THE ROLE OF VOLUNTARY CARBON MARKETS IN CLEAN COOKING

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CLIMATE FOCUS

This report is part of a series of publications developed with the UKAid-funded Modern Energy Cooking Services programme, exploring voluntary carbon markets and clean cooking. In addition to this report, two briefing papers will be published; one exploring how clean cooking projects track their impact on the Sustainable Development Goals, and the other outlining business models through which clean cooking industry actors can engage in carbon markets.

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Modern Energy Cooking Services (MECS) is a seven-year programme funded by UK aid (FCDO) which aims to accelerate the transition in cooking away from biomass to modern energy. By integrating modern energy cooking services into energy planning, MECS hopes to leverage investment in clean 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 (bio) and ethanol, though the evidence points to the viability, cost effectiveness, and user satisfaction that energy efficient electric cooking devices provide. 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 global tracking framework, including integrating access (7.1), renewables (7.2) and energy efficiency (7.3) and promote an informed integrated approach.

For more information, visit www.mecs.org.uk.

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EXECUTIVE SUMMARY

Photo by M.D. Duran

Achieving universal access to clean cooking remains out of reach. An estimated 4 billion people are still without access to modern energy cooking services. Shifting to clean cooking solutions – such as cooking with biogas, electricity, or ethanol – has potential to both improve and save lives. Access to finance to scale implementation remains a leading barrier, however. Achieving universal access to clean cooking by 2030 is estimated to cost up to USD 4.5 billion annually, but finance flows over the past decade have peaked at only 2 percent of this.[1]

Carbon finance can unlock further investments in the clean cooking industry. By helping to de-risk investments and provide an alternative source of income, carbon finance can contribute to scaling up clean cooking ventures. It can also help to bring down the up-front cost to users, making modern energy cooking solutions more accessible. Innovative financing models are breaking down barriers with pay-as-you-go services allowing users to make smaller payments spread over time, based on actual usage. As a results-based payment delivered upon achievement of results, carbon finance can also incentivise companies to provide higher-quality technologies and fuels to their customers, as well services to ensure continued maintenance, repair and use of technologies.

Aggregate historical carbon finance flows to the clean cooking sector fall between USD 60 -150 million. The acceleration of carbon credit issuances from clean cooking activities observed in recent years has been triggered by rising carbon credit prices. Combining pricing data from the cooking industry with historical carbon credit issuance and retirement records allows for an approximation of carbon finance flows that have reached the industry over the past decade. Using the volume of carbon credits issued, an estimated USD 150 million in aggregate carbon financing may have been generated by clean cooking programmes worldwide between 2013 and 2022, with annual revenue flows peaking in 2020 at just over USD 35 million. Using a more conservative approach that bases finance flows on carbon credit retirement activity only, aggregate carbon financing adds up to nearly USD 60 million over the same time period. Recognising that developers of clean cooking programmes generally transact through intermediaries such as project aggregators or brokerage firms, the true volume of finance reaching projects on the ground was likely lower.

The bulk of existing clean cooking activities in the voluntary carbon market are certified by the Gold Standard and located in Asia, with domestic biogas activities dominating the pipeline. Worldwide, there are more than 200 clean cooking activities certified by a carbon standard. Nearly all of these are certified under the Gold Standard, with a handful registered under Verra's Verified Carbon Standard. Just five countries account for 95 percent of global issuances from clean cooking activities: China, Nepal, India, Viet Nam and Cambodia. More than 80 percent of registered activities are domestic biogas programmes, with the remaining portfolio made up primarily of solar cooker and biomass or liquid biofuel programmes.

The past two years have seen a major shift in the voluntary carbon market towards greater transparency and integrity. Demand for voluntary carbon credits depends on the ability of the market to generate positive reputational returns for carbon credit buyers and investors. Not linked to a stable driver of compliance demand, voluntary markets depend on the financial or reputational benefits they bestow on buyers to ensure demand. As such, efforts to further build confidence in the market are essential to ensuring its longevity as a source of results-based

financing. Several initiatives have emerged seeking to increase transparency and integrity in the market, including the Integrity Council for the Voluntary Carbon Market and a number of carbon credit rating agencies.

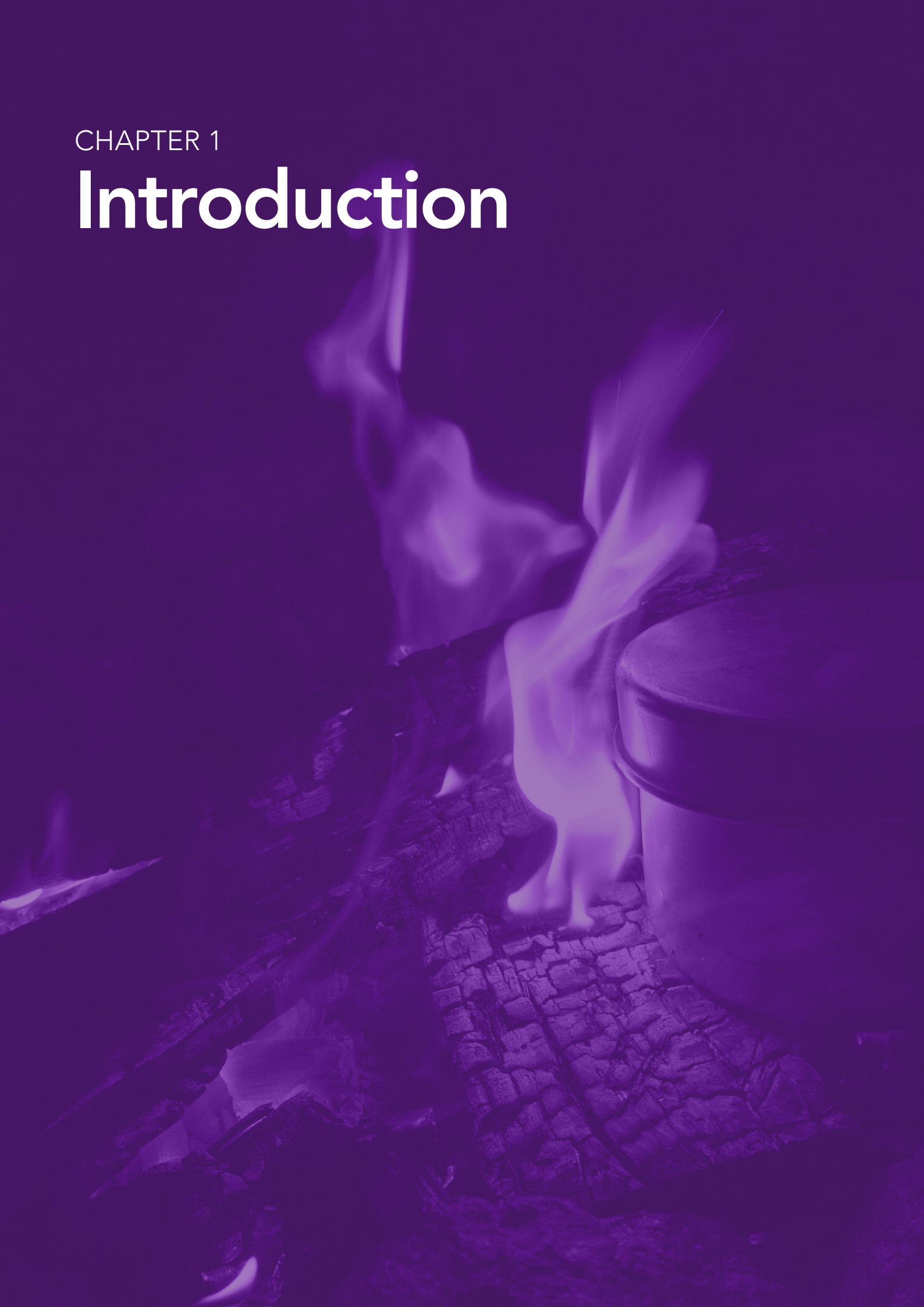
Demand for carbon credits from clean cooking activities may be dampened in response to concerns over credit quality, unless projects are able to stay ahead of the curve. Current approaches to setting crediting baselines and monitoring the performance of activities introduce over-crediting risks, unless conservative approaches are applied to calculate emission reductions. To be well positioned in a scaling carbon market, projects seeking to emerge positively under this scrutiny will need to evolve their approaches to measuring climate impacts. For some projects, this may result in the adoption of more conservative approaches to estimating emission reductions. For others, this may imply adopting more accurate measurements of technology usage and fuel consumption. Tracking performance via energy/fuel metering or through purchase records of clean fuels can reduce the costs associated with monitoring and significantly improve the accuracy of performance data. Where surveys are used to monitor performance, care should be given to how these are formulated and carried out to ensure conservative estimates of results. While doing so may mean generating less carbon credits per unit of activity, buyers looking for high-integrity carbon projects will need to award carbon prices commensurate with the level of effort needed to generate such carbon credits.

The Paris Agreement and its market mechanisms introduced under Article 6 are impacting the voluntary carbon market, triggering project developers to closely follow progress in the jurisdictions in which they operate. While in principle the voluntary carbon market is governed by independent carbon standards that define the rules for the generation and issuance of carbon credits, the rules that govern international cooperation under Article 6 mechanisms risk introducing an overlap between regulated and voluntary carbon markets. One key question is whether voluntary carbon credits can continue to be used for voluntary offsetting purposes while at the same time contributing to host countries' mitigation targets. The Gold Standard has announced that in the future it will consider allowing offsetting claims made against the use of post-2025 credits only if these are correspondingly adjusted. Furthermore, several countries have taken action to limit or temporarily halt the issuance and transfer of voluntary carbon credits produced within their jurisdictions, seeking to establish more clarity on the interaction between voluntary carbon projects and national inventory accounting. One important implication for project developers is the need to proactively engage with authorities to understand their positions on this topic and avoid unforeseen disruptions to the future issuance of carbon credits.

The ability of the voluntary carbon market to retain and further strengthen investor and buyer confidence, combined with how regulated markets will interact with them, is what will shape the market's future. The current push for greater quality in carbon credits and the claims made around them will be a critical space to watch. If carbon credits are to continue to be used to compensate for emissions occurring elsewhere – rather than purely as a means of delivering results-based finance – then it is essential that the credits generated are credible. Regarding the Paris Agreement: if countries (or certifying standards) do require corresponding adjustments for clean cooking activities, this is likely to translate into issuance delays and increased costs for credits buyers and sellers alike, at least in the first years. Going through these hoops may pay off however if premium prices for correspondingly adjusted carbon credits materialise. Looking more broadly, the diverse co-benefits that clean cookstove activities can offer – including yielding positive impacts on various Sustainable Development Goals – are likely to ensure continued demand for this project type from buyers who look for value beyond climate impacts. With the current pipeline of clean cooking activities showing potential to leverage USD 800 million between 2023 to 2030 through carbon finance, the voluntary carbon market offers a real chance for advancing progress towards modern energy access.

CHAPTER 1

Introduction



Box 1. Terminology

Throughout this report we use the Energy Sector Management Assistance Program's (ESMAP) definitions[2] of improved and clean cooking as outlined below. Our focus is on clean cooking technologies and fuels rather than the slightly narrower set of modern energy cooking services; although some data sources include both clean and improved cooking solutions data.

- **Improved cooking services:** Refers to a household context that has met at least Tier 2 standards of the Multi-Tier Framework (MTF)[3] (Figure 1) for cooking across all six measurement attributes but not all for Tier 4 or higher. Household contexts with a status of MTF Tier 2 or Tier 3 are considered in transition. For this report, this includes primarily improved wood and charcoal stoves.
- **Clean cooking solutions:** Refers to 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. These generally include solar and electric cookers, Liquified Petroleum Gas (LPG), domestic biogas, bio ethanol, liquid biofuels, and some processed biomass/pellet stoves.[4] Throughout this report we use the term **clean cooking activities** to refer to certified carbon projects, including stand-alone projects and Programmes of Activities/Grouped projects and their associated sub-projects.
- **Modern Energy Cooking Services (MECS):** Refers to a household context that has met the standards of Tier 4 or higher across all six measurement attributes of the MTF.

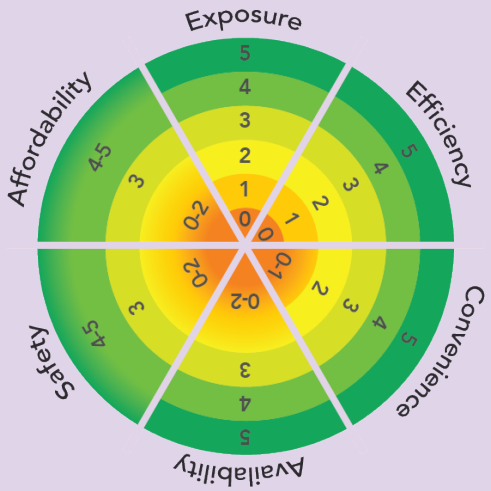


Figure 1: Multi-Tier Framework demonstrating all six measurement attributes.[5]

It is estimated that almost half the global population – around 4 billion people – are still without access to modern energy cooking services.[6] Many of these individuals rely on fuels such as firewood, charcoal, kerosene, and coal burned in rudimentary stoves or three-stone fires to meet their cooking needs. This leads to respiratory health problems through smoke inhalation, exposure to safety risks from burns and collection of fuels in remote areas; and comes at a significant cost in terms of time and energy needed to collect fuel, cook, and clean. Forest ecosystems are also affected, with the use of woody biomass for cooking being an important driver of deforestation and forest degradation in many countries.

Shifting to modern energy cooking solutions such as ethanol, electricity or biogas, (Box 1) – has potential to significantly improve lives, especially those of women and children. Concerted efforts to shift the dial towards clean and improved technologies and fuels has helped to achieve net increases in the number of people with access to clean cooking.[7] But there remains a long way to go: an estimated USD 10 billion[8] a year is needed to achieve universal access to clean cooking by 2030; yet over the past decade, annual investment has peaked at only USD 70.9 million.[9] More recently, finance channelled to clean cooking has seen a significant uptick; with the finance volumes raised by a handful of clean cooking enterprises in the first half of 2022 alone representing more than double that raised in all of 2020.[10]

Growing investment into modern energy in developing countries in recent years has also laid the foundation for scaling up electric cooking solutions; presenting an opportunity to harness already planned investment and infrastructure to accelerate the implementation of clean cooking technologies. At present, finance being channelled to electricity access in high impact countries far exceeds that going to the clean cooking sector; an estimated USD 400 billion was invested in electrical networks in Sub-Saharan Africa, Southeast Asia and India over the period 2016-2019, potentially supporting the infrastructure available for scaling up clean cooking solutions.[11] Sector experts note, however, that this accelerated progress may not continue as energy prices spike in the wake of the ongoing Russia-Ukraine conflict.[12]

Carbon markets offer real opportunities for scaling-up finance to the clean cooking industry: between 2017 and 2020 businesses saw a 21-fold increase in the volume of carbon finance secured.[13] In contrast, revenues from other sources – including grants and clean cooking sales – declined over the same period.[14] Carbon finance can help to make investing in the clean cooking industry a more attractive proposition by lowering investment risks, bringing down the cost of accessing technologies for consumers, and enabling companies to more quickly scale their operations. As a results-based payment delivered upon achievement of results, carbon finance can also incentivise companies to provide higher-quality technologies and fuels to their customers, as well services to ensure continued maintenance, repair and use of technologies.

Carbon credits generated by clean cooking activities have been transacted in voluntary and regulated markets for almost 15 years.[15] Clean cooking project registrations have been both increasing and diversifying in recent years; expanding in size and across new geographies as well as incorporating a wider range of activity types. Growth in credit supply is mirrored by a growth in demand, driven primarily by an increasing number of companies using credits to meet their voluntary climate commitments.

At the same time, carbon finance remains expensive and time-consuming to access, has been criticised as distorting markets (Box 2), and is coming under increasing scrutiny over its environmental integrity. On the project development side, clean cooking companies report challenges in securing carbon credit arrangements for their businesses, volatile credit prices, delayed credit payments, and unmanageable monitoring and reporting requirements relative to the price of the carbon credits they generate.

The regulatory framework in which carbon markets are operating is also changing. The Paris Agreement – and its associated Article 6 mechanisms – yield uncertainties as to how voluntary carbon credits will be accounted for, including whether or not credits generated by projects will be eligible for international transfer. The current uncertainty around accounting rules for voluntary carbon market credits presents considerable risks for clean cooking enterprises banking on carbon finance to support their ventures, as well as for investors hoping to generate returns through carbon finance arrangements.

So, what does the voluntary carbon market hold in store for the clean cooking industry? This report is intended to take stock of current trends influencing the likely direction of the voluntary carbon market for clean cooking ventures over at least the next five years.

We first explore the current state of the voluntary carbon market for clean cooking, outlining the representation of this project type in today's market (**Section 2**). We then outline the key trends we see being likely to influence the volume of credits delivered from the clean cooking industry; and the appetite of buyers to engage with the industry given the recent growth in quality initiatives and key integrity issues presented by clean cooking projects (**Section 3**). The impacts of the Paris Rulebook on the functioning of the voluntary carbon market, including the various Article 6 mechanisms and implications for project developers is outlined in **Section 4**. We close with reflections on the carbon financing outlook for clean cooking, tying all these developments together in **Section 5**.

Box 2. The role of carbon subsidies in clean cooking

To ensure a sustainable market transformation to clean cooking, the private sector must have the ability to implement market-driven business models. Most businesses in the industry remain unprofitable and have yet to reach scale. At the same time, clean cooking technologies remain unaffordable for the poorest segments of the population and access to modern energy cooking services nascent (although growing in South Asia). Carbon finance can help to bring down the cost of business development and affordability of clean cooking solutions. This, in turn, can enhance the financial attractiveness of the sector for investors by introducing an alternative revenue stream, as well as help to lower the financial barriers potential customers face in accessing clean cooking solutions.[16] Yet, subsidizing the cooking industry remains contentious.

A pervasive narrative exists to suggest that carbon subsidies will 'spoil the market'.[17] This is based on the idea that they introduce market distortion and set customer pricing expectations unsustainably low, making it more difficult for non-carbon finance supported enterprises to compete. However, to generate carbon credits clean cooking activities must demonstrate that they would not have occurred without carbon finance (i.e. that they are additional). This means that a level of market distortion is an inherent and necessary attribute of carbon projects. The real question is whether carbon finance is distorting markets in the right ways, and more research is needed on this.

Firstly, demand for clean cooking is highly price-sensitive, especially among low-income populations, implying that significant additional finance is needed to realise the clean cooking transition for the lowest-income consumers. Where polluting alternatives – or 'less polluting' improved cooking solutions – remain the cheapest and readily available options, subsidies can be highly effective in making clean technologies available and affordable, as well as de-risking the investment environment and 'crowding in' other sources of finance.

Secondly, while finance is a key barrier to uptake of clean cooking solutions, it is by no means the only barrier. Limited awareness of the benefits offered by clean cooking solutions; lack of distribution networks and supply chains for stove delivery and repair; and challenges in breaking old habits all present significant hurdles to realising the transition. Until the market for clean cooking is more mature, additional finance will be needed to bolster its growth.

Thirdly, carbon subsidies can positively benefit the distribution of finance to the clean cooking industry. Outside of carbon markets, the sector has historically benefitted from government subsidies, many designed to reduce the costs of LPG fuel. Evidence suggests that these kinds of subsidies – whether for fuels or technology – disproportionately benefit upper-income consumers, who are arguably less in need of financial support.[18] Carbon finance can play a vital role in filling this gap by targeting the consumers most in need. For example, most clean cooking activities specifically target households that use firewood or charcoal burned in simple three-stone fires or unimproved stoves. And domestic biogas programmes, which account for most of the current pipeline of registered activities, typically target rural smallholder farmers.

CHAPTER 2

The Market Gains Momentum

21.5 million carbon credits

The year 2022 saw record issuances from the cooking industry, totalling 21.5 million carbon credits; although clean cooking solutions accounted for only 3.6 million of these; or 16 percent of the total.

Five countries

Just five countries are responsible for 95 percent of global issuances from clean cooking activities: China, Nepal, India, Viet Nam and Cambodia.

Domestic biogas

More than 80 percent of registered clean cooking activities on the market today are domestic biogas programmes.

The Gold Standard

The Gold Standard is the primary standard of choice, with nearly all registered clean cooking activities certified by this standard.

USD 40 - 105 million

An estimated USD 40 to 105 million in aggregate carbon financing is estimated to have reached clean cooking programmes worldwide over the past decade.

2.1 How does the project pipeline look?

Improved cooking solutions lead in the carbon project pipeline

Clean and efficient cooking technologies play an important role in supplying carbon credits to the voluntary carbon market. More than 800 cooking activities have been registered since the market's inception, and today cooking solutions represent nearly 20 percent of all registered carbon projects in the voluntary market.[19] Just under one-third (27 percent) of all these activities are clean cooking activities (Figure 2).

The historical dominance of improved cooking activities over clean cooking can be explained by several factors. Firstly, lack of available alternative products is a real issue, especially in rural areas. Lack of access to energy, technical expertise and basic infrastructure needed for delivery of fuels or repair and maintenance services all stifle access to modern energy cooking services. Secondly, improved cooking projects face lower barriers to scaling. The technologies generally come at lower production cost than most clean cooking solutions, meaning that even with lower levels of carbon revenues per stove, projects can be financially attractive. In practical terms, improved cooking solutions are also easier to implement: having a user more efficiently burn a fuel they are already familiar with is far simpler than learning how to use a solar cooker or a domestic biogas system. It also does not rely on a steady supply of power, LPG refills or access to pellet fuels; which come with their own supply chain challenges. Thirdly, given the high upfront cost of many clean cooking technologies, carbon revenues alone are not always able to overcome the financial barriers to investment. Clean cooking activities often need additional financial support – such as that provided through development organisations – to be financially viable. Given historical carbon credit prices, market conditions have so far been more accommodating to improved cooking projects than most clean cooking alternatives.

Since 2008, implementation of clean cooking activities has reached a total of 224 activities worldwide. These activities include both standalone projects, as well as voluntary project activities (VPAs) included in programmes of activities (PoAs).[20] The Gold Standard has been the primary standard of choice for clean cooking project developers, with nearly all (218) registered clean cooking activities certified by this standard. Only five activities have been registered under Verra's Verified Carbon Standard (VCS) to date (Figure 2a).

Existing clean cooking activities in the voluntary market can be categorised into four main technologies: domestic biogas, biomass or liquid biofuel projects, solar cooker programmes, and projects implementing LPG stoves. Domestic biogas programmes – representing over four-fifths of all registered clean cooking projects in the voluntary carbon market today – relate to projects that reduce methane emissions by generating biogas from animal manure, with the biogas in turn being used to replace baseline cooking fuels, such as firewood or charcoal. China and India alone are responsible for 80 percent of these projects, followed by Nepal, Kenya and Tanzania. Solar cooking projects are the next best represented category (18 registered projects), with nearly all activities being implemented in China. Biomass or liquid biofuel projects, which consist of biomass briquette or bioethanol activities, follow with 15 registered projects; half of which are located in Kenya, with the remainder in Ethiopia, India, Mozambique and Malawi. Finally, there is only one LPG programme operating in the market, hosted in Kenya.

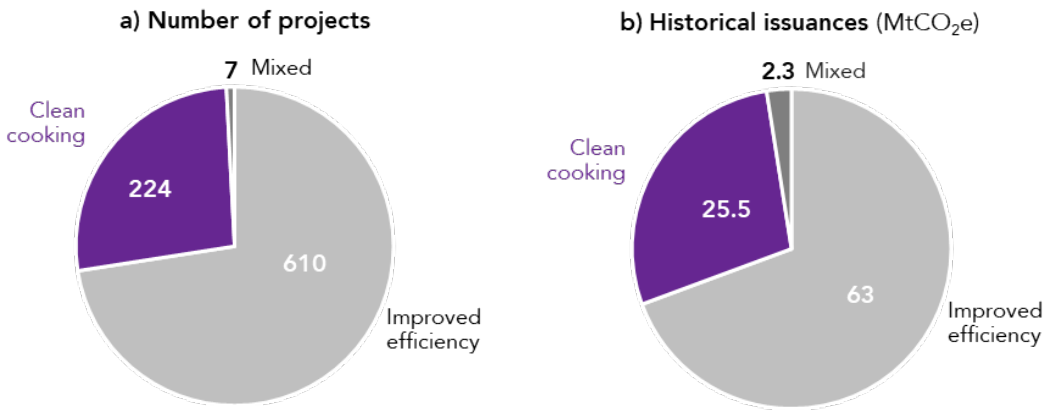


Figure 2: Efficient cooking technologies dominate the voluntary carbon market project pipeline, with clean cooking activities representing just under one-third of registered cooking activities (2023).[21]

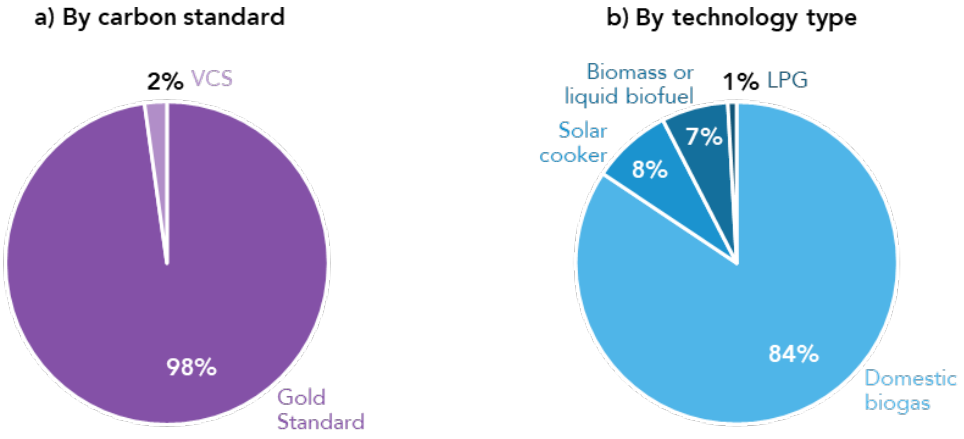


Figure 3: Gold Standard certified domestic biogas activities dominate the current pipeline of projects.

At the time of our data analysis conducted in January 2023, clean cooking activities targeting distribution of electric cookers were missing from the pipeline of registered activities. This can be explained by the challenges of implementing scalable programmes in areas that face problems with reliable electricity supply, or to a large extent are disconnected from grids. There are, however, early movers in this space that are changing this. In the spring of 2023, the first electric cooker project was registered with the Gold Standard by UpEnergy. Another example is ATEC, which is piloting the implementation of induction stoves in Cambodia and plans to adopt the Gold Standard's new methodology[22] for metered energy cooking devices developed by the Modern Energy Cooking Services programme and partners.[23]

The dominance of domestic biogas programmes is noteworthy, considering that the upfront costs associated with the technology exceed the costs of most other clean cooking solutions. Several factors could explain why this project category is so strongly represented despite its upfront implementation costs being relatively high. Firstly, once installed, biogas users enjoy continuous, free cooking fuel (biogas) that can supply multiple cooking hobs and is easily available at the switch of a dial. The lack of running costs holds true for some other clean cooking solutions (e.g., solar cookers or stand-alone solar home system solutions[24]) but not for LPG, grid-connected electric and briquette stoves, which all incur fuel usage costs throughout their lifetime. The consequence of this is that while domestic biogas activities can be feasible in even the most distant of locations, most other clean cooking solutions require reliable fuel supply chains. This adds complications to the underlying business model, and the scalability of the activity. A second factor that benefits domestic biogas activities is that they can earn emission reductions from both fuel switching and improved manure/organic material management. This means that they tend to generate more carbon credits per installation than other clean cooking technologies. Solar home systems can also provide power for activities such as charging and lighting and earn emission reductions from these activities, but the carbon credits earned are much lower than that generated from methane avoidance. And finally, domestic biogas has been effective as attracting other sources of financing from non-governmental and development organisations that are able to bring down the implementation costs of the programme while not requiring that returns are made on the investments.

Record carbon credit issuances in 2020

Clean cooking activities have issued a total of 25 million carbon credits as of January 2023. This volume represents 28 percent of all cooking industry issuances to date, with the remainder being attributed to improved cooking or programmes combining multiple interventions (e.g., combining clean and efficient cooking with lighting or electricity) (Figure 4). Peak issuance of carbon credits from clean cooking projects was recorded in 2020, when 6 million carbon credits were issued by projects globally. In 2021, while the global voluntary carbon market continued to grow and break new records, issuances from clean cooking activities declined to 4 million carbon credits. This drop in issuance was not a signal that demand from buyers was waning; rather, the sharp rise in demand observed over 2019/2020 triggered many project developers with accumulated volumes to issue credits, leaving inventory levels lower in the year that followed.[25] Issuance levels in 2022 remained near 2021 levels, totalling 3.6 million carbon credits. As noted above, domestic biogas programmes have been the lead suppliers of clean cooking carbon credits (Figure 5).

With a large share of clean cooking activities falling under just 14 registered Programmes of Activities, clean cooking projects in the voluntary market are concentrated in a handful of countries (Figure 6). China hosts over half of all registered clean cooking activities, with these projects having issued over 12 million carbon credits to date. Nepal is the second largest supplier country, with 21 projects having issued a total of 4.1 million credits to date. This is followed by India, Viet Nam, and Cambodia. Combined, these five countries are responsible for 95 percent of global issuances of carbon credits from clean cooking activities.

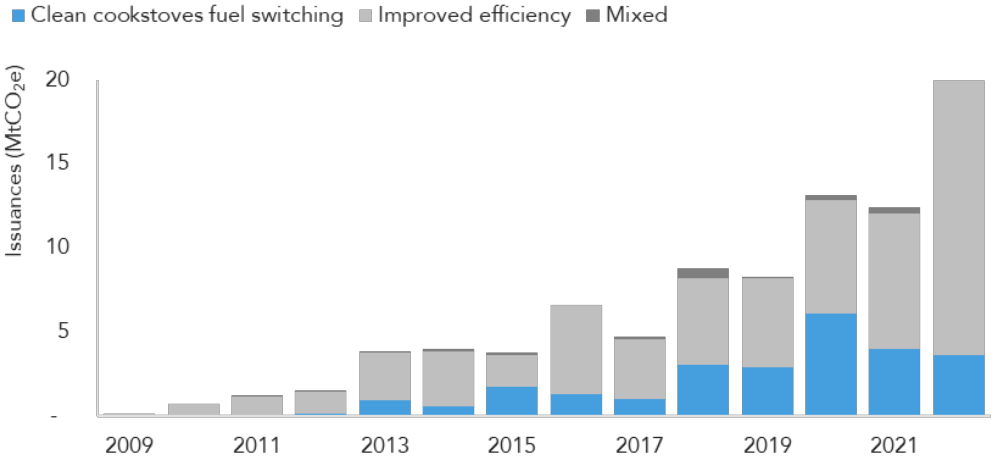


Figure 4: Issuances of carbon credits from clean cooking represent less than one-third of all cooking industry volumes.

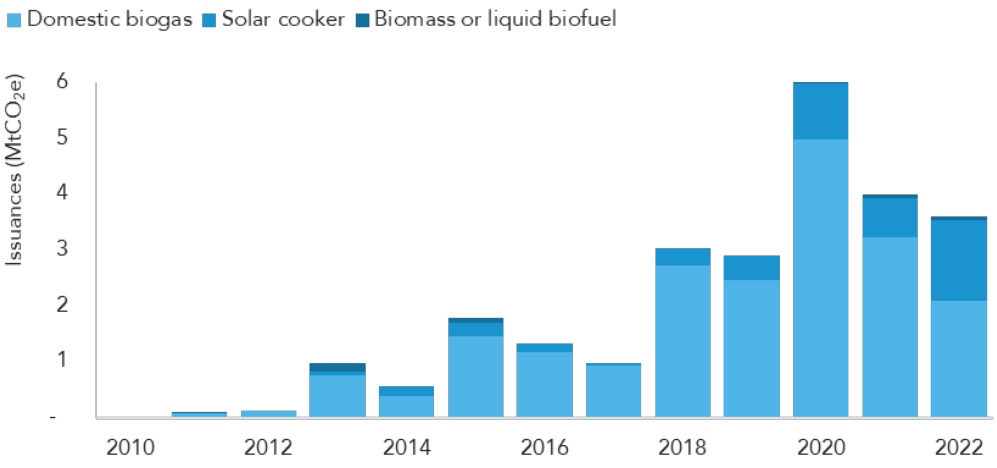


Figure 5: Domestic biogas leads supply of clean cooking carbon credits.

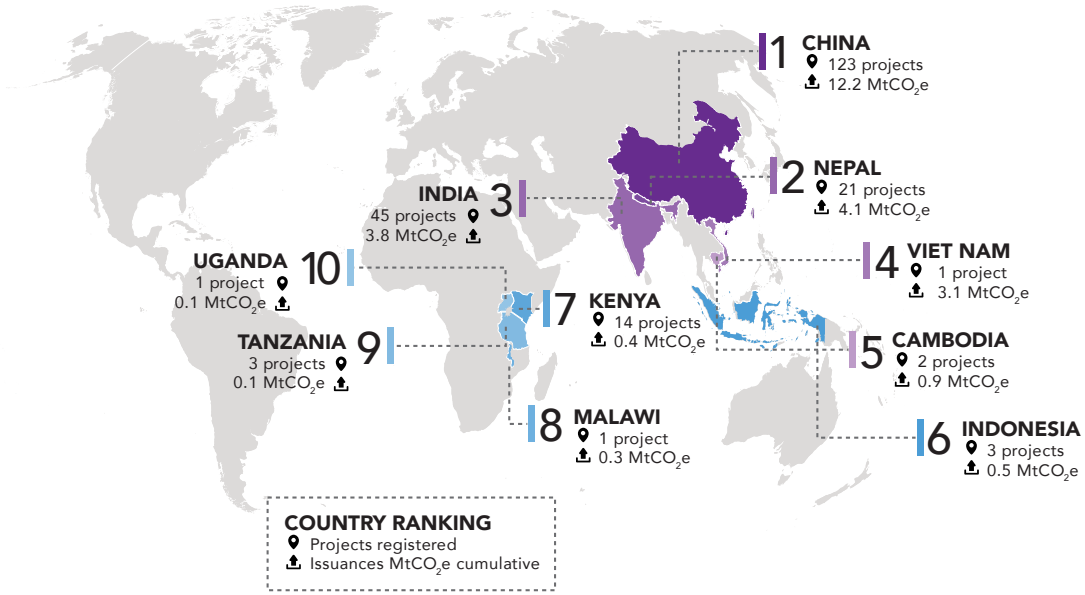


Figure 6: Just five countries are responsible for 95 percent of global issuances from clean cooking (in purple).

2.2 How much carbon finance is reaching the clean cooking industry?

Historical carbon finance flows fall between USD 60 – 150 million

The acceleration of carbon credit issuances from clean cooking observed in recent years has been triggered by improving market conditions and rising carbon credit prices. As explored in further detail in Section 2.3, this pressure on pricing is explained by growing demand from voluntary corporate buyers, which after years of operating in a buyers' market found themselves scrambling for rapidly diminishing volumes of available carbon credits. Average transaction prices for clean cooking activities more than doubled between 2019 and 2021 as a result. Global uncertainty amid the invasion of Ukraine and fears of a global recession put a break on the rapid price rises, with prices correcting downwards throughout the second half of 2022 (Figure 7) and remaining at similar levels at the start of 2023 (Box 3).

Combining pricing data from the cooking industry with historical carbon credit issuance and retirement records allow for an approximation of carbon finance flows that have been reaching the industry over the past decade. There are two ways to estimate aggregate finance flows: one using the volume of carbon credits issued; and the other using the volume of credits retired.

Using the volume of carbon credit issued, an estimated USD 150 million in aggregate carbon financing may have been generated by clean cooking activities worldwide between 2013 and 2022, with annual revenue flows peaking in 2020 at just over USD 36 million. Using a more conservative approach and basing finance flows on retirement activity only[26],

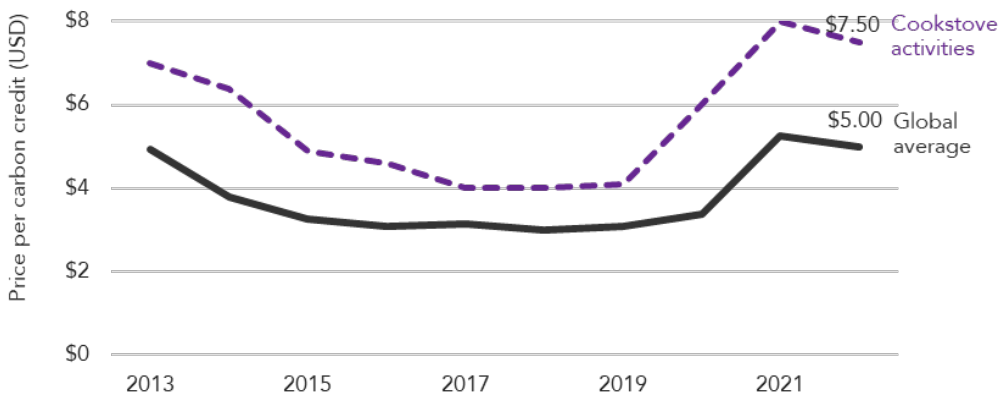


Figure 7: Price appreciation of carbon credits from cooking activities has outpaced global average prices.[27]

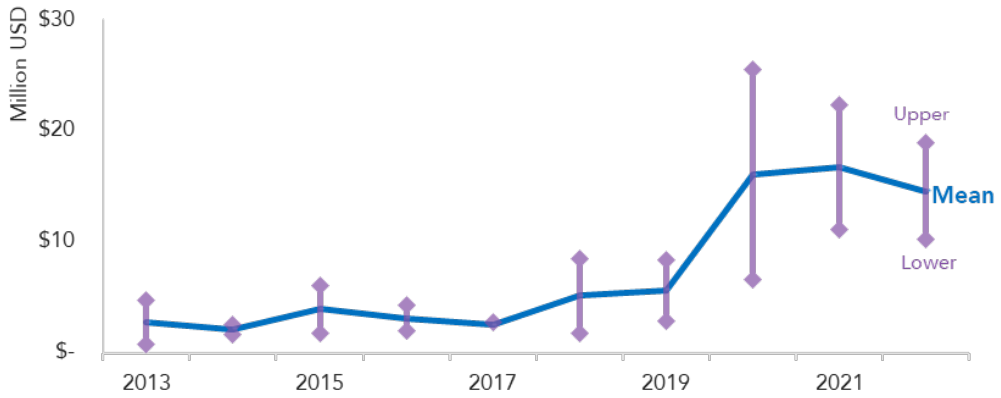


Figure 8: Historical carbon finance flows to clean cooking activities are estimated to fall between USD 40 and 105 million over the past decade.

Note: the 'Lower' bound finance flows reflect using carbon credit retirements as the indicator for carbon credit transactions; the 'Upper' bound results are based on issued volumes.

aggregate carbon financing adds up to nearly USD 60 million, with annual revenues showing steady appreciation since 2018. The difference between the two projections is explained by retirement activity always lagging issuance volumes, with a share of issued carbon credits being only transacted in the future, or buyers holding purchased carbon credits on account with the purpose of retiring them later, or possibly on-selling them.

Recognising that developers of clean cooking programmes generally transact through intermediaries such as project aggregators or brokerage firms, the true volume of finance reaching projects on the ground was likely lower. Assuming that intermediaries withheld 30 percent[28] of the total transaction value, total carbon financing flows since 2013 are adjusted to a range of USD 40 to USD 105 million since 2013 (Figure 8). For comparison, a recent analysis by the Clean Cooking Alliance investigating a sub-set of for-profit clean cooking enterprises reports that in the year 2021, surveyed enterprises (32) reported carbon revenues of USD 21 million.[29] This is against a further USD 61 million being reported as received investments by these enterprises, through a combination of grants, debt and equity. This analysis recognises while sales revenues were impacted by dropping demand for the technologies triggered by the onset of the Covid-19 pandemic (among others), revenues from carbon credit sales showed the opposite trend, supported by appreciating prices. For this subset of clean cooking enterprises, the decline in sales revenues (circa 13 percent) was compensated nearly entirely by increased carbon revenues. With the private sector dominating investment flows in these companies and showing a steadily rising trend over the past years, rising carbon prices may positively reinforce private, return-seeking investments.

Box 3. Carbon pricing across key project types

Despite attention in the market shifting towards the development of nature-based solutions that can generate removal carbon credits[30], pricing of clean cooking carbon credits has remained robust. Market data of benchmark carbon credit contracts traded on leading exchanges shows that as of early 2023, prices of household devices[31] credits exceeded those of most of other project categories (Figure 9).[32]

Figure 9: Clean cooking carbon credits transact at a premium (USD pricing as of January 2023). NBS refers to Nature Based Solutions.

Strong demand for carbon credits from clean and improved cooking activities is driven by the market's recognition that investments in the cookstove industry come paired with a host of co-benefits in addition to climate action (SDG 13). Universal clean cooking is a key component of SDG 7 – access to affordable, reliable, sustainable and modern energy for all by 2030. Clean cooking projects are also contributors to improved health (SDG 3), gender equality (SDG 5), and biodiversity through avoidance of unsustainable woodfuel harvesting (SDG 15). This demonstrably positive impact on several SDGs makes clean cooking activities attractive to buyers, who increasingly look for value beyond emission reductions only.

CHAPTER 3

The Push for Quality

Building confidence

Efforts to improve confidence in the market are essential to ensuring its effective functioning and ability to scale. A number of initiatives have emerged over the past several years seeking to increase transparency and integrity in the market.

Improving claims

To better ensure credibility in the claims that companies engaged in carbon markets are making, several initiatives are developing guidelines for corporate claims regarding the use of carbon credits.

Strengthening integrity

To provide greater clarity on what a good quality carbon credit entails, the Integrity Council for the Voluntary Carbon Market is elaborating detailed guidance on this; and several carbon credit rating agencies are now established.

Clean cooking

Clean cooking activities that do not adopt conservative approaches to emission reduction accounting are unlikely to come out favourably under scrutiny; but the diverse co-benefits that these activities yield are likely to ensure continued demand.

Not linked to a stable driver of compliance demand, voluntary markets depend on the financial or reputational benefits they bestow on buyers to ensure demand. As such, efforts to further build confidence in the market are essential to ensuring its longevity as a source of results-based financing. If the costs of engagement outweigh the benefits, concerns about the true climate impact carbon markets can deliver can dent corporate interest in the market.

Recognising this issue, several initiatives have emerged over the last two years seeking to increase transparency and integrity in the market. Central to these initiatives is the extent to which credits transacted in the market represent real mitigation outcomes. This, in turn, is prompting calls for increased quality regulation of credits transacted in the market; as well as the emergence of several initiatives aimed at guiding carbon credit buyers on how they can use these credits and the type of sustainability claims they can make around them.

3.1 Making better use of carbon credits

Corporate climate commitments have been the single largest driver behind the recent rise in demand for voluntary carbon credits, including from clean cooking activities. Left largely unchecked, this has lead to a proliferation of different uses of carbon credits in corporate climate strategies, ranging from organisation-level 'climate' and 'carbon' neutrality claims, to compensated products and services marketed to consumers. At the very least, this has resulted in confusion around what companies are trying to communicate. In the worst cases, it has created opportunties for companies to mislead consumers and other stakeholders through greenwashing.

To better ensure credibility in the claims that companies are making regarding their climate engagement, the Voluntary Carbon Market Initiative (VCMI) has created a set of guidelines for firms buying and making claims using offsets.[33] The Provisional Claims Code of Practice (which as the title suggests are currently in draft format) introduces a four-step process which can be used by firms to determine what claims they are entitled to make, assigning a rating from "Gold" to "Bronze" based on a firm's commitment to decarbonisation and achievement of targets.[34] Other relevant efforts include the International Organization for Standardization's (ISO) recently developed guidelines on net zero claims, which provides definitions, high level principles for achieving net zero and requirements for reporting.[35] The Gold Standard also offers its own Claims Guidance[36], while the Nordic Dialogue on Voluntary Compensation has published guidance on how voluntary carbon credits can be robustly used in alignment with Paris Agreement objectives.[37]

A growing share of corporates are recognising that inaction on fighting climate change will expose them to an ever-growing a set of risks, including physical risks associated with the impacts of climate change on their operations, as well as regulatory pressure, demands by customers, and shareholder resolutions. The sense of urgency to act responsibly is being strenghtened by initiatives like the Task Force on Climate-related Financial Disclosures[38] or the World Economic Forum's global risks reporting,[39] which are placing the responsibility of managing climate risks in corporate board rooms in recognition that inaction will impact sharehoder value in due course. Increasingly, this is motivating companies to shift from (over) dependence on compenstation strategies to taking on decarbonisation commitments that align with net-zero pathways endorsed by reputable initiatives.

As of late 2022, 38 percent of Fortune Global 500 companies had adopted a net zero target, marking a 50 percent increase from the year before.[40] The increasing uptake of Science Based Targets and net-zero commitments mean a rising share of large corporates are taking on absolute emission reduction targets, but the use of voluntary carbon credits in this narrative is limited. Importantly, companies need to concentrate on slashing their own emissions first. This is in line with the mitigaton hierarchy endorsed by the Science Based Targets initiative (SBTi) – the leading venture promoting best practice in setting corporate climate action targets. This value chain decarbonisation can be supplemented with 'neutralisation' efforts, which include investments in carbon removal activities (nature-based or technology enabled) that are used to balance residual emissions in net-zero target years. As such, carbon credits from clean cooking activities do not currently have a role to play in net-zero target accounting.[41]

At the same time, the use of high-quality carbon credits as a complementary effort to reducing emissions along a science-based trajectory has been recognised to play a critical role in accelerating the transition to net-zero emissions at the global level. The SBTi, for instance, takes the stance that there are

two roles carbon credits can play in science-based net-zero strategies:[42]

- In the transition to net-zero: Companies may opt to purchase avoidance (which includes clean cooking activities) and removal carbon credits as they decarbonise in line with their approved net-zero pathway to support society to achieve net-zero emissions by 2050.

- At net-zero: Companies with residual emissions within their value chain can neutralise those emissions with carbon removal credits, either nature-based or technology-enabled. Given the focus on removal credits, emission reductions derived from clean cooking activities would not be eligible.

Regarding the first strategy, recommendations of SBTi's Net-Zero Standard[43] states that companies should go beyond their near- and long-term science-based targets to further mitigate climate change by making investments that support mitigation outside of their value chains, especially those that generate additional co-benefits for people and nature. This concept of Beyond Value Chain Mitigation therefore presents an opportunity for clean cooking activities, which garner both climate benefits and important SDG impacts. Their ability to channel results-based finance to multi-benefit projects and rural communities in developing countries makes this project type likely to remain attractive for companies that plan to engage in Beyond Value Chain Mitigation.

3.2 Improving the integrity of carbon credits

Several initiatives have arisen over the past two years seeking to build confidence in voluntary carbon markets, and increase transparency and environmental integrity. The work of the Taskforce on Scaling the Voluntary Carbon Market (TSVCM) is one example of a self-regulating effort aiming to ensure integrity of the voluntary carbon market as it scales. To steer the discussion about integrity, the TSVCM established the Integrity Council for the Voluntary Carbon Market (ICVCM) which is elaborating guidance on high-quality carbon credit principles. The Core Carbon Principles and its Assessment Framework are intended to define which carbon crediting programmes and methodologies meet high quality standards, offering buyers a standard quality measure of initiatives covered under the voluntary market.[44]

Alongside the ICVCM, an increasing number of carbon credit rating agencies have recently entered the market to address the absence of standardised information for buyers. Just as traditional rating agencies reduce informational asymmetries, carbon credit rating agencies seek to provide information that allows buyers to make more informed credit purchasing decisions. In the past two years, firms such as BeZero, Calyx Global, CarbonGEO, Carbon Credit Quality Initiative, Renoster and Sylvera have established – or are establishing - ratings for carbon projects, methodologies, and standards. While these agencies are relatively new and have only assessed a share of available credits, their establishment marks a point of progress in the voluntary carbon market's growth into a mature and transparent marketplace.

While each of these initiatives are working towards a common goal of improving carbon markets and bolstering investor confidence in them, the simultaneous arrival of them risks confusing project developers and carbon credit buyers alike, who may be held up to differing evaluation criteria. Nevertheless, this is a much-needed development and the availability of more standardised approaches to evaluating the environmental integrity of carbon credit generated from clean cooking activities and other activity types will help to highlight the strengths and weaknesses of specific voluntary carbon market activities. This, in turn, should trigger project developers and standards to work towards addressing any integrity concerns to safeguard the reputation of their projects.

3.3 Performance of clean cooking activities

As the initiatives driving greater quality in the market continue to develop, a key question is how clean cooking activities are likely to fair under scrutiny. Project ratings will influence buyers' appetite for credits from this activity type and – ultimately – the amount of carbon finance that is likely to reach the industry in the years to come. It will also influence the choices that project developers will make in how they quantify emissions reductions, and may trigger updates in the rules and requirements that carbon standards set in an effort to safeguard carbon market integrity.

To explore how clean cooking activities are likely to fair in terms of carbon credit quality, the ICVCM's Core Carbon Principles[45] are used to guide the framework for assessment, with the focus on the criteria that relate to the mitigation activity (rather than requirements for carbon crediting programmes) (Table 1).[46]

Table 1. Overview of ICVCM's Core Carbon Principles relevant to the underlying mitigation activity.[47]

CORE CARBON PRINCIPLE	DEFINITION
Additionality	The greenhouse gas (GHG) emission reductions or removals from the mitigation activity shall be additional, i.e., they would not have occurred in the absence of the incentive created by carbon credit revenues.
No double counting	The GHG emission reductions or removals from the mitigation activity shall not be double-counted, i.e., they shall only be counted once towards achieving mitigation targets or goals. Double counting covers double issuance, double claiming, and double use.
Permanence	The GHG emission reductions or removals from the mitigation activity shall be permanent, or where there is a risk of reversal, there shall be measures in place to address those risks and compensate reversals.
Robust quantification of emission reductions and removals	The GHG emission reductions or removals from the mitigation activity shall be robustly quantified, based on conservative approaches, completeness, and sound scientific methods.
Contribution to net zero transition	The mitigation activity shall avoid locking-in levels of GHG emissions, technologies or carbon-intensive practices that are incompatible with the objective of achieving net zero GHG emissions by mid-century.

Additionality

Clean cooking activities usually have a strong case for additionality. Establishing a viable business model remains highly challenging, with the industry facing several investment risks including lack of established infrastructure to support business development, high up-front costs of technologies, business development and marketing and logistical challenges in reaching rural customers. These issues are compounded by limited availability of the consumer, market, company and investment data needed to design and implement effective business models; although this is changing in some markets. [48] In addition, the cost of project technologies and fuels are often prohibitively high for customers to be able to afford without additional financial support, making carbon revenues essential in ensuring the affordability of clean cooking technologies. Until the market for clean cooking is more mature, additional finance is likely to be needed to bolster its growth.

However, a handful of governments have regulatory support schemes in place for specific clean cooking technologies and/or fuels; most notably LPG. Where these are in place, the incentives provided may be sufficient to facilitate a switch to clean cooking; negating the need for carbon finance. In addition, increasing access to electrical infrastructure in some urban markets – most notably in East Asia – is also bringing down the cost of electric cooking, which now accounts for 40 percent of the fuel mix in East Asia.[49]

The additionality tools that carbon standards require clean cooking activities to apply would, though, be likely to screen out the non-additional activities; thereby avoiding that they enter the voluntary carbon market at all.

No double counting

The ICVCM defines the following types of double counting:

a. double issuance, including double registration – in which the same emission reduction is credited under two separate programs – and overlapping claims, in which overlaps in the greenhouse gas accounting boundaries of mitigation activities can occur;

b. double use, in which the same carbon credit is retired by two companies; and

c. double claiming with mandatory domestic mitigation schemes; and with other environmental credits.

To guard against double registration, carbon standards typically require project developers/ owners to sign a declaration confirming that the emission reductions are not claimed under another programme. And, in the case of clean cooking

activities, carbon standards require the unique identification of project technologies, such as recording product serial numbers or GPS coordinates. End users must also sign a declaration confirming the transfer of rights to emission reductions to the project developer. However, relative to single-point source carbon projects (such as a standalone wind power plant), clean cooking activities have a higher likelihood of undergoing double registration due to the simple fact that they can involve tens of thousands of technologies installed over large geographical areas. Clean cooking activities therefore need to have in place a strong system for tracking and tracing technologies. Electronic data collection systems – such as scanning a barcode or recording GPS coordinates – are at lower risk of data collection errors than systems that record project data via hand-written customer data collection forms; the information from which then needs to be manually transferred into an electronic database.

Some clean cooking activities are also at risk of overlapping claims. Activities that claim emission reductions from reduced use of woody biomass whilst being co-located with other carbon projects that are claiming impact on forests could have overlapping claims. For example, more than half of projects aimed at Reducing Emissions from Deforestation and forest Degradation (REDD) are co-located with improved efficiency cookstove projects that may be claiming to protect the same forest resources.[50] Projects replacing fossil fuels used in the baseline – such as coal used for cooking – would not be at risk of overlapping claims, however. At present, methodologies do not have in place safeguards to account for overlapping claims where they occur.

Guarding against double use and double claiming will need to be ensured by the certifying carbon standards, and are not issues unique to clean cooking activities. To avoid double use, carbon standards should have robust registry systems in place in which unique serial numbers are assigned for each credit issued; and other measures in place to prevent the further use of a credit once it has been cancelled or retired. To prevent double claiming with mandatory domestic mitigation schemes and other environmental credits, standards will need to have guardrails in place; such as prohibiting the registration of activities that fall under domestic mitigation schemes or are traded under other environmental markets.

Permanence

At present, no carbon standard requires clean cooking activities to consider the permanence of the emission reduction achieved. This is due to the assumption that any activity permanently reduces emissions at the moment of avoiding combustion of a baseline fuel through the use of the clean cooking alternative. Yet it could be argued that there does exist a level of permanence risk given that the emission reductions are claimed from reducing pressure on forests; which could be lost to other drivers such as forest fires. If clean cooking activities were to be required to account for non-permanence, this requirement would most likely be updated at the level of the carbon standard (rather than the methodology applied), which would involve adjusting the scope of activities to which permanence considerations would need to apply. At present, carbon standards require accounting for risks of non-permanence for nature-based project types by setting aside a portion of the issued carbon credits into a buffer account. Should reversals occur, an equivalent number of credits are cancelled to secure the permanence of issued credits.

Robust quantification

Establishing a baseline

To quantify emission reductions, clean cooking activities need to establish a baseline that reflects the amount and mix of fuels used before the project. Depending on the methodology applied, this often requires data on household size, type(s) of fuel(s) used and in what quantities, and the portion of this fuel that is non-renewable. This information can be derived from national data, or project-specific surveys. National data is often absent or too old to reflect present-day circumstances;[51] or includes information about the type(s) of fuel(s) used, but not the quantity. While the availability of baseline cooking data is improving in some countries[52], many projects must still carry out expensive project-specific data gathering.

To guard against over-crediting, methodologies require sound sampling techniques with limited ranges of permitted uncertainty. They also tend to require conservative approaches when estimates are uncertain (Box 4). For example, most methodologies refer to the UNFCCC's Clean Development Mechanism's (CDM) Standard for Sampling and Surveys, which sets a required level of reliability.[53] If these minimum sampling requirements are not met, the guidelines require that more samples are taken until the error threshold is met; or that emission reductions are discounted.

Box 4. Making methodologies more conservative: revisions to CDM default values[54]

In 2022, the CDM released a new tool that significantly revised the default values permitted for use by a range of activities, including from clean and efficient cooking. The values were developed following the principles of conservativeness that "seeks to ensure environmental integrity and avoid the overestimation of emission reductions, while considering the most up-to-date information available that are of unbiased sources and seeking to reflect conditions that are grounded in reality". [55]

These parameters are valid for clean cooking activities since almost 80 percent of the projects on the market today apply a CDM methodology (namely AMS-I.C, AMS-I.E or AMS-I.I). Registered clean cooking activities will need to consider these default values when renewing their crediting period. Projects can still choose to apply a project-specific value, but will need to provide verifiable evidence to support it. The following are of most relevance for clean cooking activities:

- Wood-to-charcoal conversion factor. Used to calculate the amount of firewood needed to produce a kilogram of charcoal. The value is revised from 6.0 kg of fuelwood (wet basis) per kg of charcoal (dry basis) to 4.0 kg.
- Value for the average annual consumption of woody biomass used per person for cooking is revised from 0.5 tonnes/person/year (wet basis) to 0.4 tonnes/person/year.
- Fraction of non-renewable biomass default value is revised to 30 percent as a global average, down from nationally approved default values ranging from 65 – 100 percent.[56]
- Efficiency of pre-project cooking device is revised from 0.10 for a three-stone fire using firewood or a cookstove with no improved combustion air supply/flue gas ventilation to 0.15. For all other types of devices the default efficiency is revised from 0.20 to 0.25.

The validity of these default values are to be re-assessed every three years.

However, establishing one key baseline value – the fraction of biomass that is non-renewable (fNRB) – remains challenging. Calculating this value requires using international and national data sets on woody biomass growth rates, biomass stocks, accessibility, and wood fuel consumption. Obtaining accurate estimates requires considerable data, and specialist knowledge of geographic information systems to process it. Doing this well is complex, and the approaches for calculating the fNRB value approved before September 2022 have unintentionally allowed projects to apply fNRB values there were likely overestimates; rather than conservative.[57] The UNFCCC's Clean Development Mechanism also published a list of default national fNRB values that were valid between in 2012 – 2020 that set high expectations for what the fNRB value should be; even after these default values expired.[58]

As a result, many clean cooking activities continue to apply fNRB values that are consistently higher than peer-reviewed scientific literature would support.[59] One study found that applied fNRB values are twice as high as the values estimated in scientific literature; although this considered projects covering both clean and efficient cooking technologies.[60]

Monitoring performance

Clean cooking activities seeking carbon finance also need to monitor and report on their performance, as only installations that are in use are issued carbon credits. This involves monitoring the portion of technologies that are operational, how often they are used, ongoing baseline stove use (stove stacking), and the amount of project and baseline fuels used during the activity's operation.[61] These parameters are usually estimated via surveys, in which the questions asked and a respondent's interpretation of them are important.

For example, consider approaches to estimating stove and fuel stacking. The most accurate standardised approach is to perform a Kitchen Performance Test in the premises in which the project stove is used, based on a representative sample of households. This involves physically measuring the amount of fuel(s) used over a 3-day time period in the user's kitchen. However, since this approach is time consuming and expensive (and logistically challenging to carry out in remote rural locations), several methodologies instead estimate stove stacking via surveys in which the project developer designs their own survey questions – such as asking a household how many meals a day the baseline stove is used for cooking. While this approach is much simpler it also requires

the respondent and surveyor to interpret the question: how to respond if a user cooks with the baseline and the project stove simultaneously? And what if the baseline stove is used to cook meals for non-household residents, such as lunches for farm or house help? And simply asking users how much fuel they use is not a solution since baseline fuel use is often measured in 'bushels of firewood', or 'sacks of charcoal', without easily being converted into a standardised metric. In all cases, this uncertainty risks overestimating emission reductions unless conservative approaches are taken in survey design and analysis to avoid this. Another key set of parameters involve determining the portion of a year a given technology is functioning (rather than being out of service awaiting maintenance or repairs); and what portion of clean cooking solutions remain operational. When these parameters are determined via sampling and surveys – which is most common – the questions asked and how they are interpreted are again important. For example, simply asking a user 'Do you use your stove?', might yield less reliable results than coupling this with an inspection of the project device to physically verify its use; or asking a user 'Has your stove been fully operational over the last two months?', might get a different response than asking the same question over an annual timeframe, in which they may struggle to recall whether their clean cooking solution was operational and for how many days or weeks it was awaiting repair.

A key advantage of clean over improved cooking solutions in this respect is the ability to derive much more accurate estimates of project technology use through either directly monitoring use (e.g., through biogas flow meters or measuring the amount of electricity a device consumes) or through purchase records of clean fuels. While these values alone will not allow a direct measurement of stove and fuel stacking, they do allow for tracking of how much the project technology is used, which can in turn paint a much more accurate picture of how much stove stacking is likely to be occurring given the energy needs of the user. It also allows accurate tracking of functionality and the portion of clean cooking solutions in operation. When coupled with innovative financing approaches – such pay-as-you-go systems – metering can also break down barriers to clean energy access by allowing users to make smaller payments spread over time based on actual usage.

Accounting for leakage

Leakage also needs to be accounted for and deducted from any emission reductions claimed. Leakage refers to a situation in which the project activity causes an increase in emissions elsewhere. This could be through the production of bioethanol or pellets, or an increase in the use of biomass by non-project end-users as a result of the project; such as a neighbour increasing their use of firewood because more is available now that demand for it is reduced locally. To account for leakage, methodologies require an assessment of whether leakage is likely to occur, and if so for it to be either quantified and deducted from emission reductions or a default deduction of 5 percent of emission reductions must be applied.

There is to date limited literature seeking to conclusively determine the appropriateness of the 5 percent discount factor, and further research is needed.[62]

Transition towards net-zero emissions

The draft CCP requires assessing whether a project avoids locking in levels of emissions, technologies or carbon intensive practices that are incompatible with achieving net zero emissions by mid-century. This involves assessing whether a technology is transformational and supports and/or enables innovation and/or the application of best-available technologies.

Given this definition, modern energy cooking activities make a strong case for facilitating the transition to net-zero emissions. They allow a user to switch away from cooking with biomass, should they wish to; representing a key advantage over improved cooking that burns baseline fuel more efficiently but does not allow a user to switch completely away from biomass. Fuels such as bioethanol and bio-based LPG, both derived from renewable sources, and electric cooking where power sources are renewable, offer real opportunities to switch to net-zero compatible modern energy alternatives. The technologies are transformational for the end-user, allowing better health outcomes, improved gender equality and a safer home.

Programmes targeting fossil fuel based LPG, however, may not be compatible with a net-zero transition. While point of combustion emissions from fossil fuel based LPG are low, life-cycle emissions from 'cradle-to-grave' LPG production and transportation are not consistent with a net-zero emissions pathway. Never-the-less, LPG remains an important transitionary fuel that is readily available, proven and in some cases the only real option available to rapidly scale access

to clean cooking, making it one part of the solution alongside other modern energy alternatives.

What does it all mean for the performance of clean cooking activities?

In general terms, clean cooking activities on the voluntary market today have a strong case for being additional. The real risks lie in how the emissions reductions are calculated, in which the fNRB value is key; as are reported frequencies of stove stacking, ongoing use of baseline fuels and operational and usage rates of the clean cooking solutions. Relative to other project types, these elements make quantifying emission reductions for clean cooking activities more challenging. Where there is uncertainty, project developers, carbon standards and independent third-party verifiers must ensure that conservative approaches are adopted.

Projects applying more conservative fNRB values are likely to be favoured by carbon credit buyers wishing to reduce their risks in engaging in carbon markets, as are projects that can accurately demonstrate performance through either energy/fuel metering or providing purchase records of clean fuels. Tracking performance in this way reduces the costs associated with monitoring (by avoiding the need for expensive and time-consuming surveys), and improves the accuracy of performance data.

Carbon credit buyers would do well to seek out such projects; although there exist few on the market at present. Projects that apply more conservative fNRB values will generate proportionally less carbon credits, meaning that buyers will need to signal willingness to award higher prices to these activities to enable them to remain financially viable. And few clean cooking activities in the voluntary market today practice energy/fuel metering: domestic biogas activities, for example, account for more than 80 percent of registered activities, and the ability to monitor biogas fuel use remains nascent and expensive. In future, the Gold Standard's approval of a new methodology specifically designed to credit emission reductions from metered and measured cooking devices may enable more such projects to access the voluntary carbon market.[63]

Looking more broadly, the diverse co-benefits that clean cookstove activities can offer – including for improved health (SDG 3), gender equality (SDG 5), and biodiversity through avoidance of woodfuel harvesting (SDG 15) – is likely to ensure continued demand for these project types from buyers who continue to look for value beyond climate impacts.

CHAPTER 4

Impact of the Paris Rulebook

Article 6

The Paris Agreement and its market mechanisms introduced under Article 6 are impacting the voluntary carbon market, triggering project developers to closely follow developments in the jurisdictions they operate.

Uncertainty

Governments remain free to determine the governance rules for integrating the two markets, and several countries have signalled that they have the intention to implement corresponding adjustments for all international voluntary carbon market transactions.

Restrictions

Several countries have taken action to limit or temporarily halt the issuance and transfer of voluntary carbon credits, seeking to establish more clarity on the interaction between voluntary carbon projects and national inventory accounting.

Implications

In certain jurisdictions, issuance of voluntary carbon credits will need to respect requirements for corresponding adjustments on the government's side. While this may create issuance delays and incur costs, such carbon credits are expected to transact at a premium in the future.

4.1 Article 6 and voluntary carbon markets

At the 26th UN Climate Change Conference of the Parties (COP26) held in November 2022, parties to the Paris Agreement adopted the implementation guidelines for a new set of carbon market mechanisms that aim to facilitate international collaboration on climate action. These mechanisms – dubbed 'Article 6' mechanisms due to their mention in that part of the text – recognise that voluntary cooperation on achieving emission reductions provide a necessary tool for countries to enhance their ambition and achieve the temperature goals of the Paris Agreement.

Of particular relevance for the voluntary carbon market and its participants are the decisions on cooperative approaches referred to in Article 6.2 and the market mechanism under Article 6.4:

- Article 6.2 establishes "cooperative approaches" by which mitigation outcomes from emission reduction activities can be transferred between governments that are Parties to the Agreement, against financial assistance. Article 6.2 offers countries the flexibility to design the specific architecture and rules for the implementation of activities that involve the generation of 'internationally transferred mitigation outcomes' (ITMOs).[82] this approach creates opportunities for countries to adapt these carbon market instruments to national circumstances, providing some form of flexibility in the use of quantification, monitoring, reporting, and verification approaches.

- Article 6.4 establishes a centralised crediting mechanism regulated by the UNFCCC that allows private and public entities to support mitigation activities that generate transferrable greenhouse gas emission reductions and removals. Fundamentally, it will reflect elements of the earlier Clean Development Mechanism (CDM) and Joint Implementation (JI) scheme; and activity participants will need host-country authorisation, all projects will need to follow the same project cycle to achieve credit issuance, and the mechanism will be based on a similar makeup of institutions and infrastructure as the previous Kyoto mechanisms (e.g., a Supervisory Body, Designated Operational Entities, and registries). Certified emission reductions and removals will be issued into a central registry as 'A6.4ERs'.

While in principle the voluntary carbon market is governed by the private standards that define the rules for the generation and issuance of carbon credits into their registries, the rules that govern international cooperation under these newly introduced Article 6 mechanisms open the door to carbon market transactions under the Paris Agreement that may overlap, integrate, or compete with voluntary market activities. The lack of clarity to date over the relationship between Article 6 of the Paris Agreement and voluntary carbon markets has prompted uncertainty about carbon market engagement from voluntary actors, including in the clean cooking space.

In this context, a highly contested question is whether voluntary carbon credits can be used for voluntary offsetting purposes while contributing to a host country's achievement of its own mitigation targets. Typically, this relates to a country's Nationally Determined Contribution, or 'NDC' – quantified, national climate targets defined by each party to the Paris Agreement on how they plan to reduce domestic emissions and climate impacts. The problem centres on the role and need for 'corresponding adjustments' for voluntary carbon market transactions – adjustments that would ensure emission reductions for which carbon credits are issued cannot be accounted towards the host country NDC. Some market participants worry that carbon credits transacted without corresponding adjustments will lead to double claiming of emission reductions, by both the organisation buying and cancelling voluntary credits, and by the project host country claiming progress towards emission reduction goals from the same sector. Others question the validity of the double claiming argument, pointing out that it has no detrimental effects on the accounting of global emissions. They also argue that allowing the transfer of only correspondingly adjusted carbon credits to buyers will hinder the host countries' ability to meet their NDCs, jeopardising the global climate effort. In addition, securing government commitments to corresponding adjustments are expected to be cumbersome and costly, introducing uncertainties that could reduce the attractiveness of engaging in the voluntary carbon market altogether.

How the voluntary market will be impacted by Article 6 domestically will ultimately depend on national regulations (Box 5). Countries that have signed up to the San José Principles, originally agreed at COP25 in Madrid, have already signalled that they have the intention to implement corresponding adjustments to all international voluntary carbon market transactions. To date, a total of 32 countries have backed these principles. Examples of these countries include The

Netherlands, Finland and Switzerland in Europe, and Colombia, Costa Rica, and Peru in Latin America.[64] Nonetheless, most countries have to date refrained from taking definitive positions in this regard, preferring to take their time to understand the implications of the COP26 and COP27 decisions on national climate action plans.

In the absence of relevant national legislation, carbon standards can still – in principle – continue their in-country operations without referencing any Article 6.2 rules. Individual carbon projects may decide to opt in to Article 6.2, comply with its requirements, and sell correspondingly adjusted credits after host country's approval. They may also decide to register under the Article 6.4 mechanism and sell either correspondingly adjusted A6.4ERs or 'mitigation contribution A6.4ERs', which would not require corresponding adjustments.

However, carbon standards may also choose to align with Article 6 rules. The Gold Standard – currently responsible for nearly all registered clean cooking activities in the market– has already announced that it may, from 2025 on, only issue carbon credits for offsetting purposes if they are backed by corresponding adjustments. Verra, on the other hand, has announced that its carbon credits can be issued both with and without corresponding adjustments (Box 6).

Box 5. Emerging national restrictions on the export of voluntary carbon credits

Countries including Indonesia, Malaysia, Papua New Guinea, and Peru have recently taken action to limit or temporarily halt the issuance and transfer of voluntary carbon credits produced within their jurisdictions. For each of these countries, the decision to restrict voluntary market activities in one way or another stems from the rapid increase in the value of transacted carbon assets, and the perceived regulatory uncertainties pertaining to the double counting of emissions reductions. None have suggested that they intend to permanently block the sale of voluntary credits, with most suggesting that any limitations imposed will be lifted once they have had sufficient time to regulate as and if needed.

Some countries have also cited potential complications of double-counting as a reason for intervention. A number of nations have signed on to the San José Principles, pledging to implement corresponding adjustments for voluntary credits sold to corporations to prevent this issue. Certain nations have thus restricted the issuance or sale of credits until the processes for corresponding adjustments can be implemented, motivated to implement these principles to mitigate the environmental harms of double-counting, regardless of economic effects. An additional trigger may be the expectation that carbon credits with corresponding adjustments may offer increased value in the market, resulting in higher prices and offering opportunities for governments to collect associated revenues in the future.

Box 6. Positions of the Gold Standard and Verra

Diverging positions are emerging from the leading independent standards that certify voluntary emission reductions in the clean cooking space. The Gold Standard has announced that in the future it will consider allowing offsetting claims made against the use of post-2020 vintage credits only if these are correspondingly adjusted. However, as the standard recognises it takes time for governments to put in place the necessary arrangements to implement corresponding adjustments, the likely requirement for credits generated in developing countries used for offsetting claims will apply only from 2025 vintages onwards (final rules to be confirmed in the future).[65] If the purchase of correspondingly adjusted credits will not be possible, offset-based claims can be made by cancelling, for every non-adjusted credit, an additional adjusted credit. The Gold Standard will also continue to issue credits without corresponding adjustments if these are intended for contribution claims, or for domestic use - where there is no risk of double counting.[66] In October 2022, Gold Standard added Article 6-related functionalities to its registry.[67] Account holders will be able to specify the purpose of retired authorised Verified Emission Reductions (VERs), compliant with the Gold Standard requirements for credits authorised under Article 6.[68]

The other major independent standard, Verra, instead leaves the issue of corresponding adjustments for voluntary market credits to national discretion, stating that a tool for corresponding adjustment is not needed in the voluntary market and it is even detrimental to developing countries.[69] On one hand, Verra argues, the national accounts of the country where the company making the claims is domiciled are not affected by voluntary action, so there is no risk of double counting. On the other hand, requiring corresponding adjustments would create "perverse incentives" for companies to buy credits only from countries where their operations are based, which would reduce carbon finance going to developing countries. This would put the limited financial resources of developing countries under pressure, as governments would have to fund additional emission reductions. In other words, what Gold Standard deems to be a potential deferral or displacement of government action is seen by Verra as the very reason for carbon finance, which contributes to climate action in countries that often struggle to meet the basic needs of their populations and are the least responsible for climate change. For Verra, companies that retire credits that are not correspondingly adjusted can continue to make offsetting claims but need to specify that the emission reductions or removals remain in the host country.

Table 2. Gold Standard and Verra's positions regarding the need for corresponding adjustments.

		ARE CORRESPONDING ADJUSTMENTS REQUIRED?	
		Currently (2023)	**In the future**
Gold Standard	For offsetting claims	No*	Yes, for 2025 and later vintages generated in developing countries
	For impact claims	No	No
	For compliance	Depends on the compliance scheme**	Depends on the compliance scheme**
VERRA	All claims	No**	No**

** Buyers will need to comply with national legislation, Gold Standard invites users to make responsible claims, considering the potential displacement of government action in host countries due to the mitigation caused by carbon finance, according to the claims guidelines.*

*** Corresponding adjustments are, for example, required under compliance schemes such as the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), which falls under Article 6 rules. Some national compliance schemes may require corresponding adjustments.*

4.2 Clean cooking in Nationally Determined Contributions

Under the Paris Agreement, all countries must meet emission reduction targets as per their adopted NDCs. This creates a dilemma for host countries: while lower-income countries will, in part, depend on international financing to decarbonise, corresponding adjustments required for trade in emission reductions affect their ability to meet NDC targets. This, in turn, could reduce their willingness to increase the ambition of their NDCs in the future, counteracting progressive climate action.

This carries implications for project developers of clean cooking activities that are implementing programmes in countries that already are, or may in the future, include the clean cooking sector in their NDCs. The Clean Cooking Alliance has mapped the inclusion of clean cooking in the NDCs of 85 high-priority countries, finding that currently 52 countries explicitly mention clean cooking activities in their NDCs (Figure 10). Some of these countries expect high growth projections for biomass and charcoal use, including the Democratic Republic of Congo, Ethiopia, Kenya, Madagascar, Malawi, Mozambique, Niger, Nigeria, Senegal, and Uganda. At the same time, 40 percent of countries with significant mitigation potential from reduced fuelwood harvest do not currently feature clean cooking targets in their NDCs.

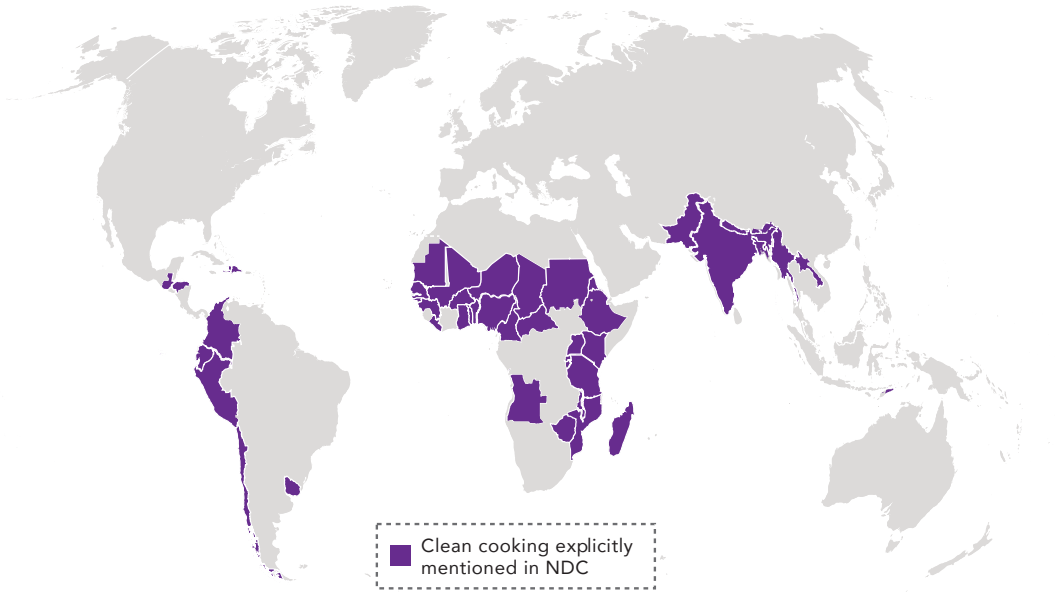


Figure 10. Clean cooking is explicitly mentioned in 52 country's NDCs as of October 2021.[70]

For the developing countries that do list clean cooking in their NDCs, a distinction can be made between targets that are 'unconditional' (i.e., which will be achieved based on their own resources and capabilities) and 'conditional' (i.e., which are dependent on international support, including climate finance or carbon finance from abroad). What NDC conditionality means for voluntary carbon market activities is at present unclear.[71] The interplay between Article 6 and NDC conditionality also remains open for discussion, and it currently is the responsibility of host country governments to provide guidelines.

Countries have so far shown a preference for the development of pilot Article 6 transactions as part of host countries' 'conditional' targets, following the understanding that any 'unconditional' targets are to be achieved through domestic efforts. The Swiss Foundation for Climate Protection and Carbon Offsets (Klik Foundation), for example, requires mitigation actions to be covered by NDCs, but also to be additional to the unconditional NDCs and to the business as usual (BAU) emissions scenarios (Klik Foundation 2020). The Swedish Energy Agency (SEA) also aims to finance activities that are additional to unconditional NDC targets (SEA 2020).[72] The implication of this strategy for project developers of clean cooking activities is therefore that if clean cooking already features under a host country's 'unconditional' NDC, this may undermine the eligibility of clean cooking carbon credits issued on the voluntary market for authorisation under Article 6.

Another point of uncertainty that may become more relevant in the future is the assessment of additionality of voluntary carbon market activities that fall under the sectors listed in the unconditional NDC (i.e., targets to be achieved without international assistance). Independent standards may need to develop additional guidelines on the matter, such as the requirement to assess the additionality of voluntary market activities covered in the unconditional NDC on the basis of whether relevant national legislation and policies are enforced or not. This may therefore further introduce risks around the scaling of clean cooking activities in countries with already ambitious 'unconditional' clean cooking implementation targets.

For activities that fall completely outside the scope of a host country's NDC, other considerations may apply. As many countries currently do not have economy-wide NDC commitments, clean cooking may be omitted entirely from national commitments, despite countries stating clear interest in engaging with the international market mechanisms. Reasons for this could include either a lack of recognition that clean cooking is an important pillar of domestic climate policy, or that poor data availability and lack of understanding of mitigation potential resulted in the exclusion of the sector from the NDC. While this may offer short-term comfort to project developers, it should be noted that the Paris Agreement (Article 4) requires each country to prepare, communicate and maintain successive NDCs that demonstrate increasing – and highest possible – ambition. This means that countries currently without clear reference to clean cooking can introduce sector targets in future NDC cycles.

4.3 Implications for market participants

In the current state of market development and regulatory uncertainty, there are two main scenarios that developers of clean cooking programmes may face when implementing voluntary market activities under the new era of the Paris Agreement:

Scenario 1: voluntary carbon market transactions remain unaffected by host country regulation

Countries that see the voluntary carbon market as a strategic tool to achieve their NDC will likely be reluctant to link any transfer and carbon market engagement to corresponding adjustments under the Paris Agreement. They may decide to support certain project activities or prioritise certain sectors for corresponding adjustments, but may leave a large part of the voluntary market untouched and free to operate as it has done to date. Such an approach could help to alleviate government concerns that prospective transfers of authorised emission reductions realised under the voluntary carbon market will compromise the achievement of NDC targets due to the 'overselling' of mitigation outcomes.

The key advantage of maintaining the 'status quo' and allowing voluntary carbon market project development to remain free from national regulation is that it gives project developers and investors the assurance that they have control over the full carbon asset development process. Experience from the Clean Development Mechanism under the Kyoto Protocol has shown that making project development conditional on host-country approval can lead to delays, costly administrative steps, and at times complete blockage of project implementation. Exemption from corresponding adjustments is also likely to give project developers and carbon credit buyers more certainly on carbon credit delivery timelines, which would not be impacted by national inventory accounting procedures.

There are also risks associated with this scenario, however. As the Article 6 Rulebook requires that credits used towards ICAO's Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) are authorised and correspondingly adjusted; not authorising voluntary carbon market credits would preclude project developers of clean cooking activities from taking advantage of this source of demand. In addition, current discussions on buyer preferences on correspondingly adjusted credits in the voluntary space are also pointing towards the likelihood that such credits may transact at a price premium, although there is currently no data to support this (given the lack of correspondingly adjusted voluntary market transactions at the time of writing this report).

Scenario 2: voluntary carbon market transactions undergo corresponding adjustments in national inventories

Governments may approve and authorise clean cooking programmes under Article 6.2 cooperative approaches, agreeing to implement corresponding adjustments against national inventories and allowing authorised activities to issued ITMOs. This carries both advantages and disadvantages.

One advantage is, as remarked above, certain voluntary market standards are already preparing for only certifying emission reductions that have gone through a corresponding adjustment process. Furthermore, companies that participate in international mitigation schemes such as CORSIA, and companies that wish to back their offsetting claims with corresponding adjustments under the Paris Agreement (as part of their corporate greenhouse gas mitigation strategies) are expected to prioritise sourcing correspondingly adjusted carbon credits. As such, this scenario opens a wider market for clean cooking project developers, positively impacting the outlook for pricing.

One important disadvantage, however, is that to receive corresponding adjustments in the first place, voluntary market credits from clean cooking activities will have to meet Article 6.2 criteria. If a voluntary market activity is connected to an Article 6.2 cooperative approach, the approved clean cooking activity would need to comply with extensive Article 6 reporting obligations and ensure the cooperative approach as a whole is consistent with Article 6.2 guidance. The private voluntary market transactions would therefore become to a large extent dependent on countries fulfilling their international procedural obligations sufficiently and in a timely manner, which in turn could introduce delays in issuance of correspondingly adjusted carbon credits.

CHAPTER 5

The Outlook for Clean Cooking

Crossroads

The voluntary carbon market finds itself at a crossroad. Without a stable source of compliance demand, the market depends on a positive reputation to foster growth. The market's ability to retain investor and buyer confidence, combined with clarity on the impact of the Paris Agreement, is what will ultimately shape its future.

Opportunity

Companies engaging in climate mitigation beyond their own value chains offer a new window of opportunity for clean cooking activities, which garner both climate benefits and come with a suite of SDG benefits.

Positioning

To be well positioned in a scaling and increasingly more demanding carbon market, projects will need to strengthen their approaches to measuring climate impacts to stay ahead of the curve. They should also closely follow domestic policy developments regarding Article 6 in the countries they are operating, and proactively engage with authorities to avoid unforeseen disruptions.

38 million carbon credits

Based on the existing pipeline, issuances from clean cooking activities will total a further 38 million carbon credits between 2023 – 2030. This supply is dominated by domestic biogas, solar cooking and biomass or liquid biofuel activities.

USD 800 million

The prospects for scaling carbon finance to clean cooking are real. Cumulative carbon finance flows to the clean cooking industry are estimated to reach USD 450 to USD 800 million by 2030, based on the current project pipeline alone.

5.1 Carbon credit supply

The public registries of the leading voluntary carbon standards referred to in this report are a helpful reference to understand historical carbon market developments in the clean cooking industry; and analysing new projects entering the pipeline offers a glimpse into the future emission reduction potentials ready to be deployed by clean cooking activities.

New projects are defined as activities that have been listed under one of the tracked voluntary carbon standards, but are not yet certified under a carbon standard. These new projects detail expected annual emission reductions, which combined with information on their crediting periods can be used to forecast likely carbon credit issuances in the years to come. Projections of these new volumes, combined with continued issuances from all the registered clean cooking activities presented above, inform the mitigation potential of all clean cooking activities currently recorded in the market's public registries.

To start with the cooking industry as a whole: future issuances are expected to continue to be dominated by improved cooking programmes. Nearly 90 percent (344) of all new (listed) projects in the pipeline are represented by these activities, with only 10 percent (43) relating to clean cooking activities. Combined with the strong representation of improved cooking activities in the existing pipeline of registered projects, future aggregate issuances from these activities over the period 2023 to 2030 are expected to be ten-fold the volumes expected from its clean counterparts over this timeframe (Table 3).

Zooming into clean cooking – between 2023 and 2030, the complete clean cooking project pipeline (including both registered and listed activities) has the potential to generate aggregate issuances of 38 million carbon credits.[73] This would represent a significant addition to the 25 million carbon credits already issued by clean cooking activities to date (Figure 11). Considering record issuances observed in 2020 - the result of accumulated vintages flooding the market - annual future issuance levels are not expected to revisit the 6 $MtCO_2e$ peak. Annual issuances are instead expected to level off at 5 $MtCO_2e$ in 2024, thereafter declining due to old projects coming to the end of their (fixed) crediting periods. Domestic biogas activities are projected to account for nearly 60 percent of all future issuances until 2030 (23 $MtCO_2e$), followed by solar cookers with 21 percent (8 $MtCO_2e$), biomass or liquid biofuel activities with 19 percent (7 $MtCO_2e$) and LPG with 1 percent (0.4 $MtCO_2e$).

One important caveat needs to be pointed out with regards to this forecast. As the presented figures only account for new projects already listed in carbon registries, this forecast excludes emission reductions from activities that may enter the market in the future. In reality, new clean cooking activities are likely to emerge, and existing programmes will expand to include new sub-projects. In particular, as the range of clean cooking options is rapidly increasing and new markets are being opened up, it is likely that currently underrepresented cooking activity types – such as solar, electric cooking, and bio-ethanol stoves – will become more visible in the future project pipeline. Outside of the carbon market, there are some early signs of cooking ventures pivoting from improved biomass stoves to for instance electric pressure cookers or pay-as-you-go induction cooking appliances.[74] The introduction of this new generation of e-cooking appliances will likely at some point also make it into the voluntary carbon market.

The introduction of a new methodology approved by the Gold Standard is supporting this development. The Gold Standard's Methodology for Metered and

Table 3: Improved cooking activities are expected to continue to dominate future supply of carbon credits.[75]

	NUMBER OF PROJECTS			ISSUANCES ($MtCO_2e$)	
	Registered	Listed	Total	2010 - 2022	2023 - 2030
Improved cooking	613	344	954	63	463
Clean cooking	224	43	267	25	38
Total	834	387	1221	88	502

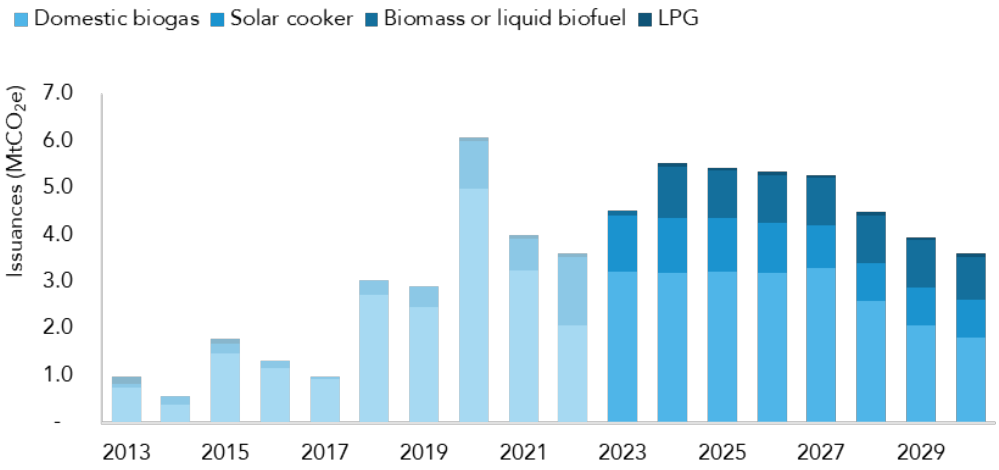


Figure 11. The existing project pipeline alone may not be sufficient to sustain record issuances as older projects starts dropping out.

Measured Energy Cooking Devices introduces a novel approach to quantify greenhouse gas impacts from metered cooking devices through direct measurement of energy or fuel.[76] It is applicable to LPG, electric and biogas metered appliances, and bio-ethanol cookstoves, among others. This can facilitate the monitoring of usage and energy consumption related to cooking activities, both reducing the costs associated with monitoring (by avoiding the need for expensive and time-consuming surveys), and improving the accuracy of performance data.

As such, this forecast can be regarded as a conservative projection of what is to come in the years ahead. In addition to this, as the forecast is based on annual emission reduction potentials and thereby represents anticipated volumes per vintage year, actual issuance volumes will rather be dictated by market conditions, resulting in larger volatility. These two factors combined imply that while the 2020 peak may not be revisited based on annual emission reduction potentials alone, as market prices move and new project developers enter the market it is likely that new issuance records will be realised in the coming years.

When the future emission reduction potential of the clean cooking project pipeline is considered, assuming two different carbon price development scenarios, cumulative carbon finance flows can reach between USD 640 million and USD 1.15 billion in the 2023 – 2030 period. The lower carbon finance flow projection is based on a scenario where carbon prices for clean cooking projects would increase to reach USD 25 per tonne by 2030. In the higher-price scenario, pricing would reach USD 50 by the end of this decade (Box 7). Adjusting these projections for a 30 percent transaction fee (see Section 3.2) to derive an estimate for the prices received by project developers, these cumulative carbon finance flows to projects would be adjusted to a range of USD 450 to USD 800 million until 2030, depending on the selected carbon price development scenario (Figure 12).

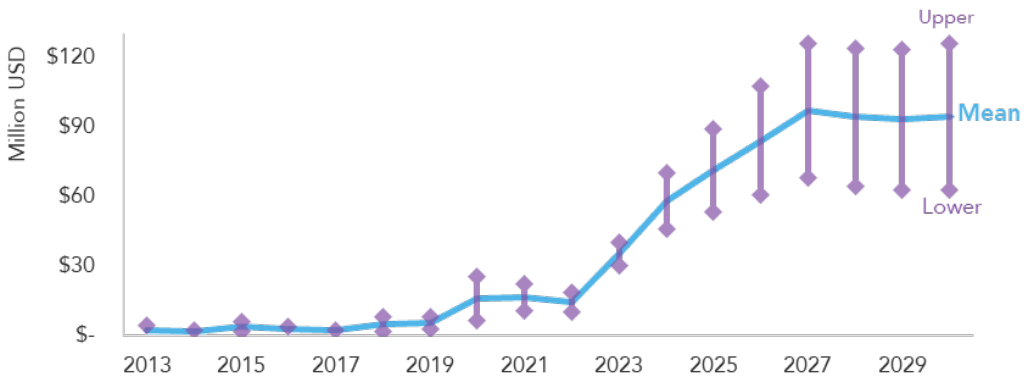


Figure 12. By 2030, cumulative carbon finance flows to clean cooking activities may reach between USD 450 million and USD 800 million.

Note: 'Lower' scenario refers to carbon prices reaching USD 25 per carbon credit by 2030, 'Upper' scenario refers to carbon prices reaching USD 50 per credit by 2030, and 'Mean' shows the average between the two.

Box 7. How voluntary carbon prices compare to other carbon valuation approaches

Carbon credit prices are a bellwether of investment flows into climate change mitigation action. Low prices restrict the ability of project developers to scale operations, limiting the impact carbon finance can have on transformational change. Price rises – as witnessed in recent years in the voluntary carbon market – trigger inflows of investment capital in anticipation of further price appreciation.

Despite the growing interest in the voluntary carbon market, voluntary carbon prices remain far below prices observed in some compliance markets. For instance, the price of European Allowance Units traded in the EU Emissions Trading System reached EUR 100 per tonne in February 2023, marking a three-fold increase since 2019 levels. Such high price is the result of increased demand from covered installations, in part triggered by the recent gas price increases which encouraged electricity producers to switch to more CO_2-intensive coal-fired power generation.[77]

Another benchmark against which carbon prices can be compared is the social cost of carbon. This metric represents an estimate of the damage done by each additional tonne of carbon emissions released into the atmosphere.[78] Its value is derived using economic modelling (rather than through a market based approach as under an emissions trading system). As a result, estimates of the social cost of carbon vary widely depending on the assumptions used to calculate it. For example, in the United States the current social cost of carbon applied by the Biden administration is set at USD 51 per tonne.[79] Alternative models estimate that the true social cost may be much higher than this, varying between USD 120 to USD 340 per tonne.[80]

While it is unlikely that average prices in the voluntary carbon market will reach price levels that reflect the social cost of carbon, projections by market analysts foresee future price appreciation triggered by rising demand for credits.[81] Higher prices would infer increased carbon finance flows to existing projects, while at the same time unlocking new abatement opportunities in segments that are currently economically unviable. They would also be more reflective of the true environmental benefit emission reductions offer.

5.2 The big picture

While there is no doubt that voluntary carbon markets have seen substantial growth in recent years, the market finds itself at a crossroads. Without a stable source of compliance demand, voluntary carbon markets depend on a positive reputation to foster growth and secure long-term backing from investors and carbon credit buyers. The ability of the voluntary carbon market to retain and further strengthen investor and buyer confidence, combined with much-needed clarity on the market's future role in the context of the Paris Agreement, is what will ultimately shape the market's future.

The current push for greater quality in carbon credits and the claims made around them will be a critical space to watch. If carbon credits are to continue to be used to compensate for emissions occurring elsewhere – rather than as a means of delivering results-based finance through financing contributions – then it is essential that the credits generated represent real, additional, and permanent emissions reductions. There is no shortage of media reports questioning the real climate impact of selected carbon projects, some of which can be accurate in pinpointing certain flawed initiatives, but incorrectly draws conclusions around the entire market failing to deliver on its objective. Baked into the design of many carbon standards are processes for continual improvement. This includes tightening additionality requirements and improving methodological approaches to quantifying emission reductions. The increased attention on quality in the carbon market can help standards to recognize where gaps remain and to prioritize addressing them in future updates.

While companies starting their journeys towards net-zero will be expected to pay particular attention to sourcing (nature-based) carbon removal credits spurred by the current SBTi guidelines, high-quality emission avoidance initiatives are well positioned to continue to generate growing demand in the years ahead. Current SBTi guidance acknowledges that companies should strive to go beyond their near- and long-term science-based targets to further mitigate climate change by making investments that support climate change mitigation outside of their value chains, especially those that generate additional co-benefits for people and nature. This concept of

Beyond Value Chain Mitigation offers a new window of opportunity for clean cooking activities, which garner both climate and community benefits.

To be well positioned in a scaling carbon market, projects seeking to emerge positively under scrutiny will need to evolve their approaches to measuring climate impacts to stay ahead of the curve. For some projects, this may result in the adoption of more conservative approaches to estimating emission reductions. For others, this may imply adopting more accurate measurements of technology usage and fuel consumption. While doing so may mean generating less carbon credits per unit of activity, buyers looking for high-integrity carbon projects will need to award carbon prices commensurate with the level of effort needed to generate such carbon credits.

How the Paris Agreement will affect carbon finance flowing to clean cooking activities is another important piece of the puzzle, and one in which project developers will have less control over. Depending on the choices countries (and carbon standards) make with respect to the need for implementing corresponding adjustments on voluntary carbon market transactions, the market could either be left largely to operate independently as they have done alongside compliance markets, or be brought into the fold of government regulation. If countries (or certifying standards) do require corresponding adjustments for projects being implemented by project developers of cooking solutions, this may translate into issuance delays and increased costs for credits buyers and sellers alike. Going through these hoops, however, may pay off if sufficient buyers agree to offer premium prices for correspondingly adjusted carbon credits. As such, project developers will need to closely follow domestic policy developments in the countries they are operating, and proactively engage with authorities to avoid unforeseen disruptions.

While the road ahead may be bumpy, the prospects for scaled up growth of the voluntary carbon market are real. As the market matures and tightens the rules to stimulate the generation of high-quality carbon credits, project developers of clean cooking activities have the opportunity to benefit from the current momentum in rising demand. With the current pipeline of clean cooking projects having the potential to leverage in the region of up to USD 800 million between 2023 to 2030 through carbon financing alone, the voluntary carbon market offers a real chance for households to break away from reliance on cooking basic fuels and technologies. This brings with it positive impacts on several Sustainable Development Goals; not least enabling access to modern energy, improving health of women and children, enhancing gender equality, and tackling a key driver of deforestation and forest degradation.

ENDNOTES AND REFERENCES

[1] Between 2015 and 2019. Finance needs estimate from IEA, IRENA, UNSD, World Bank, WHO. 2021. Tracking SDG 7: The Energy Progress Report. World Bank, Washington DC. World Bank; finance flows to clean cooking estimate from SEforAll (2021) Energizing Finance: Understanding the Landscape 2021. Available at https://bit.ly/3GBjepW.

[2] Energy Sector Management Assistance Program (ESMAP) (2020) The State of Access to Modern Energy Cooking Services. Washington, DC: World Bank. License: Creative Commons Attribution CC BY 3.0 IGO

[3] The Multi-Tier Framework (MTF) for cooking refers to a 'multidimensional, tiered approach to measuring household access to cooking solutions across six technical and contextual attributes with detailed indicators and six thresholds of access, ranging from Tier 0 (no access) to Tier 5 (full access). The aggregate MTF tier is the lowest tier rating across the six attributes'. Source: ESMAP (2020).

[4] LPG has historically been considered a clean cooking fuel owing to its lower carbon emissions, particularly black carbon, which is linked to a host of human health problems. Nonetheless, as a fossil fuel its extraction and processing drives greenhouse gas emissions. In this report we recognise the role that LPG has played in advancing the clean cooking transition to date, but also the need to prioritise solutions which can benefit both climate and human health going forward.

[5] Energy Sector Management Assistance Program (ESMAP) (2020) The State of Access to Modern Energy Cooking Services. Washington, DC: World Bank. License: Creative Commons Attribution CC BY 3.0 IGO

[6] Modern energy cooking services (MECS) refers to cooking solutions which are clean, efficient, convenient, reliable, safe, or affordable. Source: Energy Sector Management Assistance Program (ESMAP). 2020. The State of Access to Modern Energy Cooking Services. Washington, DC: World Bank. Available at https://bit.ly/3vVyxVG.

[7] Energy Sector Management Assistance Program (ESMAP). 2020.

[8] The USD 10 billion total is based on the IEA World Energy Outlook Model, in which the annual investment required to achieve universal access to clean cooking accounting for Net Zero Emissions by 2050 (NZE) scenario is USD 8 billion. This amount does not include fuel cost to the user or technology. See Clean Cooking Alliance (2022) Clean Cooking Systems Strategy: Horizon 1 Update. Available at https://bit.ly/404bfeb.

[9] Investment into the clean cooking industry has been increasing slowly since 2014, growing from around USD 20 million in 2014, to USD 43 billion in 2018. A considerable uptick was seen in 2019, where total investment reached almost USD 71 million, followed by a slight decline in 2020, to approximately USD 60 million.

[10] Clean Cooking Alliance (13 December 2022) 2022 Year-End Letter. Clean Cooking Alliance News. Available at https://bit.ly/3IGil2a.

[11] See Batchelor, S. (18 October 2021) "No silver bullet". MECS blog. Available at https://bit.ly/3jHz1w8; and MECS (2022) Modern Energy Cooking: Review of the Funding Landscape. Report 5 of the Financing Clean Cooking Series. Available at https://bit.ly/3I4daZ3.

[12] Clean Cooking Alliance (11 January 2023) "The Energy Crisis No One is Talking About: Cooking". Clean Cooking Alliance News. Available at https://bit.ly/3XrEhSH.

[13] The total revenue from carbon credit sales reported by companies has increased from USD 500,000 in 2017 to more than USD 11 million in 2020. See CCA (2022) Clean Cooking Industry Snapshot. Available at https://bit.ly/3ToShu6.

[14] CCA (2022) Clean Cooking Industry Snapshot, Figure 13. Available at https://bit.ly/3ToShu6.

[15] The first cooking projects registered under the Gold Standard began issuing credits as early as 2008.

[16] Das, I., Jeuland, M., and Plutshack, V. (2022) Policy Brief: The Role of Taxes and Subsidies in the Clean Cooking Transition: A Review of Relevant Theoretical and Empirical Insights. Nicholas Institute for Environmental Policy Solutions. Available at https://bit.ly/3UVoxWW.

[17] Das, I.; Jeuland, M. and Plutshack, V. (2022)The Role of Taxes and Subsidies in the Clean Cooking Transition: A Review of Relevant Theoretical and Empirical Insights. Nicholas Institute for Environmental Policy Solutions. Available at https://energyaccess.duke.edu/wp-content/uploads/2022/08/The-Role-of-Taxes-and-Subsidies-in-the-Clean-Cooking-Transition_Brief.pdf

[18] Das, I.; Jeuland, M. and Plutshack, V. (2022)The Role of Taxes and Subsidies in the Clean Cooking Transition: A Review of Relevant Theoretical and Empirical Insights. Nicholas Institute for Environmental Policy Solutions. Available at https://energyaccess.duke.edu/wp-content/uploads/2022/08/The-Role-of-Taxes-and-Subsidies-in-the-Clean-Cooking-Transition_Brief.pdf

[19] This report covers all leading voluntary carbon standards certifying emission reductions in the cooking sector, including the Gold Standard, Verra's Verified Carbon Standard, and Climate Forward. For more details, please visit the Climate Focus Voluntary Carbon Market Dashboard at https://climatefocus.com/initiatives/voluntary-carbon-market-dashboard/

[20] Fourteen clean cooking Programmes of Activities are registered across the leading voluntary carbon standards as of the start of 2023. These programmes include 125 Voluntary Project Activities.

[21] Mixed projects include a mix of the following technologies: improved cookstoves, clean cookstoves, lighting, clean water and electricity.

[22] Gold Standard (2022). Methodology for Metered and Measured Energy Cooking Devices. Available at https://globalgoals.goldstandard.org/news-methodology-for-metered-measured-energy-cooking-devices/

[23] MECS (2022) ATEC & MECS to pilot digitised 'cook to earn'. Available at https://mecs.org.uk/blog/atec-mecs-to-pilot-digitised-

cook-to-earn/

[24] MECS (2022) Integrating Hot Water, Hot Iron, and Long-cycle-life Batteries to provide Off-grid Solar PV Cooking Energy Storage in Malawi. Available at https://mecs.org.uk/blog/integrating-hot-water-hot-iron-and-long-cycle-life-batteries-to-provide-off-grid-solar-pv-cooking-energy-storage-in-malawi/

[25] The volumes presented in the graphic show the number of carbon credits issued in any given year. As such, these do not represent 'vintages', or the emission reductions that have been generated in those years

[26] Retirement of a carbon credit refers to the purchased carbon credit being cancelled, after which it cannot be transacted again. Retirement data is publicly available on carbon standards' registry systems.

[27] Global average pricing data is informed by annual reporting by Ecosystem Marketplace. Reports available at https://data.ecosystemmarketplace.com/. Average pricing for cookstove projects informed by market data collected by Climate Focus. As this data is informed by surveys and a sub-set of global market transactions, these average historical prices are to be regarded as indicative only. Furthermore, pricing per project depends on multiple factors, including the activity type, project location, vintage and volume offered, and governing carbon standard, among others. There are, of course, outliers and the values presented here are averages only.

[28] For example, see historical data provided by Ecosystem Marketplace in its State of the Voluntary Carbon Markets reporting. Available at https://www.forest-trends.org/publications/maneuvering-the-mosaic-state-of-the-voluntary-carbon-markets-2013/

[29] Clean Cooking Alliance (2022) 2022 Industry Snapshot. Available at https://cleancooking.org/wp-content/uploads/2022/05/CCA-2022-Clean-Cooking-Industry-Snapshot.pdf

[30] Historical data shows that to date, the vast majority of transacted and retired voluntary carbon credits relate to avoided emissions credits, generated by project activities like renewable energy, energy efficiency and cookstove activities. Of the circa 1.45 billion carbon credits issued globally since inception of the voluntary market, just over 100 million relate to (nature-based) removal activities. See the Climate Focus VCM Dashboard for more details, available at https://climatefocus.com/initiatives/voluntary-carbon-market-dashboard/

[31] This terminology refers to the Platts Household Devices Assessment, a standardised contract offered by S&P Global Platts. The daily-traded price assessment reflects the most competitive household device carbon credits certified by the following standards: The Gold Standard, Climate Action Reserve (CAR), Verified Carbon Standard (VCS), Architecture for REDD+ Transactions, and American Carbon Registry (ACR).

[32] Explanation of the pricing data sources: 'NBS removals' refers to the S&P Global Platts CRC Assessment; 'Household devices' refers to the S&P Global Platts Household Devices Assessment; 'NBS all' refers to Xpansiv's CBL N-GEO spot contract; 'Waste' refers to S&P Global Platts Methane Collection Assessment; 'Renewables' refers to S&P Global Platts Renewable Energy Assessment.

[33] VCMI (2022) Provisional Claims Code of Practice. Available at https://vcmintegrity.org/vcmi-claims-code-of-practice/

[34] Under the VCMI's proposed framework, companies pursuing a 100 percent compensation of their remaining emissions once interim decarbonisation targets are met, would quality for a "Gold" designation. Companies compensating at least 20 percent of their unabated emissions would quality for a "Silver" designation. The final version of the Code is expected to be released in the first quarter of 2023.

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[36] Gold Standard (2022) Claims Guidelines. Available at https://globalgoals.goldstandard.org/105-par-claims-guidelines/

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[61] The exact parameters to be monitored depend on the accounting methodology applied and technology used.

[62] Gill-Wiehl, A.; Haya, B.K.; Bailis, R. and Kammen, D. (2023) Cooking the books: Pervasive over-crediting from cookstoves offset protocols [unpublished manuscript] University of California, Berkeley

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[71] Greiner et al. (2021) NDC conditionality and Article 6. Available at https://www.climatefinanceinnovators.com/wp-content/uploads/2021/05/CFI_NDC-conditionality-and-Article-6-short-study-1.pdf

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[73] Carbon credit issuances from listed projects are considered to reach their full potential (defined as the estimated annual emission reductions as per the standard's databases) in their third year of operation. To be conservative, the forecast assumes that one-third of stated emission reduction potentials is unlocked in the first year of operation; and two-thirds in the second year. This assumption reflects a more realistic roll-out process of clean cooking activities.

[74] MECS and Energy4Impact (2022) Modern Energy Cooking: Review of the Funding Landscape. Available at https://sun-connect.org/wp-content/uploads/mecs_landscape_report.pdf

[75] These figures include Programs of Activities, Voluntary Project Activities and Standalone projects. The pipeline used to estimate future issuances includes registered projects with crediting period remaining and listed projects. For conservativeness, projects registered on or before 2019 that have not issued credits as of 2023 have been excluded from the calculations, and projects registered after 2019 that have not issued credits are assumed to start issuing only in 2024. Similarly, projects listed on or before

2019 are excluded from the calculations, and it is assumed that the remaining listed projects will start issuing credits in two years' time (i.e., in 2025).

[76] Gold Standard (2022). Methodology for Metered and Measured Energy Cooking Devices. Available at https://globalgoals.goldstandard.org/news-methodology-for-metered-measured-energy-cooking-devices/

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[82] Instead of being referred to as simply "greenhouse gas (GHG) emission reductions and removals", the term "ITMOs'" is purposefully open and undefined, providing an umbrella for a wide array of different metrics that account for mitigation outcomes (for example, they could refer to greenhouse gases mitigated or to megawatts of power installed or trees planted).