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Reforming Climate and Development Finance for Clean Cooking

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Abstract: A transition to clean fuels and technology for cooking is increasingly recognised as a cornerstone of sustainable development. However, sufficient, appropriate, affordable finance to support the transition is lacking. Grounded in primary data collection via expert interviews, this study's research objective was to critically assess development finance institutions' (DFIs) delivery of climate and development finance to address cooking poverty. Interview findings underscore DFIs' important role in the transition, including to create the ecosystem conditions conducive to sustained investment. However, as a group they are not demonstrating the risk appetite and financial solutions that clean cooking markets need. Nor are they operating with the agility and flexibility required for rapid scale-up. Consequently, DFIs are not optimally fulfilling their mandates to create additionality and mobilise private capital in these markets. Interviewees call for DFIs to reconsider their approach, and we rely on these findings to posit a theory of change for clean cooking finance.

Keywords: energy poverty; energy transition; clean cooking; climate finance; development finance; development finance institutions; Sustainable Development Goal 7



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1. Introduction

This paper's contribution is to critically assess, through primary data collection and analysis, development finance institutions' (DFIs) delivery of climate and development finance to address cooking poverty and make recommendations to enhance its impact. Two research questions are explored. Firstly, what role should DFIs play in building sustainable clean cooking markets? Secondly, what characterises DFIs' delivery of climate and development finance for clean cooking? The paper adds to the limited academic literature focused on clean cooking finance at the macro level, as distinct from assessing individual institutions, financial instruments, or funding programs. It also contributes to efforts, led by developing countries, to comprehensively reassess the international financial architecture to fund solutions to address climate change [1–4].

1.1. Clean Cooking Access Deficit

Households can use a range of cooking fuels and hardware to meet their needs. A household cooking fuel or technology is considered “clean” if it meets the emission rate targets for fine particulate matter and carbon monoxide set by the World Health Organization. Biogas, liquid petroleum gas, natural gas, ethanol, electricity, and solar fuels emit low levels of harmful pollutants and are therefore clean fuels for this purpose, while “improved” cookstoves (ICS) are those that burn solid or liquid fuel more efficiently than three-stone or traditional stoves, typically made of mud or metal [5,6].

Past the halfway point of the 2030 Agenda for Sustainable Development, there is a persistent shortfall of access to clean fuels and technology for cooking as measured against the Sustainable Development Goal (SDG) 7.1 universal access target [7]. In 2022, 2.1 billion people lacked access to clean cooking and, as of 2023, they resided in 128 countries [8,9]. Rapid population growth in sub-Saharan Africa resulted in the clean cooking access deficit in that region increasing from less than 600 million to more than 900 million people between 2000 and 2022, while a business-as-usual approach is estimated to result in 1.8 billion people globally remaining without access in 2030 [8].

Cooking poverty gives rise to negative health, gender and climate impacts quantified at USD 2.4 trillion per annum [10,11], with household air pollution from the use of open fires and inefficient stoves powered by kerosene, biomass (wood, animal dung and crop waste) and coal estimated to cause 3.2 million preventable deaths annually [12]. Much has been written about the disproportionately negative effects of cooking poverty on women and girls [10,13–17]. Conversely, the co-benefits of access span multiple SDGs [18–21], to such an extent that the issue is said to warrant elevation to “the top of the sustainable development agenda” [22].

1.2. Funding Deficit

Governments’ capacity to develop and implement policies that enable clean cooking solutions to be deployed in the field is often sub-optimal [10,23–25]. Exacerbating this, fewer than twenty percent of extant country clean cooking plans are backed by clear financing schemes [9] and investment volumes are wholly inadequate to achieve SDG7 targets. The International Energy Agency (IEA) estimates that together with initiatives to incentivise adoption, USD 8 billion per annum for clean cookstoves, equipment and infrastructure is required up to 2030 to achieve universal access [9,26], while the World Bank Energy Sector Management Assistance Program (ESMAP) estimates an annual cost to 2030 of USD 148–156 billion, based on current policies, to achieve universal access to modern cooking services that rely on cleaner fuels [10]. In contrast, the IEA found total investment of USD 2.5 billion in clean cooking in 2023 [9,26], the Clean Cooking Alliance (CCA) tracked USD 215 million in enterprise investment in 2022 [27], and in twenty countries in sub-Saharan Africa and Asia where in aggregate more than eighty percent of people without access reside (“High Impact Countries (HIC)”), Sustainable Energy for All (SEforALL) and Climate Policy Initiative (CPI) [28] found that finance commitments averaged approximately USD 130 million per annum between 2015 and 2019.

1.3. Development Finance Institutions

This paper adopts a broad definition of DFI that encompasses government-owned or -controlled institutions mandated to provide capital at below market rates in support of clean cooking. References in this paper to public finance are construed as funding from governments that capitalise these institutions.

DFIs are primary conduits of concessional finance, which is not a single mechanism or type of financial support but “below market rate finance provided by major financial institutions, such as development banks and multilateral funds, to developing countries to accelerate development objectives” [29]. These specialised financial institutions, usually majority-owned by governments and capitalised from national or international development funds, are established to support private sector development in developing countries [30]. They play a key role in addressing countries’ often poor access to external financing through their core business of providing finance, through technical assistance (TA), and by promoting standards in the funds or companies they invest in [31]. Examples of bilateral DFIs include the Nordic Development Fund and the Netherlands’ development bank FMO, while multilateral DFIs encompass the multilateral development banks (MDBs), for example, the African Development Bank and the World Bank [32,33]. Concessional finance includes, for example: (i) grant funds in respect of which there is no expectation of repayment; (ii) equity or debt finance at lower interest rates, for longer tenors, or with

reduced or no collateral requirements than the private market might otherwise demand; and (iii) making finance available to start-up and early-stage growth companies that would otherwise have difficulty accessing it [9,33].

When delivered effectively, DFI finance can crowd capital into markets by mitigating credit, political, foreign exchange and other risks specific to individual investments and, in so doing, create additionality by providing services where the private sector is unable or unwilling to [34,35]. DFIs' catalytic role is also effected through their participating in blended finance structures, considered a key instrument to mobilise commercial capital and move towards fully market-based financing for the SDGs [36]. These combine "concessional finance from donors or third parties alongside DFIs' normal own-account finance and/or commercial finance from other investors, to develop private-sector markets, address the Sustainable Development Goals (SDGs), and mobilize private resources" [37]. Effective DFI participation in blended finance requires that the instruments they deploy align with the market barriers that motivate their contribution, that they articulate how their participation is additional, and that they do not use blended finance resources to gain a competitive advantage [38].

DFIs are a critical source of climate finance, understood as the funding of public and private investments to mitigate and adapt to climate change [39], notably as committed by developed countries to assist developing countries under the Paris Climate Agreement [40]. Within the evolving global climate finance architecture that has developed since the Paris Agreement [41], MDBs provided approximately USD 61 billion in climate finance to low- and middle-income developing countries in 2022 [42]. The twenty-six members of the International Development Finance Club constitute the largest provider of public development and climate finance globally, with annual commitments in aggregate exceeding USD 600 billion, including USD 150 billion of climate finance [43]. The Green Climate Fund (GCF) is the largest multilateral climate fund, established under the auspices of the United Nations Framework Convention on Climate Change Financial Mechanism [44], and as of 2023 had committed over USD 13.5 billion in aggregate to climate adaptation and mitigation projects [45].

1.4. Data on Finance Flows

DFI finance for clean cooking has remained modest over time and its success in leveraging private capital is inconclusive [9]. It has been suggested that MDBs and other DFIs have been prone to disregard clean cooking in their mainstream operations because the ICS projects that have traditionally dominated the sector do not match the larger investment profiles the institutions typically target [32]. While some dedicated, publicly capitalised funds exist, notably the World Bank's Clean Cooking Fund, the Spark+ Africa Fund, and the Modern Cooking Facility for Africa (MCFA), no DFI exclusively funds clean cooking.

As summarised in Figure 1, SEforALL and CPI [28] tracked uneven volumes of finance commitments for clean cooking from DFIs and multilateral climate funds between 2013 and 2019. In 2019, these accounted for half the total finance commitments identified that year from all sources, down from sixty percent in 2018. Contributions from private capital include those from institutional investors, impact investors, venture capital and private equity, commercial banks (including multilateral finance institutions), angel investors, and entrepreneurs. Commitments from multilateral DFIs amounted to USD 4.5 million in aggregate in 2019, compared to USD 45 million in 2018. The largest such commitment was USD 2 million from the World Bank for ICS distribution in Bangladesh, while the remainder amounted to under USD 1 million per project. International donor governments, including bilateral DFIs, made eighty percent of public finance commitments for clean cooking in 2019, distributed across several projects and HICs. Notably, commitments from domestic governments are not shown as these amounted to less than USD 1 million each year.

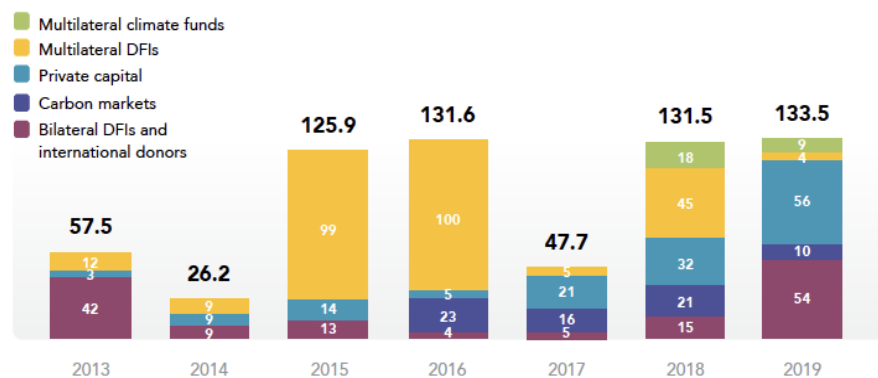


Figure 1. Clean cooking commitments in high-impact countries by source and financial institution, 2013–2019 (million USD). Source: Sustainable Energy for All and Climate Policy Initiative, *Energizing Finance: Understanding the Landscape 2021*.

More broadly, despite a modest uptick in 2022, flows of international public finance to developing countries for clean energy research and development and renewable energy production, in accordance with indicator SDG7.a.1, are in decline. The global average for the five years ending in 2022 totalled USD 14.1 billion, a reduction of USD 1.5 billion compared to the five-year average ending in 2021 that likely delays the achievement of SDG7 in especially vulnerable countries [8].

1.5. The Reform Agenda

An April 2024 G7 commitment [46] to promote clean cooking technologies and the May 2024 Clean Cooking Declaration [47], which proclaims the issue a critical priority and applauds efforts to bring forward USD 2.2 billion in public and private-sector funding commitments, reflect momentum to elevate cooking poverty on the global policy agenda.

This ambition is contrasted with the clean cooking sector’s unmet need for concessional and higher-risk funding. Indeed, of the USD 8 billion per annum the IEA estimates to be required to achieve universal access by 2030, it posits that around half (USD 4 billion) must be concessional finance [9]. For companies that provide solutions, there is evidence of longstanding and persistent shortages of finance in the early stages of the business growth cycle and limited, targeted public finance to accelerate innovation and mitigate risk for later-stage investors [48]. However, the IEA considers that “a full scale up of international capital and concessional financing” “in very short time [sic] with a relatively modest level of funds required on an annual basis” can set the international community on a path to universal access, making clean cooking a more attractive proposition for private investors through innovative financing solutions and mechanisms [9].

2. Methods

Primary data collection via in-depth, semi-structured interviews underpins this research. This method was selected considering the research questions and the small number of practitioners conversant in the intersection of climate and development finance and clean cooking. Semi-structured interviews permitted the research themes to be explored systematically and, by asking important open-ended questions about the subject matter, afforded a highly experienced group of interviewees the opportunity to share their unique experiences and perspectives [49].

In total, twenty-three interviews were conducted between August 2023 and September 2023. To the best of the authors’ knowledge, the interviewee sample is the largest yet assembled to inform academic research on public finance for clean cooking. Identification of interviewees was highly targeted, with participants selected based on their institutional affiliation and experience of clean cooking markets and/or climate and development finance. Of the twenty-three, only three were identified using the snowball method [50]. The research questions required that interviewees be drawn from two key stakeholder

groups representing demand for, and supply of, clean cooking finance, respectively; that is, companies that provide clean cooking products and services, and organisations that provide funding. The interview sample incorporates a range of funder types: international financial institutions, development agencies, private financiers (including impact and commercial investors), and philanthropies. Additional perspective was sought and obtained from multilateral organisations active in clean cooking markets and experts in climate finance policy and practice. Interviewees were located in fifteen countries, spanning five continents. Interviews were conducted in English and took place via online videoconference, ranging in length from thirty-two to seventy-four minutes, with an average duration of approximately fifty minutes.

Table 1 sets out the composition of the interviewee group by type (and number) of organisation.

Table 1. Interviewees by stakeholder group.

Category	Identifier Code	No. of Participants
Clean cooking company	CC	7
Climate finance	CF	3
Development agency	DA	3
Impact investor/private fund/foundation	PF	6
Multilateral organisation/international financial institution	MO	4

Data collected through interviews were recorded electronically and transcribed using Zoom and Microsoft Teams, and subsequently analysed by the lead author to identify common themes for discussion. Additional data collection occurred via email exchanges with interviewees and was supplemented by peer-reviewed literature; commercial, government and institutional reports; articles; and web pages, identified through keyword searches.

All interviewees gave their informed written consent before they participated in the study. The study was conducted in accordance with the Declaration of Helsinki and the ethical review guidelines and processes of The University of Queensland and complies with the National Statement on Ethical Conduct in Human Research (Australia) (2007, current revision).

The research methodology's limitations are noted. Specifically, data collection and analysis were performed by the lead author, which creates a risk of undue subjectivity and bias in the reporting of results. Being a qualitative study, the sample size could also limit the generalisability of its findings and recommendations. The authors attempted to mitigate these risks through co-authors undertaking a review of the key, recurring themes arising through the interview process, as identified by the lead author. Further, the interviewee recruitment strategy sought to capture a robust sample of expert interviewees with diverse subject matter expertise and institutional affiliations, as well as good geographical and gender balance.

3. Results

Interviewees were invited to share their views about the role that DFIs play, and should play, in building sustainable clean cooking markets. They were then given the opportunity to characterise DFIs' current delivery of climate and development finance for clean cooking and to recommend any changes. Interview responses were grouped according to key, recurring themes arising from the discussions. These are set out below in order of the frequency with which they were mentioned by interviewees.

All interviewees from the clean cooking, development agency, and multilateral organisation groups spoke to sub-themes 3.1 and 3.2.1–3.2.3. A clear majority of interviewees from the private finance and climate finance groups also provided responses aligned with these sub-themes, noting that in aggregate, members of these groups tended to emphasise sub-themes 3.1.2 and 3.2.1–3.2.2. This could reflect the broader mandates and experience

of some interviewees from the private finance and climate finance groups, beyond clean cooking. While not responding to a question asked directly during the interview process, sub-theme 3.2.4 captures and describes a sentiment expressed by members of all interview groups.

3.1. DFIs' Role in Clean Cooking Markets

This section sets out respondents' views about DFIs' unique position and influence within clean cooking markets, which provides context for the discussion in Section 3.2 about the effectiveness with which they are perceived to execute their mandates.

3.1.1. Ecosystem Building

Citing the size of the access challenge, chronic finance shortfalls, and poor coordination, respondents unanimously asserted that a system change approach, encompassing appropriate skills, technology, policy, and finance, is required to transform clean cooking markets and improve the acceptance and investment readiness of solutions. "Clean cooking is such a humungous challenge that we really need to tackle it from a number of different angles" [MO2]. DFIs are integral to building the ecosystem to support such transformation, including to increase markets' capacity to absorb finance, and many respondents considered this to be arguably their most important function. By operating at the interface of government policy, finance, and markets, DFIs are uniquely placed to shape and influence market transformation, provided this is done in the manner of a true partnership that values and respects local institutions and knowledge.

As a priority, it was felt that DFIs can raise clean cooking's profile among host country governments. As one interviewee from a multilateral organisation explained:

Clean cooking can be invisible to policymakers because the people who are experiencing the pressures and pain of lack of access are far away from the capital cities. They don't have access to a voice, they don't talk to decision makers, they're easily forgotten about. [MO3]

A private funder elaborated by emphasising the importance of positioning end use consumers at the centre of solution-making:

One thing we all, myself included, [should do] is to really put yourself in the position of those that need the solutions. I don't think that happens often enough. I spent time in the field talking to a woman who said 'my day is only about cooking. It starts early in the morning collecting wood, and then I cook for ten people and then clean up. And that's my day'. [PF2]

While as of March 2023, seventy-two low- and middle-income countries had included clean cooking targets in their Nationally Determined Contributions (NDCs) under the Paris Agreement [51,52], many countries with access deficits lack them. Respondents considered that DFIs can help governments formulate NDCs and clean cooking roadmaps and define policy measures to make good on them, within an integrated approach to energy sector planning [53]. Such action by DFIs is apposite considering research findings that suggest delays in developing countries receiving climate finance have resulted in a "trust deficit" that has weakened those countries' determination to enhance their emissions reduction commitments [54].

Once targets are established, DFIs can help governments operationalise them. This includes support to formulate laws, policies, and regulations; to develop product standards and reform tariff policy, for example, tax exemptions on imports of stoves and appliances; and to design local manufacturing incentives. Together, these actions can "soften the market" and make market entry more attractive for companies and investors. They also create efficiencies to address what one respondent perceived as constraints on DFIs' activities due to host country government structures. "It takes too much time, and it may be that one reason is that it always has to be channelled through the government" [DA2].

Beyond the public sector, respondents confirmed a pressing need for domestic financiers to participate in clean cooking markets, especially to supply local currency finance. “It becomes very difficult to scale locally unless you’re able to access local finance. That’s absolutely critical” [MO4]. This, in turn, requires focused policy efforts to encourage local capital market participation [9]. Respondents encouraged DFIs to educate local financial actors about the commercial opportunities arising from clean cooking, and in due course to co-finance with them. For experienced local financiers, especially those from countries with high vulnerability to climate risks that have historically contributed least to greenhouse gas emissions [55], but that research has shown received only 8% of MDB climate funds in aggregate between 2015 and 2020 [56], DFIs and other climate funders must proactively engage.

Accessing public finance is quite difficult, even when you look at it from a developing country like us. It’s more challenging. How are we going to unlock that process or how can we make it easier to access that funding? The [emissions] contribution from our country is negligible. But we are one of the most vulnerable countries. So it’s not created by us but we are feeling the impacts of climate change. We have not been supported enough to meet our climate-related funding requirements. I think public financial institutions should focus on that point and then make the deal process easier, or even look at country funding envelopes. [PF3]

Respondents favoured DFIs taking action to nurture demand by sponsoring awareness raising and education initiatives among disenfranchised consumers, for example programs that promote clean cooking’s health benefits and demonstrate the use of modern stoves to cook traditional meals. These initiatives were seen as important in helping to inform potential customers and improve their agency in decision-making.

We have to look at the inclusive aspects, on the socioeconomic aspects rather than the economic aspects. Everybody talks about the energy transition from the supply side. Behaviour change will, to a certain extent, determine the market where supply needs to follow. [MO1]

Inclusion requires efforts to engage all householders involved in activities that facilitate the adoption and sustained use of solutions, to address what research indicates is a historically limited engagement of men and children in cookstove programs [57].

Respondents from multiple groups urged DFIs to fund market building initiatives to address investor concerns about a lack of viable business models, limited investment pipeline, and potential investees’ lack of profitability and operational history as barriers to scale [32].

Addressing some of the systemic issues that prevent more companies from becoming investable in the space is a very good use of public funding, if it’s done right. [PF1]

Such interventions could include, for example, identifying and working closely with small- and medium-sized enterprises, especially local enterprises, to improve their investment readiness.

It’s hard to find the right local entrepreneurs, but if you have them, I think they can make much more speed, because they know the game locally. Local entrepreneurs find a way to the right people. [CC2]

This view is supported by evidence that, despite chronic underinvestment, locally owned and/or women-led companies in the off-grid energy sector in developing countries, including clean cooking enterprises, achieve outsized social impact and high rates of customer satisfaction, and reach more women customers and customers living in poverty compared to their peers [18].

Entrepreneurs’ calls for TA come with the caveat that it must be thoughtful, targeted, and unpatronising.

Technical assistance, sometimes it's as good as money and sometimes even better. But for the most part it's less good than money and at worst it's even a negative. Some programs kind of force you to. They assume that you are not capable. [CC1]

Further, without access to finance or introductions to potential funders, capacity-building programs for emerging businesses have been viewed as “essentially useless and ineffective” [58].

Notwithstanding cooking poverty’s increased profile, a clear majority of interviewees noted wide scope to capture knowledge from the field, amplify success stories, and undertake more peer-to-peer learning. They suggested that DFIs take a leadership role in these activities, for example by sponsoring the development of best practice case studies, including learnings arising from unsuccessful projects, and evaluating business models to generate adaptable, publicly accessible evidence to inform stakeholder decision-making [59]. One interviewee cited the relevant questions as: “Who’s doing what? In which country? What are the best practices? What failed? What worked well?” [MO3] Others concurred, adding that DFIs must remain close to their investees and funded projects at field level rather than adopt an arms-length approach. These reflections are consistent with ESMAP’s observation that most clean cooking sector data come from academic journals, with the results of a great deal of valuable fieldwork not incorporated into the synthesis of evidence [60].

3.1.2. Financial Catalysts

All respondents confirmed that capital is available for clean cooking but in volumes that do not reflect the sector’s importance and are manifestly insufficient to support a transition to universal access.

It's really a remarkable space. When you think that over the last years, annually, there's just a few hundred million [dollars] being invested in this sector, while there are huge implications for climate as well as a whole raft of other SDGs. It's one of the highest impact potential investments but still it's received such little focus and attention. [MO4]

With limited exceptions, private financiers were considered risk-averse to clean cooking investment. Excepting the small number of companies that have reached scale, respondents described the sector overall as uncommercial and unbankable, marked by high risks, substantial affordability challenges, and poor data availability. In their view, these multiple market failures point to an outsized role for governments in supporting clean cooking as a public good. “Because the market is so nascent, I think the role of public finance is even greater because the functioning of the market is not optimised yet” [PF4]. Respondents noted DFIs’ historically prominent part in addressing cooking poverty and emphasised their catalytic role in attracting private capital. “[Public finance] has to unlock. The big money comes from private investors.” [CC1] Some respondents observed that DFIs have tended to invest through intermediaries rather than directly, for example through capitalising clean cooking funds and via development partners. They suggested that this may be because, traditionally, DFI minimum transaction sizes greatly exceed the absorptive capacity of most clean cooking companies and projects.

Entrepreneurs noted that good, well-informed investors, including DFIs, can act as powerful partners for businesses and help drive their strategy. They cited positive experiences with the International Finance Corporation, MCFA, SNV, Spark+ Africa Fund, United States Development Finance Corporation, and Klik Foundation and emphasised the valuable feedback loops that benefit financiers when they collaborate with investees. This positive spirit of partnership was echoed by a funder who described their investees as having “joined hands with a reputable international organisation backed by public donors, and that hopefully gives them the opportunity to leverage more funding” [MO2].

3.2. Characteristics of DFI Finance for Clean Cooking

The balance of the interviews discussed how DFIs carry out their financing activities and canvassed ideas about strategic and operational reforms to increase their impact.

3.2.1. Bureaucratic, Slow, and Rigid

A clear majority of interviewees, including all respondents from the clean cooking group, agreed that, with some exceptions, DFIs as a group are not moving at the speed, or with the agility and flexibility, that clean cooking markets require.

Entrepreneurs expressed frustration at what they perceive as slow and opaque decision-making, queried the reasons for such inefficiency and highlighted the commercial impacts of delay. “They’re taking so long to make decisions” [CC5]. Another elaborated: “It takes normally 12 to 18 months from concept note to contract signing or money in the bank. How can that be streamlined to one month?” [CC1] Aside from the opportunity cost of entrepreneurs’ time, excessive delay in a funding decision or funds disbursement can be detrimental to business planning and cash flow. This has a negative impact on customers and suppliers, but also on potential private-sector co-financiers accustomed to a much faster pace of transactional finance.

The challenge is that public finance doesn’t operate at the speed of private equity. And they need to if they’re going to operate in this space. You’ve got to be able to transact in a way that is commercial. [CC5]

An interviewee from the climate finance group concurred:

The frustration that we had working with DFIs, it was just too slow. I mean, everything’s so frantic in the private sector that if you don’t get an answer, you call the next number. [CF3]

Published data support these respondents’ views. SEforALL and South Pole [61] found significant gaps between commitments and disbursements of development finance for energy projects and programs, as tracked in the Organisation for Economic Development’s Creditor Reporting System database. Committed finance is not the same as the disbursement of funds necessary for impact on the ground. Between 2002 and 2018, fifty-eight percent of planned disbursements of development finance to the energy sector in HICs were delayed, and disbursements of USD 32 billion substantially lagged finance commitments of USD 52 billion in the period 2013–2018.

Respondents from all groups described a DFI funding approach that is overall reactive, bureaucratic and inflexible, and that DFIs tend to be poor at systems thinking and innovating.

There’s a perception that DFIs and multilaterals have a particular way of working and like to stay within that. Sort of ‘swim lanes’, as people might say. And to jump outside of that takes an incredible bureaucratic effort. [PF5]

Interviewees from the clean cooking group opined that companies are constrained by such inflexibility and can experience substantial difficulties accessing funding. As a threshold issue, they noted that most start-up companies are too small to have the standing to do so and suggested that DFIs reduce the funding application burden, for example by limiting “absurd and extraordinary [due] diligence processes” [CC5].

A specific obstacle faced by a private financier relates to achieving GCF-Accredited Entity status, which would permit their institution to develop climate funding proposals for GCF evaluation and to oversee resulting GCF-financed projects. In their view, GCF rules are overly restrictive by giving national governments a power of veto over entities seeking accreditation, even those with a pipeline of potential transactions, and therefore unduly limits the number of accreditations.

It’s a bureaucratic process, and our institution alone cannot even directly approach [GCF]. So we have to go through the government bureaucratic processes, and the government is not supportive of our request. How can that issue be addressed? [PF3]

Multiple respondents from the clean cooking, private finance, and climate finance groups described a situation of poorly designed or perverse incentives underpinning DFIs’ operations, observing that they can be hampered by an aid/development/NGO

mindset of how private markets operate that is at odds with the clean cooking sector's increasing market orientation. This is exemplified by DFIs' historical tendency to favour long-term program funding over bespoke financial solutions. Respondents noted that rules attached to such programs can become obsolete in dynamic markets, with unintended distortionary effects when companies that have secured funding remain tied to outdated performance metrics.

You often end up doing things that you put in your proposal three years ago, and it's not relevant. Some are extremely rigid with it, others less so. If you have a blowtorch in your back to deliver to get the next payment, you may sacrifice for low quality because essentially your most important customer at a certain stage is not the customer, it's the grant giver. [CC1]

As an alternative, interviewees suggested that DFIs harness entrepreneurs' commercial experience and work in closer partnership with them, to better understand the financing risks they face, inform a pathway to better manage those risks, and ultimately remove the need for DFI concessionality.

Entrepreneurs noted a frequently heavy reporting burden. As one expressed it, DFI financing terms are "still largely market rate, but with a lot of baggage" [CC7]. On the one hand, making available data arising from DFI-funded activity is considered wholly justified to grow the sector. On the other hand, the scope of reporting is considered excessive in the context of companies', especially early-stage companies', limited resources, resulting in high opportunity cost. "It was just so much work, and the expectations were so disproportionate to where the business was and what we could do and had the capacity to do" [CC3].

Often, DFIs justify grantees' reporting obligations in the name of ensuring value for public funds. To this point, one entrepreneur opined:

The amount of costs throughout the chain to ensure that money is spent properly can be astronomically high. A direct transfer, even given the risks, may still come out better as we've seen in the disaster response sector. [CC4]

A second concurred, querying whether the approach aligns with the expectations of those that ultimately capitalise DFIs.

If we're talking about custody of taxpayers' money, if that is justifying how some programs are running, including the risk aversion, is that really what taxpayers want? Do they understand how some of these programs are actually run? If money was earmarked for climate finance in sub-Saharan Africa, and if money is not paid out, what happens to that money? I feel there's an opaqueness in the whole sector. If it cost taxpayers a million dollars, how much of that reaches the distribution company, and how much reaches the end beneficiary? [CC1]

Interviewees from multiple groups emphasised important technological advances that facilitate monitoring of cookstove and appliance use and suggested that DFIs could, including by collaborating with governments and utilities, harness that technology to support a more streamlined approach to funding and reporting. Further, when usage data are shared outside the funding agency, they can assist financier credit assessment, empower end users, and help build the sectoral evidence base.

3.2.2. Risk Aversion and Fear of Failure

Respondents emphasised that to catalyse commercial finance and grow clean cooking markets, DFIs must assume risks that are additional in these markets. However, the overwhelming majority of interviewees across all groups considered that DFIs as a group demonstrate a risk appetite that is incompatible with these objectives. One entrepreneur stated:

I don't think the public money out there has an interest in actually solving this problem to the scale required, otherwise it would be solved. What have they delivered to date? Very little in forty years. [CC7]

A philanthropic funder endorsed this view:

I mean the clean cooking sector has been around for a while now. If the reality is that today, in 2023, we're still calling it a nascent sector, that essentially means that a lot of the public financing flows that were intended to come to the market haven't in the way that would have enabled the market to move from nascent. [PF4]

Respondents from all groups perceived an overall risk aversion, describing DFIs' approach as "often skewed against risk-taking" [PF1] when they should be "risk seeking" [CC1]. Underpinning this is a pervasive view that DFIs are overly concerned with preserving their capital and credit ratings, resulting in a perceived low tolerance for failure. "The mentality is to not take risk and not to lose money" [DA3]. One entrepreneur reflected: "The challenge, I think, is that too much public financing operates from a space of fear of screwing up. That is the driver" [CC5]. Another noted the paradox between DFIs' low risk tolerance and their government donors' climate finance commitments. "I find it particularly interesting for DFIs, especially the European DFIs, because there's so much European government commitment to the Paris Agreement" [CC6].

The corollary to DFIs' perceived risk aversion, and a recurring theme in interviews, especially with members of the clean cooking and private finance groups, regards DFIs' finance facility pricing. Interviewees noted that DFIs, including when making finance available through intermediaries, seek returns that are unrealistic at this stage of the sector's development, uneconomic for companies seeking finance and un compelling for potential co-financiers.

Achieving market rate returns with that baked into your growth requires businesses to be uncommonly profitable and to grow uncommonly fast in markets where we know that's harder to do than in other places. And so my view of a public finance institution is that it should be taking risks and catalysing growth. Their view is that it should be operating for a very long time, preserving its capital and preserving its high bond rating, and its ability to access the capital markets at low cost. [PF6]

In contrast, respondents from development agencies, multilateral organisations and international financial institutions spoke to a conflict between fulfilling their mandates to assume risk, while experiencing pressure from some donors to leave no one behind in the clean cooking transition and therefore an obligation to cater to the very hardest-to-reach end users. This can create a difficult choice between allocating scarce public funds to scale up successful strategies, including by co-financing with the private sector, or to projects in markets that are far from commercial and therefore unlikely to attract private capital.

Multiple respondents noted that a symptom of investors' risk aversion is the high concentration of investment in a small number of established companies. "It's not a sector where you've got a bunch of massive players" [PF6]. This is confirmed by CCA's finding that in 2022, the seven largest clean cooking companies by capital raised accounted for 90% of total investment, the same number as in 2020 [27]. To reduce concentration, interviewees suggested that DFIs broaden the universe of companies that commercial funders consider investable by exiting their positions when technology and business models mature. "If money was available more democratically and earlier, it would really drive growth" [CC1].

Fundamental to DFIs' risk appetite are the investment criteria that guide their staff. Interviewees overall regard DFI personnel as skilled, capable, and well-intentioned, with some bringing decades of relevant experience. One interviewee from the clean cooking group summed up a common sentiment among this cohort that "some programs have been very supportive, and it goes a really long way as an entrepreneur" [CC1]. However, individuals are often constrained by restrictive investment and underwriting guidelines that limit their capacity to take risks. A healthy risk tolerance is considered essential as DFIs, by their nature, should be considering borderline transactions at the margins of viability. Respondents emphasised that failure is inherent in such risk-taking and, importantly, the valuable lessons arising therefrom. As one entrepreneur elaborated:

It's like we need to throw out the net wide to get the unicorns, and many will fail, whatever fail means, because it contributes to the [sector] understanding. [CC1]

Another concurred:

If you really want to go and build an impact unicorn in whatever sector, then you're going to have to expect that eighty percent of your best will fail. And you get fired for that sort of stuff in public sector land. [CC7]

A member of the private finance group reflected on the effects of DFIs' low risk tolerance on their ability to catalyse commercial finance:

In emerging markets and in a nascent sector like clean cooking, doing the right thing involves taking risk and sometimes failing, and DFIs and MDBs often don't have the mandate required to develop a nascent sector. While we were fortunate with numerous DFIs who bucked the trend, in many cases their incentives don't lead them to extend sufficiently concessional capital (in terms of risk and/or return expectations) to mobilise private capital. [PF1]

Respondents urged DFIs to focus less on the possibility of failure, leading to timidity and a reluctance to assume risk, and place more emphasis on procuring outcomes and impact from their funded activities, with both DFIs' and their investees' success measured accordingly.

To me, the best development would be if public finance procured validated outcomes. So, for example, SDG impact or gender impact. Or climate impact. And there are some very good proxies [to enable this], for example, payments, electronic payments, mobile money. [CC1]

3.2.3. Limited Range of Financial Solutions

The majority of respondents perceived DFIs to commit their capital for clean cooking through a relatively limited range of financial instruments and structures. In several cases, they conflated DFIs with grant funders, with grants provided either unconditionally or on achievement of predefined results, known as results-based financing (RBF) [62,63]. While grants are considered useful in some instances, respondents noted their limitations and believed DFIs often fail to consider them in the context of the whole financing cycle. They suggested that DFIs "stop copy paste RBF programs for stoves" [CC7] and noted that RBF "is not designed for the private sector that it's supposed to mobilise" [CC6]. Funders themselves recognise the instrument as a potential distraction:

RBFs have almost no risk for the donor. They actually keep a lot of the sector in hibernation, because RBF doesn't really enable things to grow. Companies just get rewarded for particular behaviour. [DA3]

Several respondents expressed that, while grants should be part of the suite of DFI financial solutions, they have the potential to distort markets if not well designed and targeted. Grants are also of decreasing relevance to companies as they mature and require increasing amounts of capital to scale [48]. "When people are able to run a business, they are not actually looking for grant funding" [CC2].

Interviewees observed that, contrary to the need to attract private finance to clean cooking [9,64], relatively few examples of blended finance structures exist. They noted the importance of DFIs anchoring such structures, to mitigate risk and share learnings with private investors through co-financing transactions.

There is definitely this grey zone between outright grants and semi-commercial investment or concessional finance. I believe that's where a lot more intervention is needed from public funding. And given that public funding is scarce, of course it needs to blend with other forms of capital to make the scale equation work. [MO4]

Respondents from all groups advocated strongly for a more nuanced and tailored approach to DFI financing that draws on an expansive toolkit of instruments and structures

and reflects the sector's need for high risk and patient capital in challenging markets. The ability to tailor financing to individual circumstances is important because clean cooking solutions are heterogeneous and serve different markets, underpinned by different enterprise business models. As one interviewee from a development agency explained:

We have public finance resources, we have aid, we have grants, and we also have guarantee instruments. One way to look at it is as the different types of finance that a sector, and particularly companies, need to scale and grow and establish themselves. [DA2]

Another added:

You need multiple instruments available in the markets; some companies need a bit more on the equity side and some more on the loan side. But in the end, these bigger and smaller companies, they all need to have access to finance, and public organisations need to make sure that this somehow happens. [DA3]

The quality of clean cooking access that individual products deliver is measured by reference to ESMAP's Multi-Tier Framework, which incorporates a multi-dimensional definition of access measured across a tiered spectrum, ranging from Tier 0 (no access) to Tier 5 (the highest level of access) [10,65]. Interviewees observed that DFIs' tendency to provide grant funding for high volume distribution of low tier cookstoves, while perhaps initially helpful in raising clean cooking's profile, is less relevant for the sector at this stage of its evolution. Evidence from the field supports this view and corroborates a perceived top-down DFI funding approach.

So, these improved cookstoves, people used them for a while. They are too slow to cook, and they are still using the same dirty fuel that we tell people not to use. . . Therefore, people don't see the reason for adopting them. But I would blame this on the development partners who have been pushing down the throats of Africans to use improved cookstoves. [66]

Respondents from multiple groups asserted that meaningful scale at this juncture requires a greater focus on fuels for higher tier solutions and related storage and distribution infrastructure and supply chains. "It takes two minutes to study the problem statement and realise it's about the fuel. Appliances are just a small part of the thing" [CC7]. A private funder noted the effect of these market dynamics on financing: "It's an infrastructure play that needs long term, low interest finance and also risk capital" [PF2]. To achieve adoption of electric cooking at scale, several respondents noted that in addition to appliance funding, funders must engage with host country governments to ensure that their electricity utilities and networks are fit for purpose.

In contrast, two development agency interviewees emphasised the role of small companies that deliver lower tier solutions to hard-to-reach customers, and that it was important for DFIs to cater for them.

I think it's these companies that will keep the ecosystem going and they will go to places where, let's say, the marginal returns for a big company are just not enough. [DA3]

Another concurred:

Mainstream clean cooking solutions/technology are indeed too often ignored in the global discourse, whereas innovations (pay-as-you-go, forced draft gasifiers, briquettes, etc.), products in a pilot phase and/or serving niche markets, are getting a lot more attention and funding. [DA1]

Subsidies were considered important, especially for last-mile consumers, and this theme arose in several interviews. Acknowledging that a range of definitions, metrics, and cost components are used to measure affordability [67], companies and private investors alike cite consumers' lack of capacity and willingness to pay for clean cooking solutions as one of the most important barriers to uptake [32]. Respondents advocated for DFIs to work with host country governments to design and offer consumer subsidies where appropriate.

The affordability gap is a huge issue which can essentially only be covered by a smart subsidy approach. And I think that's a very tough combination still for many donors to figure out what the sweet spot is. [MO4]

Nearly all respondents spoke to the increasingly important role of carbon finance, which is revenue arising from the sale of verified emissions reductions through the use of a clean cooking solution [68], as a funding source. Two-thirds of investment tracked to companies in 2021–2022 was to enterprises that were either generating carbon credits or certifying a Program of Activities with a carbon registry [27], and interviewees noted that some companies achieving scale are driven by significant amounts of carbon finance rather than investment capital. However, several respondents stressed that carbon markets are not yet fully mature and carry risks associated with methodologies and crediting [69]. Others noted the importance of capturing the benefits and proceeds of carbon credits and the difficulties in ensuring that these are appropriately shared with communities and households. In this regard, interviewees emphasised that advances in Internet of Things-enabled data collection from the field can facilitate monitoring of cookstove usage and supported calls to improve methodologies to verify results and thereby help monetise SDG impacts [70].

Above all, respondents from all groups urged DFIs to have a comprehensive understanding of the markets they operate in, to actively listen to market participants to inform their financing strategies, and course correct as necessary. DFIs should “have the ability to continuously engage with the sector and see where it’s going, start with a basic theory of change and then continuously change that. That’s how we’re working” [DA2].

3.2.4. Strategic Misalignment

The expert interviews revealed a high level of mutual respect between funders and entrepreneurs, and a shared desire to achieve flourishing clean cooking markets. As one respondent from a development agency put it: “I think our role with public financing is to see how we can best support and share some of the risks, while seeing that this can become sustainable in the future” [DA2]. However, while exceptions exist, respondents spoke to a historically poor implementation record: “it’s a failed sector, but I think mostly because of how we executed on it” [PF2]. Some interviewees opined that DFIs are simply not the right “homes” for clean cooking, with one predicting: “my expectation is that the whole sector will be disrupted, but it will likely come from a brilliant idea that then applies into the development sector as part of a wider global shift” [CC4]. Respondents perceived a lack of strategic intent in DFIs’ approach, that they are “not thinking of cooking as a scalable industry” [CC7], and have not created leverage for private financiers.

There’s all this talk about the financing gap in clean cooking, but not nearly enough conversation around what it is you’re trying to finance, and what you’re trying to do with that finance. [CC5]

One interviewee reflected as to why DFIs are not assuming the risks the sector needs, and the structural problems preventing finance from flowing in the volumes and forms required.

It’s not that they’re not fit for purpose. It’s just that they’re not doing it. The world is awash with maps and roadmaps. But actually, I don’t think we’ve got the right engine for driving decisions, and that is a fundamental condition for scale. Do we need to think differently about the problem, because we can’t scale outcomes unless we start talking about it in a different way and grappling with it. [CF2]

Underpinning this is a perception among interviewees of a fundamental misalignment of culture and practice between DFIs and the clean cooking market actors they serve. On one level, this is expressed as DFIs attempting to facilitate entrepreneurship in small, dynamic markets through typically large, rigid bureaucratic structures whose mandates encompass the full spectrum of development. Consequently, the objective of eradicating cooking poverty is insufficiently embedded in the investment strategies, instruments

and underwriting processes of DFI projects and programs. This can result in an inflexible, top-down funding approach that does not adequately account for individual market characteristics and loses sight of end use consumers as ultimate beneficiaries, thereby undermining DFIs' development objectives. Several respondents reiterated that poorly designed and targeted interventions can distort markets and delay their maturity.

If there had been even less public investment than there was, maybe we would have been already at the stage of electric cooking 10 years ago. [CC3]

Much of the misalignment in culture and practice is not specific to clean cooking but reflects the nature of DFI institutional structures and how they interact with developing country markets. An impact investor noted a certain institutional inflexibility that does not easily adapt to changing market needs.

Public financing agencies have particular buckets of money which need to be deployed in a particular way. They are constrained by terms and conditions and specific characteristics that they need to meet. So there's a set of guidelines, whether that be from a debt perspective or an equity perspective. They'll have a credit policy sitting there. They'll have a set of underwriting perspectives from the equity side. Yet they're often being developed for markets which are already established rather than those really early-stage markets. And I think that's where you need that high level of flexibility to come into structures so that you're actually fitting the financing structure to the need versus trying to fit the need to the financing structure. [PF5]

Respondents reflected that clean cooking impacts can be hard to measure and that it can be difficult for financiers to define "success." They queried whether a fixation on access is the appropriate key performance indicator, or if the sector would be better served by emphasising a clean cooking transition and adopting metrics that prioritise its benefits, for example healthier populations, time savings, improved educational attainment and increased income from participation in economic activities outside the household. Multiple interviewees referred to the Clean Impact Bond, co-developed by a DFI, as an example of an innovative financial instrument that monetises clean cooking co-benefits [71].

Expanding on this, respondents considered that a key strategic omission is DFIs' failure to properly reflect co-benefits in their finance facility pricing and overall funding approach.

Public finance has a very key role to play of being able to price in not just commercial, but social and environmental returns of an intervention. If an intervention could already deliver pure commercial returns, there'd be no additionality and no need for public finance. [CC4]

A perceived outsized focus on financial returns sends certain signals to market participants, with some interviewees believing that DFIs are coming to cooking deals too late because of this, in contrast with their fundamental rationale to create additionality. "What you don't see is them willing to absorb some of the risks and the costs of investing in these markets" [PF6]. It has been suggested that as the leading providers of concessional funding, DFIs should be more ambitious and intentional in aligning their capital with the mobilisation of private finance, and that their organisational targets and performance metrics should be revised to reflect this [72].

4. Discussion

Despite interviewees' own institutions adopting a strategic approach to guide their clean cooking interventions, some reflected on the absence of an overarching theory of change for the sector. "What is the unified theory of clean cooking?" [MO3]

From a financing perspective, the absence of a collective statement of strategic intent from the funding group manifests in limited translation of targets to policies and financed activities in the field.

We've had a whole debate that's been enormously successful in many respects since Paris, about sustainable finance and green finance and sustainable infrastructure. There's been

an absolute gap between that tier of debate and the one underneath, which is how do you deliver outcomes? But engaging with finance practitioners in that debate points to things that have plain names, but are unfashionable in the sustainable finance world, like policy, regulation, public finance. [CF2]

This view is consistent with calls for a mission-oriented approach to financing the SDGs, especially through a more dynamic and coordinated ecosystem of DFIs:

While the SDGs present a commendable blueprint for achieving inclusive and sustainable growth, they do not yet provide a detailed investment strategy or guide for actualizing that vision. [73]

Interviewees for this study spoke of a historical approach to DFI financing that is risk averse, top-down, and technology focused, executed through a limited range of financial instruments. With some exceptions, there is a perceived lack of attention to the highly localised nature of cooking poverty and to the diversity of financial transactions between companies and end use consumers. Without an enabling ecosystem that addresses manifold barriers relating to consumers, sector transformation, market development, and information, growth in the volume of individual transactions that are the foundation of clean cooking markets will be limited. By extension, the benefits of cleaner cooking do not arise unless they are grounded in sustained consumer adoption of solutions. Arguably, these factors require all financiers to place individual transactions at the centre of financing efforts and take steps to identify and mitigate the associated risks, while being conscious of how each transaction contributes to growth of the overall ecosystem.

A theory of change model [74] provides a useful framework to articulate how activities identified by interviewees for this study as potentially transformational can lead to impact. Efficient financial markets require institutions, including DFIs, to be clear about the strategic intent behind their activities and where each institution sits in the financial value chain. Consistent with the observation that a delay in the energy transition may be attributable to a mismatch in demand and supply of finance, rather than the existence of an absolute financing gap [75], this should inform how individual institutions' investments will contribute, through risk mitigation and shared learnings, to sustainable growth in clean cooking markets. Put another way, a finance theory of change requires a system-wide view of the capital continuum for clean cooking and a shared understanding among financiers about the conditions that make markets sustainable and companies and projects investable. From a public policy point of view, an emphasis on the context in which finance is provided aligns with evidence that climate finance policies are more effective when grounded in a broader set of complementary policies that together are designed to achieve climate-related goals [76].

Figure 2 outlines a theory of change for clean cooking finance that incorporates a set of outcomes and sustainable development impacts and how these are expected to be achieved through a reformed approach to financing that is especially, though not exclusively, applicable to DFIs.

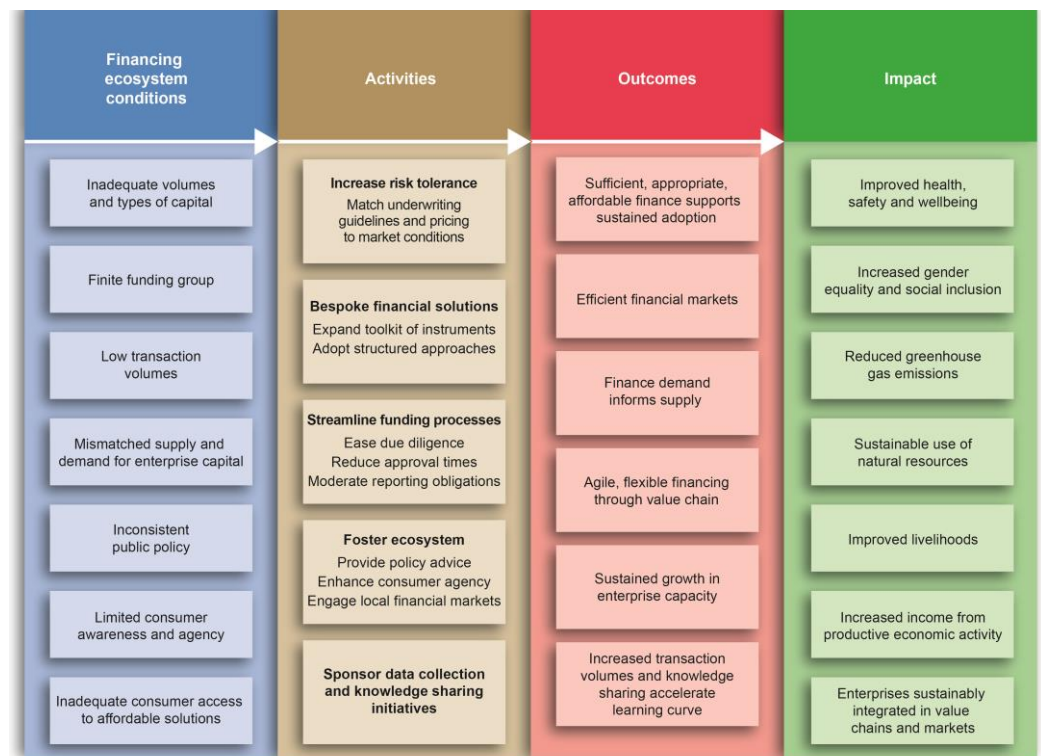


Figure 2. Theory of change for clean cooking finance.

The theory of change enables stakeholders to see financing activities and their resulting outcomes and impacts as a logical sequence, and therefore to better discern finance's role in effecting change. The ecosystem conditions in which finance is provided present key barriers to clean cooking investment [48]. Interviewees for this study articulated a set of activities that financiers could undertake to help address these barriers. These are summarised as financiers demonstrating increased risk tolerance; a greater willingness to tailor financial solutions to individual transactions; a streamlined approach to funding processes; deeper engagement with local market participants; and a leadership role in knowledge sharing. In carrying out the activities, financiers address barriers to investment in individual transactions, while in aggregate contribute to mitigating risk within the financing system as a whole. Implementing the activities can be expected to foster a more vibrant financing ecosystem marked by the availability of greater volumes and types of capital from diversified sources and improved access to finance on more attractive terms for consumers and businesses. These conditions are conducive to outcomes in the form of more efficient, responsive, and flexible financial markets that facilitate sustained consumer adoption of clean cooking solutions and support enterprise growth; an accelerated learning curve for the sector arising from an increased volume of transactions; and effective knowledge sharing among the funding group. Consistent with interviewees highlighting clean cooking's many co-benefits, a faster transition enabled by a reformed financing system can be expected to lead to a range of positive social, environmental, and economic impacts for consumers, industry, and society at large.

5. Conclusions

Through a series of expert interviews, this paper examined DFIs' role and record in supporting the clean cooking transition. This work is timely because of persistently high rates of cooking poverty globally, the associated costs of inaction, and DFIs' unique mandates to effect change. It is also salient as the performance of DFIs and MDBs, as the principal institutional channels of climate and development finance, is currently under scrutiny.

Collectively, interviewees considered that, while DFIs are mandated to play a critical role, their approach is overall bureaucratic, slow, and inflexible, and their financing marked by risk aversion and a limited toolkit of financial instruments and structures. More fundamentally, there is a perceived strategic misalignment between DFIs' approach and market needs. Reconsidering and reforming their approach would, in interviewees' opinion, meaningfully advance the sector's growth and accelerate the uptake of solutions.

Interviewees coalesced around a set of activities that DFIs could undertake to increase their impact in clean cooking markets, while noting the absence of a sector-wide theory of change for finance for clean cooking. They called for a statement of strategic intent to address this gap. In response, this paper proposes a theory of change for clean cooking finance, informed by data collected through the interview process.

While this paper has highlighted perceived areas for improvement in the delivery of climate and development finance for clean cooking, its limitations must be noted. Principally, the paper has not considered the institutional reforms necessary to effect such improvement. This creates a natural opportunity for further inquiry. Secondly, while a detailed analysis of carbon finance is outside the scope of this paper, in view of the frequency with which interviewees raised this growing source of finance for clean cooking, there is wide scope for further research in this area. Lastly, while the paper has proposed a theory of change for clean cooking finance, there is an opportunity to expand on this by interrogating the elements of a theory of change for the clean cooking transition more broadly, beyond its financing dimensions.

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