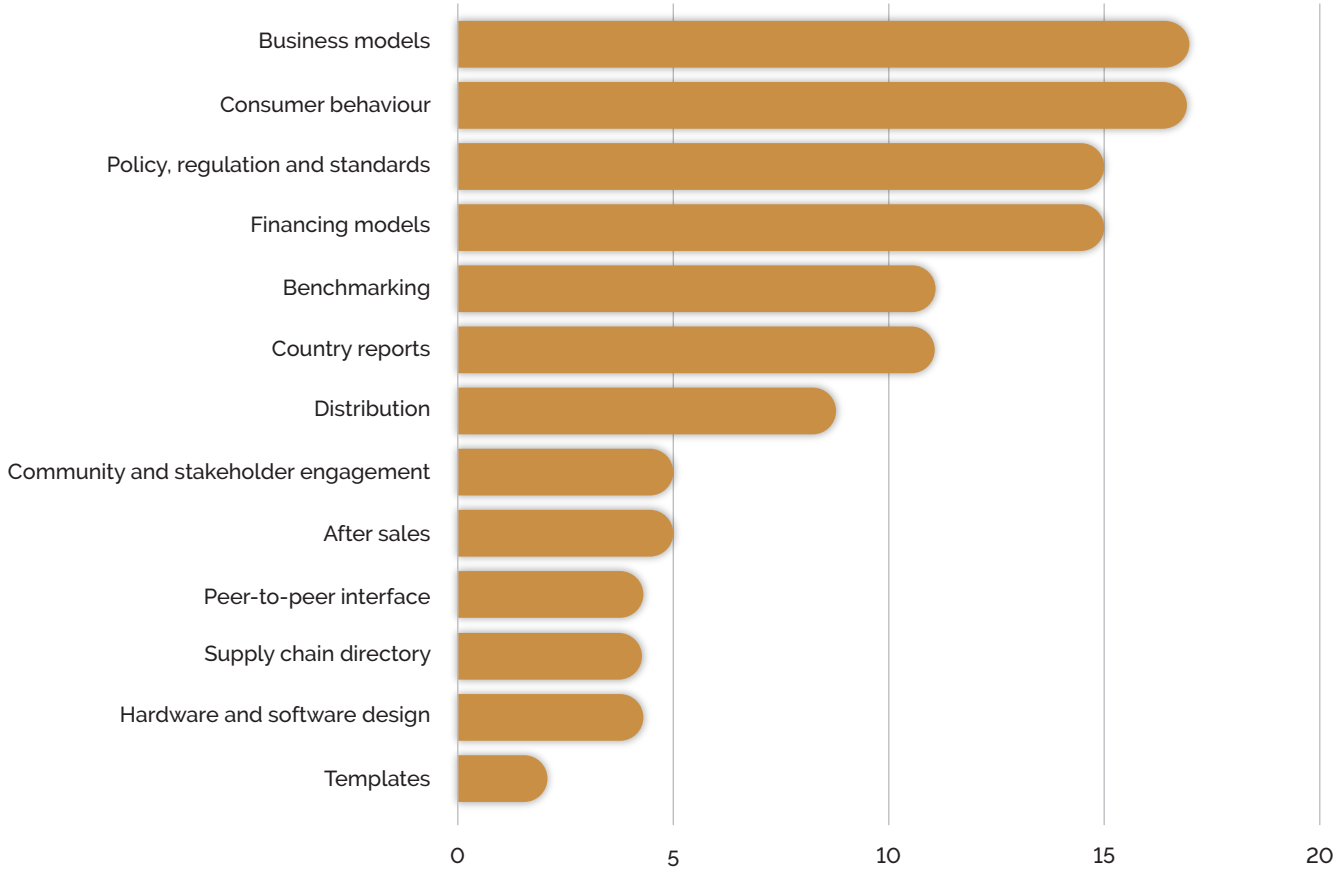


Figure 28 presents responses to the question to funders whether they would be interested in an online data portal on clean cooking. Over 80 per cent responded positively to the question, with several respondents saying it was important that it should be a collaborative effort with other stakeholders, notably CCA. The funders were primarily interested in getting content on business models, consumer behaviour and policy and regulation. One impact investor suggested it could include a list of companies looking for funding. There was comparatively little interest in peer-to-peer information exchange.

THE THREE AREAS OF MOST INTEREST TO FUNDERS ARE UNIT PRODUCTION ECONOMICS, AFTER-SALES SERVICE AND DISTRIBUTION.

52. Source: Energy 4 Impact Clean Cooking Companies' Survey

Figure 28: Demand by Funders for Online Portal Content (ranked by number of responses)[53]



8.5 CONCLUSIONS

In this chapter, the key gaps in data for clean cooking and the need for standardised KPIs and impact metrics have been evaluated. In general, while data on customers has increased, due to the closer feedback loop between customers and modern cooking fuel companies, most of this data is not public and funders still need more customer data (e.g., ability and willingness of customers to pay, demand patterns).

On the market side, the CCA's Clean Cooking Industry Snapshot is a valuable new source of information. However, getting accurate and reliable data on the market size and status of competing fuel markets remains a challenge.

The other big issue is the lack of industry agreement on standardised KPIs and impact metrics. This makes it very difficult for investors and other stakeholders to compare the performance of clean cooking companies and understand the impact these companies are making.

53. Source: Energy 4 Impact Clean Cooking Companies' Survey

Photo: Hannah Blair (CLASP)

9. COOKING WITH ELECTRICITY

9.1 BACKGROUND

Historically, the clean cooking sector has been considered as a stand-alone sector separate from other energy initiatives. As a result, energy access funding interventions (electricity, Grid and off-grid) have tended not to integrate clean cooking into their planning and design, even though they can make an important contribution to the impacts. However, institutions involved in promoting development are increasingly appreciating the advantages of linking clean cooking more effectively into the broader energy agendas.

SEforALL and other organisations have been promoting integrated energy planning to cover both electricity and clean cooking access. Some large programmes, such as 'Beyond the Grid Fund for Africa' and the Global Leap Awards, among others, are including clean cooking components for the first time and other funders are starting to engage more in the sector. The World Bank Clean Cooking Fund is explicitly linking clean cooking projects with other energy programmes. There is a growing recognition of the need for this kind of rethinking of the clean cooking landscape and its positioning within a wider energy access framework.

Coordinated promotion of electric cooking potentially provides a mechanism for channelling the capital available for electrification towards clean cooking objectives. The increasing use of modern energy cooking has been driven by technical innovations, which have generated reduced appliance costs, as well as improved efficiency and performance. This, in turn, has led to greater consumer awareness of the benefits of modern energy cooking. The emergence of electric cooking as a viable proposition is particularly important because it provides a further strengthening of the potential financial viability of the sector, not only via exploiting the existing market presence of electric appliance manufacturers, but also via the potential role of large utilities, mini-grid companies and SHS companies in facilitating the spread of the technology. Such a strategy could also position e-cooking as a synergistic opportunity to improve delivery infrastructure and stimulate demand.

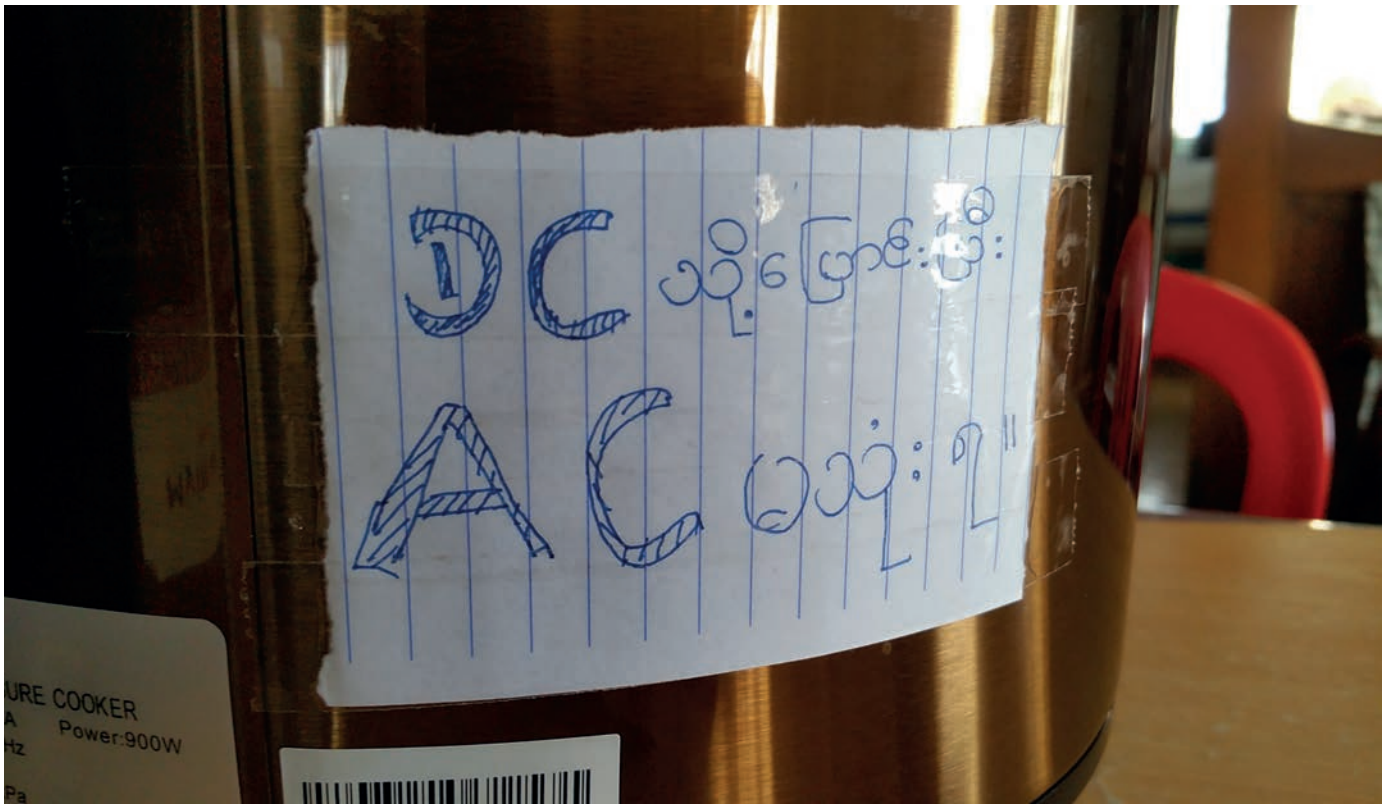


Photo: Jon Leary/MECS

The 2020 ESMAP/MECS report "Cooking with Electricity: A Cost Perspective" suggested that cooking with electricity could make a significant contribution to the United Nations Sustainable Development Goals (SDGs) by simultaneously enabling cost-effective access to modern energy and clean cooking. The report's study team collected data on energy consumption, cooking practices and user experiences from households in four countries: Kenya, Myanmar, Tanzania, and Zambia. Their findings showed that, for these countries, AC e-cooking on national grids or mini-/micro-hydropower was already cost-effective for many people and that battery-supported DC e-cooking and solar-hybrid mini-grids should become cost-effective.

9.2 THE CHANGING E-COOKING LANDSCAPE.

As an emerging part of the clean cooking landscape, cooking with electricity raises several questions that require further research. Should the presence of energy-efficient electric cooking appliances in retail shops be treated as a 'tool only' business model. Certainly, some companies can be seen in this 'tool only' light. For instance, BURN, as described above, is pivoting from improved biomass stoves to electric pressure cookers. Then, ATEC, also described above, similarly is pivoting from biogas digesters to PAYGO induction cooking appliances.

The introduction of this new generation of energy-efficient e-cooking appliances is transforming the economics of e-cooking. Induction stoves are able to heat a pot directly through magnetic induction, making the heat source as responsive as gas (Parikh et al. 2020)[54]. Although induction stoves are efficient at transferring heat to the pot, heat also leaves the pot as easily as for conventional stoves. In contrast, an Electric Pressure Cooker (EPC) uses insulation, automatic control and pressurization to significantly reduce energy use. The benefits of using EPCs are most significant for cooking dishes that require lengthy boiling. The need to pressurize the pot to accelerate cooking times reduces the cook's access to the dish to stir and check on progress. However, this functionality can also be an asset in freeing up the cook's time to perform other tasks while food is cooking. The EPC may be to cooking what the LED bulb was for lighting. BURN launched its locally produced EPC in 2021 under the ECOA brand name and its progress is being watched with great interest by the clean cooking community.

54. *https://irade.org/Final%20%20Report%20-%20Electricity%20as%20Clean%20Cooking%20Option.pdf*

Photo: Jon Leary/MECS

The landscape also includes significant global appliance manufacturers, such as Instapot, Philips, Midea and Groupe SEB, to name just four. They have begun to see the potential of the emerging markets and can be found in retail stores across Asia and in SSA countries, such as Zambia, Ghana and Kenya, again to name but a few. Import data from countries, such as Kenya, show that consumers are already buying task-specific electrical appliances in significant numbers (30,000 kettles in six months, Kenya). The higher use of task-specific cooking devices in Asia is not summarised yet, but 42,000 rice cookers were imported into Vietnam in a single day in March 2020. The challenge for the future will be how to enable energy-efficient devices that are affordable to the poorer sections of society. To this end, one large global appliance company has begun a special project bringing their existing products into the market through different channels and working towards redesigned products that fit the markets for the poor and displaced.

The prices of lithium-ion batteries and solar photovoltaic (PV) power have dropped significantly, whilst the cost of biomass fuels has been rising in many markets. This trend is encouraging mini-grid developers, solar home system companies and utilities to explore e-cooking possibilities. In most developing countries, electricity grids are expanding their coverage and becoming more reliable (Power Africa, 2015, 2018), while battery-supported appliances can support weaker grids and enable off-grid access. Energy-efficient e-cooking appliances can also be powered by batteries, as they draw much less power than conventional electric hotplates. Advances in energy storage can shift electricity demand away from peak times and allow users to cook during blackouts or brownouts. Battery storage and solar PV also have the potential to provide electricity access in remote areas. This is particularly significant in the context of accessing some of the poorest communities.

9.3 GRASPING THE NATURE OF FINANCING ELECTRIC COOKING: 'TOOL ONLY' OR 'FUEL AND TOOL'?

The ESMAP/MECS report points out that cooking with electricity raises particular financing challenges to mitigate the upfront cost of devices to consumers. An EPC can potentially cook a meal

Photo: Jon Leary/MECS

Photo: ATEC (PAYGO Box)

for 1/10th of the cost of charcoal, but consumers may be deterred by the high upfront costs of the appliances. Innovative approaches are required to address this challenge. Traditionally, microcredit organisations have not seen cooking appliances as an 'effective use' of credit, i.e., revenue-generating. However, the emergence of electric cooking opens up new possibilities for small businesses. Even at a domestic level, the time saving (which exceeds that provided by any of the alternatives on the market, due to the lack of any open flame) can enable other work to be done. A basic information and awareness campaign showing how an appliance could fit most micro-credit criteria could unlock upfront appliance costs. Developed economies are full of schemes where consumers can purchase consumer goods on credit. Indeed, there are many past and current examples of how technologies have become the norm through lease arrangements. A prime example of this is the uptake of the mobile phone where the upfront cost would deter the majority of consumers, but the mobile network operators offer the handset as part of the monthly charge.

This leads to the thinking around utility-led models and the ideas of 'fuel and tool'. Similar to telecom companies taking on the cost risk of the handset, in order to obtain and keep a long-term customer who consumes airtime, one concept proposed in the report is for reformulating e-cooking as a form of household expenditure. So, for example, utilities or mini-grid developers with excess generating capacity can absorb the initial cost of an EPC and arrange repayment through a PAYGO lease or through on-bill financing. Subsidies may not be required as the upfront costs could be spread over time through the regular electric utility bills. Lifeline tariffs are proposed as another useful instrument for subsidizing some of the ongoing costs of cooking with electricity. Typically, these would subsidise the rate up to a certain number of kWhs, which is often enough to cover basic needs. This was the approach taken in Ecuador, which offered free electricity for the first 80kWh.

Cooking with electricity may fall partially under the lifeline tariff and partially above it. In this case, targeted subsidies tied to extending the lifeline tariffs to enable cooking for households in need could be designed. Staying within the lifeline tariffs focuses attention on energy-efficient appliances. Energy-efficient devices tend to be more expensive than their inefficient cousins and the need to mitigate the upfront costs could prove a barrier. The solutions are the many financial instruments already discussed above, such as Credit, Leasing and Utility On-bill

financing. However, beyond this, energy efficiency is a cornerstone of effective use of limited electrical generating capacity. From that utility point of view, it can be worth subsidising upfront costs to achieve demand-side management and/or facilitating bulk procurement. If utilities were to get involved from a demand-side management perspective, the characterisation of clean cooking responses being dominated by nascent clean cooking sector companies can be set aside and the weight of the utility can come to bear in negotiating bulk procurement.

From a consumer point of view, the use of a crude cheap coil hotplate is not cost-effective, as the losses lead to the cost per meal exceeding charcoal and LPG costs. However, from the utility point of view, the use of an energy-efficient device, not only benefits the consumer, but is important for the longer-term demand profile on the grid and for off-grid provision. There are examples of energy-efficient devices[55] in other sectors being provided or subsidised by utilities as part of their demand management approach.

One of the more well-known examples of this comes from the Ghana Refrigerator Efficiency Project.[56] This swapped out older refrigerators that were consuming 1,200 kWh per year for ones that were on the global market for 500 kWh energy-efficient appliances. This was part of Ghana's management of supply and demand in 2009 as energy demand had steadily risen since 2007.[57] Hence, the government needed to reduce the demand for electricity that had been generated mainly from hydropower until 2015.

Alongside clearer standards labelling and importation tariffs, it was worthwhile for the government to offer a $50 and $100 rebate coupon (depending on the efficiency rating). The project

55. *https://www.ctc-n.org/sites/www.ctc-n.org/files/resources/manual-of-financing-mechanisms-and-business-models-for-energy-efficiency2.pdf*
56. *http://www.energycom.gov.gh/files/The%20Success%20story%20of%20the%20Energy%20Efficient%20Refrigerator%20Project.pdf*
57. *https://www.cgdev.org/sites/default/files/electricity-situation-ghana-challenges-and-opportunities.pdf*

Photo: Earthspark

Photo: KOKO Networks

was not without challenges, but it is widely regarded as a success and the importation of old inefficient fridges was negligible by 2015. However, the increasing commission of thermal power plants has led to the dominance of thermal power in the energy generation mix of Ghana since then, Similarly, there are many examples of swapping out inefficient lighting for energy-saving bulbs; a programme that, by 2014, had saved Rwanda 64Gwh per year.[58] India's example of bulk procurement of energy-efficient light bulbs[59] was able to reduce the cost of each bulb by 90% by ordering 1.2 billion units. The EESL's Unnat Jyoti by Affordable LEDs for All (UJALA, meaning Light in Hindi) is the world's largest lighting replacement programme.

These three interesting examples also give us an insight as as to how such action could influence the future markets for efficient cooking devices – high-efficiency refrigerators and high-efficiency lighting are now the global norm. One can imagine that investment of finance into high-efficiency cooking appliances now would result in their being the norm by 2030. Indeed, EESL of India is embarking on bulk purchase of energy-efficient cooking appliances as part of the current GoElectric campaign. They aspire to create a similar price reduction through the purchase of 100 million units over the medium term.

In the case of mini-grids, high upfront costs for the development of the grid and long-term payback of investment are additional challenges for developers. However, recent technology innovations on metering and control processes by leading firms are enabling innovations, such as prepaid smart metering, mobile payments, load limits and remote monitoring/control. These create opportunities for providing finance to consumers for new appliances, which can then be more easily recovered through sales of electricity. In the case of poorly functioning networks or solar home systems, energy storage is likely to be needed for e-cooking with consequent impacts upon overall costs. In these contexts, consumers will often require credit to convert the high upfront cost of e-cooking into instalments.

58. *https://www.worldbank.org/en/news/feature/2014/11/06/raising-awareness-energy-efficient-light-bulbs-pays-off-rwanda*
59. *https://eeslindia.org/img/uajala/pdf/UJALA_Case_Studies_1.pdf and https://eeslindia.org/en/ourujala/*

9.4 SPECIFIC FINANCING MECHANISMS

PAYGO

In recent years, many leading clean cooking companies have developed PAYGO solutions, similar to those used in the off-grid solar market. These cover a wide range of appliances and fuels, including EPCs, induction stoves, LPG cooking kits, biomass gasifiers, biodigesters and ethanol cooking, as illustrated by the company profiles in Section 4 of this report. PAYGO removes the upfront price barrier of the cooking kit by allowing end-users to pay a small or zero deposit, followed by affordable instalments over time. Most companies use PAYGO for end-users (business-to-consumer or B2C), but some also offer their PAYGO solution to intermediaries (business-to-business or B2B). The features of the PAYGO model, as it typically applies to clean cooking companies, are set out in more detail in Section 3.12 of this report, as well as in the report Clean Cooking: End User Finance for Appliances, which is part of this series of reports published by Energy 4 Impact and MECS.

On-bill Financing (OBF)

Utility-led financing could be a powerful tool for reducing the upfront cost of e-cooking devices and increasing uptake of e-cooking. It can take different forms, as follows:

- On-bill financing (OBF) in which the devices are financed on the balance sheet of the utility and the repayments are collected through the utility bill;
- On-bill repayment (OBR) in which the devices are financed by a third party (e.g., an asset financier or clean cooking distributor) and the repayments are collected through the utility bill; and
- Co-marketing and data-sharing in which the finance and the billing for the devices is covered by a third party, but the utility provides data and other support related to their customers for credit scoring and marketing purposes.

The main benefits of these forms of financing for the utilities are increased electricity sales and other potential revenues from the financing, e.g., on sales of appliances, plus a measure of demand-side management. Most utilities in East Africa are looking to increase demand on their grids. Therefore, they are keen to encourage the uptake of e-cooking. The same is true of many private mini-grids. In developing Asia, the picture is more complex, with most countries intentionally pivoting from fossil fuels to renewables to reach the Paris Agreement.

The advantages that utilities have in promoting these forms of financing include: access to an existing customer base and payment system, the ability to mitigate payment risk with historic customer data, the ability to monitor ongoing stove usage and the ability to curtail energy service for non-payment (subject to local regulations). Sometimes, these are seen as compelling reasons for promoting these forms of funding as a means to extend e-cooking.

The main benefits for end customers of OBF and OBR are: increased affordability for energy-efficient devices, financial and other benefits from the use of the devices and increased awareness of the financial savings of their investments.

In reality, many African utilities are cash-constrained and are likely to prefer informal partnerships with financing companies over OBF and OBR where they would need to manage the payment collections themselves. Many are already struggling with collections, so do not want to increase the financial burden on their customers through on bill payments for appliances or to have the reputation risks associated with repossessions. Again, in contrast, the grid markets in Asia are more developed and there is more capacity to both arrange OBF and OBR, as evidenced in the energy efficiency projects mentioned above and the green climate finance being made available[60]. Other challenges include potential regulatory hurdles for disconnecting customers and the potential need to upgrade billing systems. Nevertheless, the advantages of On-bill financing make it a highly attractive method of promoting e-cooking.

60. *https://www.adb.org/sites/default/files/publication/706641/financing-clean-energy-developing-asia.pdf*

Photo: Benjamin Dada/unsplash

10. RECOMMENDATIONS

10.1 INTRODUCTION

This chapter presents recommendations for potential interventions by donors and other funders to finance the scale-up of the modern cooking sector and to address the TA challenges of companies and the data needs of funders.

10.2 RECOMMENDATIONS FOR SCALE UP

There are currently three main types of clean cooking companies active in the market that might be prioritised for donor funding:

1. Several late growth companies focused solely on clean cooking that have scalable business models.
2. Another larger group of energy access companies, including utilities, SHS and mini-grid operators, where clean cooking is a relatively small part of their business.
3. A large number of seed and early growth companies, not all of which are pure cooking companies. Most of these are struggling to scale and raise capital.

In Section 4.5, the life cycle of a clean cooking company was presented as an S-curve, which represents growth over time. Our assessment is that the most difficult part for these existing clean cooking companies is the seed and early growth phase (representing the third group identified above). As companies move into the later growth phases, there tend to be more financing options open to them. The recommendations that follow reflect on the needs of all three enterprise types.

Photo: Burn

Provide R&D Grant Funding for Innovation

Public capital for R&D on clean cooking remains scarce and continues to be both urgent and critical in order to sustain and accelerate technological progress. The companies surveyed in this report highlighted this as a key priority. Therefore, it is important that R&D funding be expanded within this sector to encourage technology and business model innovation. Priority areas are digitalisation, connectivity and the Internet of things (IoT) – around half of the companies who responded to our survey reported this segment as being important for them. Many companies are looking to transform their clean cooking hardware into IoT-connected devices through GSM technology. IoT stoves are important because they allow for remote monitoring and control of hardware and mobile money payments and provide better insights into stove usage and customer preferences.

Other areas highlighted for R&D include: innovations in the functionality and performance of stoves, mechanisms for fuel dispensing and last-mile distribution of stoves and fuels. Companies are interested in getting funds for prototyping, lab testing, emission testing, field trials and pilots, patenting and tooling.

Promote Clean Cooking with broader energy access funding initiatives and undertake more research on financing options associated with this approach.

Modern energy cooking has the potential to transform the clean cooking sector radically and is increasing hugely the scope of activity for potential funders. Historically, Multilateral Development Banks (MDBs) and other Development Finance Institutions (DFIs) have tended to ignore the clean cooking sector. The changing landscape will now offer a greater opportunity for them to engage in clean cooking with large potential benefits for the sector. Their intervention across different areas should be supported by donors. The amounts of funding being channelled into energy projects are very large indeed and clean cooking can benefit from leveraging off these funding flows.

To this end, more research is required. This report focused on surveys and interviews conducted around the 'cooking sector'. As clean cooking becomes more integrated with the broader energy access initiatives,

Photo: Jon Leary/MECS

the funding and financing landscape becomes less clear. Few global e-cooking appliance manufacturers could be said to be at the start of the S curve, and neither could most utilities. The finance required by say an international appliance company to create an appliance for the poor in Africa is more about accessing companies' resources with the permission of the management than identifying external finance. For them to transform their clean cooking hardware into IoT-connected devices through GSM technology would be a design exercise internal to the company.

Similarly, we have mentioned but not explored in depth the finances of the utilities, acknowledging the African ones are cash strapped but noting the Asian ones are in a better place to move forward with projects that increase their use of renewables and utilise energy efficiency to undertake demand-side management. We have shown how energy-efficient appliances (lights, fridges) can be provided with on-bill financing (bulk purchase to lower costs, and upfront purchase subsidy), but more research is required to identify how this can be applied to modern energy cooking services. This research will be published in our final 6th Report in this series during 2022.

Facilitate Carbon Credits and other Impact Funding

The clean cooking sector has a very strong potential to advance SDG outcomes and avert GHG emissions. This creates opportunities for clean cooking projects to benefit from different forms of impact payments, including carbon credits. Most modern energy cooking companies now have 'Smart Data' features that can measure energy use and patterns. Smart Data can be used to streamline measurements and reporting for GHG emissions as well as other SDG impacts. Some targeted financial support from donors is needed for pilots to establish viable approaches on which larger amounts of scaled-up impact funding can be based.

Support Early-Stage Equity Investment

Early-stage, patient, risk-taking equity is one of the key success factors for growing the clean cooking sector.

- Donors can support early-stage equity provision with higher risk funding to crowd in private sector finance. One concrete example of this is the

Photo: Visual Stories – Micheile/unsplash

proposed investment in Spark+ Africa Fund for Africa (SEFA), an AfDB-managed multi-donor trust fund. SEFA has provided a significant first loss capital tranche, which in turn protects mezzanine and senior investors and reduces their risk as well as ensuring that financial returns are sufficient to encourage commercial investors to participate in the fund.

- Donors can support TA which accompanies investments which can be very valuable in boosting investment results and focussing efforts around SDGs.
- Donors could make lump sum grant investments in equity crowdfunding campaigns. This could be accompanied by TA to the companies for setting up and running effective campaigns.

De-Risk RBF for Clean Cooking Companies

Donors could potentially play an important role in the de-risking of RBF programmes. One of the challenges of RBF for clean cooking companies is the need to raise bridge funding. This could be done in different ways. Donors could provide concessional capital (e.g. first loss, zero-interest loans) to local lending institutions or to debt funds to facilitate the bridge loans. The clean cooking companies would repay the loans from the proceeds of the RBF once they have met their RBF milestones. Donors could also consider offering repayable project preparation grants. Another challenge with RBF is the lack of proven business models for the different clean cooking technologies. Donors could provide grant funding for pilots in those countries that are planning RBF schemes. By providing grants upfront, they would increase the number of viable projects for the RBF.

Finally, donors could also play a role in developing better RBF frameworks for clean cooking.[61] It will be important to consult with different stakeholders (companies, donors, customers and policy-makers) and agree on key parameters: eligibility of cooking technology, criteria for measuring cooking performance and fuel efficiency, desired outputs (number of stoves sold, quantity

61. See for example: *https://www.nefco.org/wp-content/uploads/2020/06/Invitation-for-Expression-of-Interest_BGFA_Clean-Cooking-Solutions.pdf*

Photo: Nancy Serenje, CEEEZ Zambia

Photo: Sigmund/unsplash

of fuel sold, number of stoves sold to BoP customers or women), desired outcomes (energy, environmental, gender and health impacts), monitoring and verification systems to measure outputs and outcomes and compliance with the RBF goals, other support provided alongside RBF such as TA and bridge funding. It will also be important to learn lessons from other energy access RBFs (for SHS, mini-grids, productive use appliances etc). As previously mentioned, Smart Data has an increasing role to play over time.[62]

Integrate Cooking with Electrification initiatives

The emergence of electric cooking as a viable alternative is particularly important because it provides an opportunity for channelling the capital available for electrification towards clean cooking objectives. Donors can promote this opportunity not only by strengthening the presence of electric appliance manufacturers but also by supporting large utilities, mini-grid companies and SHS companies in facilitating the spread of the technology.

Donors can support utilities and mini-grid developers to pilot and scale-up e-cooking services through TA grants for pilots and for introducing new services such as On-Bill Financing.

Donors can support initiatives for companies in the existing clean cooking value chain to expand their product range to include e-cooking appliances.

Donors can incentivize appliance manufacturers to develop products targeted at the bottom of the pyramid, in particular DC–and battery-supported e-cooking products.

Initiatives to integrate cooking into country electricity planning should also be supported.

Promote Debt finance through innovative financing solutions

Clean cooking companies are often struggling to raise debt, however, appetite from debt investors is likely to increase

62. See also: MECS and Energy 4 Impact (2021). Clean Cooking: Results-Based Financing as a Potential Scale-up Tool for the Sector.

as more evidence on the viability of different business models becomes available. Debt is important for the scale-up of clean cooking businesses. It is needed for working capital for inventories and consumer financing, and also CAPEX for distribution and occasionally manufacturing of fuels. Some debt investments would be catalysed if donors offer some form of downside protection. Donors could potentially provide first loss and concessionary funding to stimulate clean cooking loans.

There are currently over 20 off-grid debt funds and most of those are not directly involved in clean cooking but could have an important role to play. In addition to the debt funds, there are large family offices that make impact loans. Some of these are particularly interested in last-mile distribution to the BoP and making further loans to intermediaries that can help grow the sector.

There is potential for donors to support the crowdfunding sector, by providing first loss match funding for peer-to-peer lending campaigns with clean cooking companies.

Many successful clean cooking companies face the challenge of funding their receivables from fast-growing sales against a small capital base. Solving this problem is critical to their ability to scale up and follow an international expansion path. Creative funding solutions such as securitisations offer one interesting path and should be promoted.

Another challenge in the sector, and particularly amongst its earlier stage players, relates to the difficulty of determining corporate valuations and how an investor would monetize/exit its investment. Here again, innovative financing solutions can be leveraged to allow financing to flow to companies in the clean cooking space. Spark+ Africa Fund, for example, has developed a quasi-equity instrument that allows companies to achieve long-term, subordinated equity-like capital that can be leveraged with senior debt, but that is non-dilutive and does not convey some of the governance rights typically given to an equity investor. Meanwhile, the fund achieves its aims, namely: a mezzanine position in the capital structure with some degree of downside protection from the company's equity base, a structured exit over time without forcing a sale of the company or other disruptive liquidity event and an equity-like return profile.

Provide Grant Funding for Scale-Up of Successful Projects

Certain grant programmes[63] have a process for scale-up funding, with the first grant for pilots and testing proof of concepts being relatively small, around $100,000 or less, and follow-on grants for scale-up being up to $1 million. It would be good to promote similar mechanisms for clean cooking companies.

Fund Research to Bring Large International Companies into the Sector

One of the big challenges is getting global corporates interested in the clean cooking sector in Africa. They are likely to need data on the size of the 'viable' market, introductions to local distribution and financing partners and financial support and de-risking before they enter the market. Most will not be familiar with the end-user financing requirements of African markets and will need support in this area as well. There will also be a need for some awareness-raising among these corporates.

There are many types of global corporates that could transform the sector[64], including large appliance manufacturers, such as Panasonic, Instant Pot, Morphy Richards and Hotpoint. Energy strategics, such as Shell, ENGIE and Trafigura, have already invested in the sector, both directly in companies and through broader industry programmes. Other sectors that have an interest in seeing the PAYGO 'tool & fuel' model grow include: telecom operators, internet service providers, mobile money operators and financial institutions.

Support National Utilities with E-Cooking Appliance Financing

Another area where donors could provide support is the financing of e-cooking equipment for grid-connected customers of national utilities. Donors could provide seed funding or a letter of credit for a revolving fund from which the utility could purchase the equipment and sell it to their customers on credit. The loans

63. Good examples are US Aid DIV and Partnering for Green Growth funded by the Danish and Dutch governments.
64. For an overview of strategic investors in energy access, please refer to the Energy 4 Impact /Wood Mac report: *https://www.energy4impact.org/file/2086/download?token=9-hw5RF1*

from the utility to the customers could be repaid through extended payment plans implemented through on-bill financing. One of the advantages of this approach is that the utility already has a billing relationship with their customers, as well as access to information about their energy usage patterns and payment history.

Support Consumer Awareness Raising Campaigns

Donors can play an important role in funding consumer awareness campaigns about the benefits of clean cooking. Indeed, this was the number one priority for clean cooking companies, according to our survey. MECS has launched several different initiatives in this area.

10.3 TECHNICAL ASSISTANCE (TA) RECOMMENDATIONS

Section 7 has presented the different areas of TA, the main TA providers and the TA needs of companies at different stages in their growth curve. In preparing the TA recommendations below, the report addresses all aspects of TA including: the areas where TA is most needed, the importance of providing TA to early-stage companies, as well as more advanced companies, and the need for a flexible and long-term approach to delivering TA.

Dedicated Clean Cooking TA Programmes

The authors strongly recommend that donors support dedicated and wide-ranging clean cooking TA programmes, such as those managed by CCA and MECS. Around 80 per cent of companies surveyed by Energy 4 Impact said it was a priority for them. Such dedicated TA services enable companies to develop their clean cooking capabilities and also prepare the grantees for life after the grant.

New efforts should make such TA attractive and valuable to energy access stakeholders (i.e., government departments, regulators, planners) beyond those currently working in clean cooking so as to embed clean cooking in their thinking. Initiatives should also ensure that TA is available to show how cooking as a load for modern energy infrastructure is part of demand-side management through both the 'tool and fuel' models and the 'fuel and tool' models. Similarly, corporate (global and regional) appliance manufacturers can be provided with TA for specific teams to lobby within their organisation for new markets and new products that are fit for the poorer users within emerging markets.

Ensure TA is Targeted in the Right Areas

TA for fundraising is the number one priority for clean cooking companies

Photo: Jon Leary/MECS

Photo: Jimmy Agaba, CREEC Uganda

according to our survey. This includes assistance on: financial modelling, pitch decks, investor introductions and support in negotiations. Companies often need support in other areas as a precursor to fundraising, for example, on: business model design, partnership building or impact measurements. TA for other purposes, such as R&D, pilots, human resources, governance and reporting is also very necessary.

Flexible TA Delivery Mechanisms
Most TA programmes today are very transactional. They are centred around individual consultancy assignments of a few weeks or months and are largely desktop-based. In reality, the needs of companies can change very quickly given their particular circumstances. They also evolve over time as a company moves through its development life cycle. This is particularly true of seed and early growth companies and those operating in the dynamic environment of clean cooking. What these companies need are TA providers that are prepared to support them over a period of years providing flexible support, ranging from handling small ad hoc enquiries through to longer tasks, possibly involving work on the ground. Ideally, funding should also be available to accompany the TA.

Support for Online Clean Cooking Portals
There is strong demand among clean cooking companies for an online clean cooking portal. Currently, CCA has the most complete online information service and is developing further ideas to support this area – see Section 8.2. Please refer to Section 7.3 and 8.4 for the data requested by companies and funders respectively and Section 9.4b for our ideas on knowledge management reporting.

10.4 DATA RECOMMENDATIONS

Section 8 presented the three most important data categories (market, enterprise and customers). It examined the various clean cooking impact metrics, the need for standardisation and summarised the key data gaps identified by funders. While data on clean cooking customers is increasing, due to the closer customer feedback loop offered by 'tool & fuel' business models, the industry is still fragmented. There is a need to bring standardised data together under one roof in a similar way to GOGLA for the SHS sector.

Fund R&D Projects to Address Data Gaps of Investors

As stated above, it is vital that donors continue to fund R&D projects. In developing cross-sector pilots, it will be important to understand the business case for e-cooking for both energy suppliers and their customers and to see if a scenario can be created that works for both sets of stakeholders. Key R&D topics of interest to funders, according to our survey, include: customer behaviour (demand patterns, ability and willingness to pay), unit economics, distribution strategies and consumer credit.

Photo: MECS/Jon Leary

Promote Knowledge Management Reports and Databases

Many of the early investors in the clean cooking sector have come from the electricity access sector and made investments in PAYGO SHS companies. They are familiar with the generic SHS business models – vertically integrated companies, last-mile distributors or ancillary service providers – and stand-alone PV technology is well understood. In contrast, the clean cooking sector is still evolving, with multiple fuels and business models (e.g., 'tool & fuel' and 'tool only'), and the level of understanding is much lower. With this in mind, donors should consider funding the development of knowledge management reports and databases in specific reporting areas, including: reports on business models for different clean cooking technologies; comparative analysis between different technologies; country reports; reports on integrated energy planning and clean cooking; reports on markets and prices of competing fuels; and, databases to track clean cooking investments and checklist existing and potential investors.

Development of Standardised Health Metrics

Health is probably the single most challenging and important clean cooking impact to track for funders. Donor funding can be used to help develop accurate and affordable approaches to collecting, measuring and analysing health impacts. This could build on the considerable progress that has been made in this area through, inter alia, Berkeley Air and the Clean Air Africa team, with their long-term aim of being able to accurately measure health impacts cost-effectively.

Development of Standardised KPIs and Impact Metrics

Donors could support the development of key performance indicators (KPIs) and standardised impact metrics for the different cooking technologies. The most important impact metrics are: health, environmental benefits, gender equality, poverty alleviation and energy access.

ANNEX 1: CLEAN COOKING COMPANY QUESTIONNAIRE RESPONDENTS

African Clean Energy
ARC Power
Bidhaa Sasa
BioLite
BBOXX
BURN
Cal Poly
Connected Energy
CREATIVenergie
GenDev Centre for Research and Innovation
GERES
International Development Enterprise (IDE)
Kachione
KopaGas (Circle Gas)
Easy Solar
ECOS Rwanda
Greenway Grameen
HOBUKA
Kisambara Ventures
MeshPower
M-KOPA UK
NESELTEC
PayGo Energy
Pereybere Energy
PEEDA
Pesitho
PowerCorner
PowerGen Renewable Energy
Practical Action
RVE Sol
ServedOnSalt
SESCOM (TaTEDO)
Smart Villages Research Group
Straw Innovations
Sustainable OneWorld Technologies CIC
Fosera
SCODE
SunCulture Kenya
University of Southampton
Ventura Logistics

ANNEX 2: CLEAN COOKING CAPITAL PROVIDER QUESTIONNAIRE RESPONDENTS

Acumen
AfDB
AHL Venture Partners
bettervest
Beyond the Grid Fund (REEEP)
Cardano
CLASP
Clean Cooking Alliance
European Union
FINCA
FMO
Gaia Impact Fund
IDCOL
Kawisafi Ventures
Lendahand
Mercy Corps Ventures
Nithio
Oikocredit
Open Road Ventures
Osprey Foundation
Pact Inc.
Persistent Energy Capital
Proparco
Singh Family Trust
Shell Foundation
Solar Frontier Capital
SunFunder
UNCDF

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ABOUT ENERGY 4 IMPACT

Energy 4 Impact is a UK-registered non-profit organisation seeking to reduce poverty in Africa by accelerating access to clean energy, helping businesses and communities make better use of that expanded access, and working with the private sector to support the sustainability of these efforts. Energy 4 Impact values access to energy not as an end in itself but for the difference it makes to people's lives every day, in terms of agricultural development, economic growth, humanitarian recovery and climate resilience. Supported by a small headquarters in London, Energy 4 Impact currently operates from regional offices in Kenya, Senegal, Benin, Tanzania, and Rwanda. Over the last 14 years, Energy 4 Impact has provided access to 18 million people in Africa. In September 2021, Energy 4 Impact became a 100% subsidiary of the humanitarian and development NGO Mercy Corps. The merger allows Energy 4 Impact and Mercy Corps to increase impact by building on each other's technical expertise and reach, opening up new opportunities and funding for placing energy access at the heart of development projects. For more information on our work, please refer to *www.energy4impact.org*

ABOUT MECS

Modern Energy Cooking Services (MECS) is a five year programme funded by UK aid which aims to spark a revolution through rapidly accelerating the transition from biomass to clean cooking on a global scale. By integrating modern energy cooking services into energy planning, MECS hopes to leverage investment in renewable energy (particularly in electricity access, both grid and off-grid) to address the clean cooking challenge. Modern energy cooking is tier 5 clean cooking, and therefore MECS also supports new innovations in other relevant cooking fuels such as biogas, LPG and ethanol. The intended outcome is a market-ready range of innovations (technology and business models) which lead to improved choices of affordable, reliable and sustainable modern energy cooking services for consumers. We seek to have the MECS principles adopted in the SDG 7.1 global tracking framework and hope that participating countries will incorporate modern energy cooking services in energy policies and planning. Visit *www.mecs.org.uk* for more information.


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