



CLEAN  
COOKING  
ALLIANCE

**A CALL TO ACTION**

# Accelerating clean cooking as a nature-based climate solution







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Cover: A man stands by a smoldering kiln burning wood being turned into charcoal on a swathe of deforested land on the edge of Virunga National Park, DRC. Guerchom Ndebo pour la Fondation Carmignac.

Left: A woman prepares a meal using a portable and smokeless biomass cookstove. © Biolite.



# CLEAN COOKING IS ONE OF THE MOST UNDERVALUED AND UNDERFUNDED TOOLS TO PROTECT NATURE AND LIVELIHOODS

Global climate and development goals cannot be achieved without changing the way people cook. Some 2.4 billion people are without access to clean cooking, costing the world more than US\$2.4 trillion in damage to the climate and local economies and contributing to 3.2 million premature deaths each year.

Despite these unacceptable consequences, lack of access to clean cooking remains the most underinvested health and environmental problem in the world. This report presents the urgent business case and practical proposals to mobilize and align global finance for clean cooking as a nature-based climate solution.

Cooking is a fundamental part of life. Yet, billions of people do not have the luxury of safe meal preparation. Instead, they depend on polluting, open fires or inefficient, climate-harming stoves to cook their daily meals, emitting over 120 megatons of climate pollutants every year. More than half of anthropogenic black carbon emissions come from burning solid fuels for cooking and heating in homes, making household energy the largest controllable source of black carbon.

Lack of access to clean cooking is a major threat to nature,

climate, and sustainable livelihoods. Up to 34% of woodfuel harvested is unsustainable, contributing to forest degradation and climate change. More than 275 million people live in “hot spots,” where over 50% of woodfuel harvest is unsustainable. Women and children can spend up to 10 hours each week gathering fuel, walking ever-greater distances and carrying heavy loads due to forest degradation.

It is not possible to overstate the urgency for action, especially in sub-Saharan Africa, where access to clean cooking is particularly low and where the absolute number of people relying on polluting cooking fuels and stoves continues to rise.

This report outlines the evidence base for the fundamental role of clean cooking in delivering and achieving the benefits of nature-based solutions. It illustrates how clean cooking enterprises and conservation

organizations are leveraging clean cooking value chains to deliver inclusive and sustainable rural development and ensure long-term success of nature-based solutions, and it provides an overview of the key financing barriers and opportunities to align and scale clean cooking approaches with nature-based solutions.

The report offers a set of strategic recommendations for governments, investment decision-makers, conservation organizations, and the private sector to scale clean cooking as a nature-based solution.

- Governments and multilateral finance institutions need to step up their support to countries to integrate clean cooking into nationally determined contributions (NDCs) as well as programs on environment and climate, such as REDD+ and park development plans. Furthermore, it is the opportune moment for government donors and development finance institutions (DFIs) to leverage international and national private finance for clean cooking through cooperation and transactions of the Paris Agreement’s Article 6, as well as other gender, health, and biodiversity impact-linked instruments.

- Local conservation organizations are invaluable “boots on

the ground” with a deep understanding of the challenges and pressures on local communities and the natural resources on which communities are so reliant. As populations grow in these sensitive areas with a high dependence on nature and unsustainable fuelwood harvesting, it will be increasingly critical to ensure that the challenges faced by these communities are at the center of conservation efforts and nature-based solutions.

- As the focus on the interrelationship between nature and climate intensifies, clean cooking companies should develop new partnerships with conservation organizations, local government stakeholders such as forestry administration and national parks, and other environmental groups to leverage clean cooking value chains for nature-based solutions. Intensified collaboration in hot spots for unsustainable woodfuel use would allow conservation organizations to achieve inclusive and regenerative rural development that reduces pressure on critical ecosystems.

- Corporations should ensure that they are aligning with the IUCN Global Standard on Nature-based Solutions™ and addressing societal challenges of local communities, with clean cooking integrated as

a foundational component in nature-related carbon removal and sustainable agriculture investments as well as in supply chain environmental, social, and governance standards and targets.

- Investors should screen nature-related investments to identify where clean cooking solutions can help to de-risk nature-related investments in nature-based solutions. Additionally, investors need to drastically scale finance for the clean cooking sector and improve incentives that enable enterprises to serve remote and vulnerable populations, ensuring that there is a strong pipeline of companies to serve these markets.

## Time is running out

Without increased effort, 2 billion people will still lack access to clean cooking in 2030, making it impossible to achieve global development and climate goals and putting billions of dollars in nature-based investment at risk.

This report serves as a call to action for governments, investment decision-makers, conservation organizations, and the private sector to accelerate the transition to clean cooking as foundational to safeguarding nature-based solutions and ensuring that they deliver the intended benefits for both people and planet.



**Dymphna van der Lans**  
CEO  
Clean Cooking Alliance

**The fates of our natural ecosystems and human populations are deeply interconnected.** It is increasingly recognized that safeguarding nature is critical to addressing climate change and protecting billions of the most vulnerable people around the world. Yet, as governments, donors and investors look for ways to protect and restore nature, they often overlook one of the most accessible and impactful solutions: clean cooking.

Every year, cooking with solid fuels produces as much climate-harming emissions as the global airline industry, and 30% of global emissions from forest degradation result from wood fuel harvesting. In countries like the Democratic Republic of Congo, where 90% of the population relies on charcoal for cooking, over a million acres of forest were lost in 2020 alone to wood fuel collection, harming precious ecosystems that naturally remove carbon from the atmosphere and support biodiversity and livelihoods.

The good news is this trend is reversible. We have the knowledge and technologies to provide affordable clean cooking to every person in the world—but only if governments, investors, and the private sector make it a priority. Last year, at COP26, more than 130 countries pledged to halt and reverse deforestation and land degradation by 2030 and billions of dollars were committed to restoring natural habitats and transforming food systems. Making good on these commitments will require a holistic approach that addresses the drivers of degradation and unsustainable biomass use.

As COP27 approaches, this report serves as a call to action for those truly serious about accelerating and financing solutions that work for climate, nature and people. Failure to invest in clean cooking puts millions of lives at risk, threatens to undermine billions of dollars in climate mitigation investments – and imperils the future of all of us and our planet. We must align our efforts to protect nature and ensure no one's lives are limited by the way they cook.



**Dr. Leela Hazzah**  
Executive Director &  
Cofounder, Lion Guardians  
Cofounder & Leadership  
Council, WE Africa

**Our planet has a wealth of diverse ecosystems that offer many benefits to humans; including food, fuel, shelter, and freshwater.** They are fundamental to addressing some of humanity's most pressing challenges like climate change, biodiversity loss, and food security. Yet around the world trees are disappearing at an alarming rate; and Africa remains one of the most affected regions. Where four million hectares of forest disappear annually, and up to 65 percent of productive land is degraded, leading to a three percent loss of GDP and threatening the lives of more than one billion people.

But there is hope for Africa's vital landscapes. The most successful examples of reforestation and species recovery in Africa have two things in common - they are inclusive throughout the entire process and support local solutions. The future of Africa's critical ecosystems will depend on a radical new form of leadership that is holistic and innovative; and with 90 percent of Africans relying on wood and charcoal for their cooking needs, access to clean, safe and affordable cooking solutions is imperative. With women being the primary cooks in African households, solutions that are culturally appropriate and that incorporate women's knowledge will be most impactful and sustaining. This will become even more valuable as we incorporate and recognize the importance of nature-based solutions to buffer the aftershocks of decades of over-harvesting.

This report highlights the critical role of local communities and conservationists as key stakeholders and offers valuable recommendations for governments, investors, and the private sector. As the clock ticks towards 2030, now is the time to implement what we know works (e.g., the inclusion of communities, women, and people's traditional knowledge) to heal forests, woodlands and farmlands, bringing water, food, income, and energy to homes.



**Preeti Sinha**  
Executive Secretary  
United Nations Capital  
Development Fund

**UNCDF commends the Clean Cooking Alliance for publishing this excellent paper that places clean cooking at the forefront of nature-based climate solutions.**

2.4 billion people lack access to clean cooking, which results in millions of premature deaths, large quantities of climate pollutants, unabated deforestation in global biodiversity hot spots, and a continuous burden on women and children typically charged with collecting fuel wood.

Therefore, it seems odd, and unfortunate, that clean cooking solutions attract such a miniscule fraction of international climate finance and private capital aligned with Environmental, Social and Governance (ESG) principles.

UNCDF is the UN's flagship catalytic finance entity for the world's 46 least developed countries, which we see as the frontier markets of today and the growth markets of tomorrow. We strongly believe that innovative finance can incentivize investments in the right technologies and business models to build sustainable markets for cleaner fuels and tools, while also unlocking newer forms of capital for these markets through carbon and outcome-based finance. In Nepal, Cambodia, Uganda, Ethiopia, Tanzania, and the DR Congo, UNCDF has observed this first-hand through our own work.

On top of this, UNCDF sees key opportunities emerging from combining innovative finance approaches. With digitalization of business processes as well as application of digital assets such as blockchain technologies to reduce transaction costs, increase transparency and accountability, we can create opportunities for climate finance to flow directly to enterprises, communities, and households. Taken together, these innovations can accelerate clean cooking target contributions towards NDCs (Nationally Determined Contributions) and the achievement of SDG 7 (Affordable and Clean Energy).

Let us be clear: a lot remains to be done. Serious capital still needs to be mobilized. However, the impact and business case for dramatically increased investment in clean cooking is undeniable. UNCDF looks forward to a strong collaboration with the Clean Cooking Alliance and other partners to make this a reality.



**Eddy Kambale Syaluha, DVM, MSc**  
Head Veterinarian, DRC  
Gorilla Doctors

**At Gorilla Doctors we advance a One Health approach recognizing that the health of people, gorillas, and the environment are intrinsically connected.**

In my country, the Democratic Republic of Congo (DRC), we face significant health threats such as population growth, poverty, civil unrest and violence, and infectious disease (e.g. Ebola outbreaks in 2018). These threats also impact endangered mountain gorillas and critically endangered Grauer's gorillas through their susceptibility to human diseases, poaching and habitat loss.

So, what do clean cooking stoves have to do with gorilla conservation? In DRC, people enter the protected parks where gorillas live to illegally harvest wood for fuel, timber and conversion to charcoal. Studies have shown that wood collection contributes to habitat degradation impacting primates through food loss, stress, and increased risk of disease transmission. Additionally, the use of inefficient cooking stoves is also detrimental to the health of people, as this excellent report states.

The Gorilla Rehabilitation and Conservation Education Center (GRACE) conducted a clean stove pilot study<sup>1</sup> in eastern DRC and found that weekly fuel wood use decreased by half in the households using cleaner burning stoves. The study also found that adoption of the clean stoves was only the first step. Lasting behavior change and the environmental and health benefits that follow requires commitment to and investment in long-term projects. This report is a clarion call for that investment.

The conservation of nature and wildlife is complex and growing more so each day. Solutions that benefit the health of people, animals, and our shared environment are our best chance for redirecting our future to one where we all thrive together.

<sup>1</sup> Kahlenberg, Sonya M., et al. "A case study of improved cook stoves in primate conservation from Democratic Republic of Congo." *American Journal of Primatology* 83.4 (2021): e23218.



**PART ONE**

# Reversing nature loss requires clean cooking

Humanity is at “code red” to address climate change and halt the spiraling loss of biodiversity. As governments, investors, and corporates look for opportunities to meet their commitments to align net-zero carbon emissions and nature-positive development, clean cooking must not be ignored. Instead, the transition to clean and efficient cooking solutions should be central to policy, investment, and supply chain decisions.

Left: Kenya - In the arid lands to the north, stark expanses of open desert offer a tough life, especially for women searching endlessly, for what few trees remain to provide wood fuel for their 3-stone open fire to cook their meals. © 2022 Rascona/Indiastock.



# CHANGING THE WAY FAMILIES COOK THEIR FOOD EACH DAY IS A CRITICAL LEVER TO SLOW CLIMATE CHANGE, PROTECT FORESTS, AND IMPROVE LIVELIHOODS

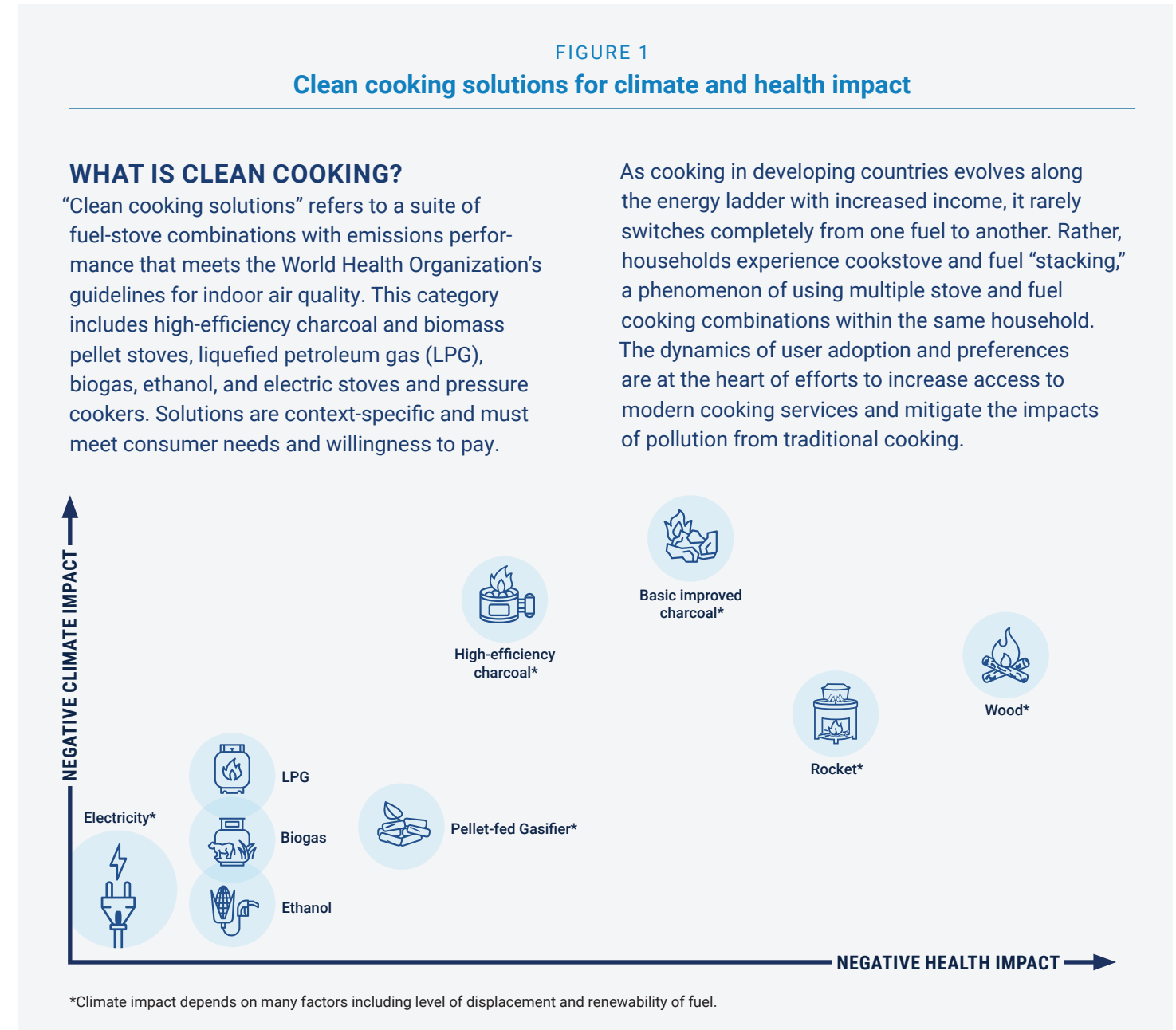
## Approximately 30% of global greenhouse gas (GHG) emissions from forest degradation are derived from woodfuel harvest.<sup>1</sup>

In total, emissions from nonrenewable woodfuels for cooking amount to 1 GtCO<sub>2</sub>e per year – about 2% of global emissions and up to 4.3% of total emissions in the pan-tropical regions, and roughly on a par with emissions from aviation.<sup>2</sup> These include both carbon dioxide (CO<sub>2</sub>) and short-lived pollutants like black carbon, which has a warming impact on climate that is up to 1,500 times as strong as that of CO<sub>2</sub>.<sup>3</sup> At the same time, switching from traditional cookstoves induces radical improvements to the health, safety, and economic security for women, who typically conduct 91% of the work to obtain fuel and to cook and who account for over 60% of all premature deaths from household air pollution.<sup>4,5</sup>

**Despite progress, universal access to clean cooking by 2030 remains far off-track.** On a global scale, the number of people gaining access to clean cooking increased, however, population growth continues to outpace these improvements,

particularly in sub-Saharan Africa. As a result, the total number of people lacking access to clean cooking – the “access deficit” – has stagnated for decades. Between 2010 and 2020, the access deficit dropped from 3 billion people to 2.4 billion, primarily due to improvements in Asia. In contrast, the access deficit in sub-Saharan Africa has nearly doubled since 1990, reaching a total of 923 million people in 2020. Without increased effort, 2.1 billion people globally will still lack access to clean cooking in 2030.<sup>6</sup> However, the level of funding and investment in the clean cooking sector has not matched the global magnitude of the challenge, hovering around US\$130 million, well below the US\$4.5 billion required annually to 2030 to scale clean cooking to the 2.4 billion people who still depend on polluting fuels.<sup>7</sup>

**Transitioning to clean cooking is foundational to safeguarding nature-based solutions and ensuring that they deliver for climate, the environment, and people.** Approximately 30% of global mitigation needs



can be resolved through such nature-based and natural climate solutions as conservation and restoration of forests and improved land management.<sup>i</sup> The multiple benefits provided by nature-based solutions make them a strategic piece in delivering mitigation in a way that is cost-effective; enhances resilience and adaptation to climate change, food security, biodiversity, and other ecosystem

services; and contributes to international sustainable development goals.<sup>8</sup> The focus on human well-being and addressing key societal challenges through nature-based solutions underlines the central role for clean cooking in many parts of the world. Put in the most straightforward terms, it “does not make any sense to grow trees, unless you address why people are cutting down trees in the first place.”<sup>9</sup> Reducing

the firewood demands of local communities should be core to nature-based solutions where communities lack access to more efficient and cleaner stoves and fuels. The avoidance of emissions from shifting to clean cooking should be considered a central activity for ensuring the “permanence” of nature-based carbon removals through reforestation, while also enabling a transformation of rural livelihoods.

i. **CLARIFICATION:** This report will use “nature-based solutions” as the overarching term, recognizing its focus as more holistic than “natural climate solutions.”



**The Global Standard for Nature-based Solutions (NbS)<sup>TM</sup> of the International Union for Conservation of Nature (IUCN) defines nature-based solutions as “actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits.”<sup>10</sup>**

**Nature-based solutions are becoming increasingly central to national climate-resilient development plans and must integrate clean cooking to ensure success.** In the past few years, both the public and private sectors have begun to recognize the powerful tool of nature-based solutions. More than 30 countries representing over a third of the world’s population pledged in 2021 to increase support for nature-based solutions. For

example, Kenya has committed to planting 2 billion trees by 2022, restoring 5.1 million hectares of forests, and transitioning from biomass energy to 100% clean cooking fuel.<sup>11</sup> Currently, US\$133 billion flows into nature-based solutions each year, with calls to triple that investment by 2030 and quadruple it by 2050, in order to meet global climate change, biodiversity, and land degradation targets. However, more than 80% of investment comes from public

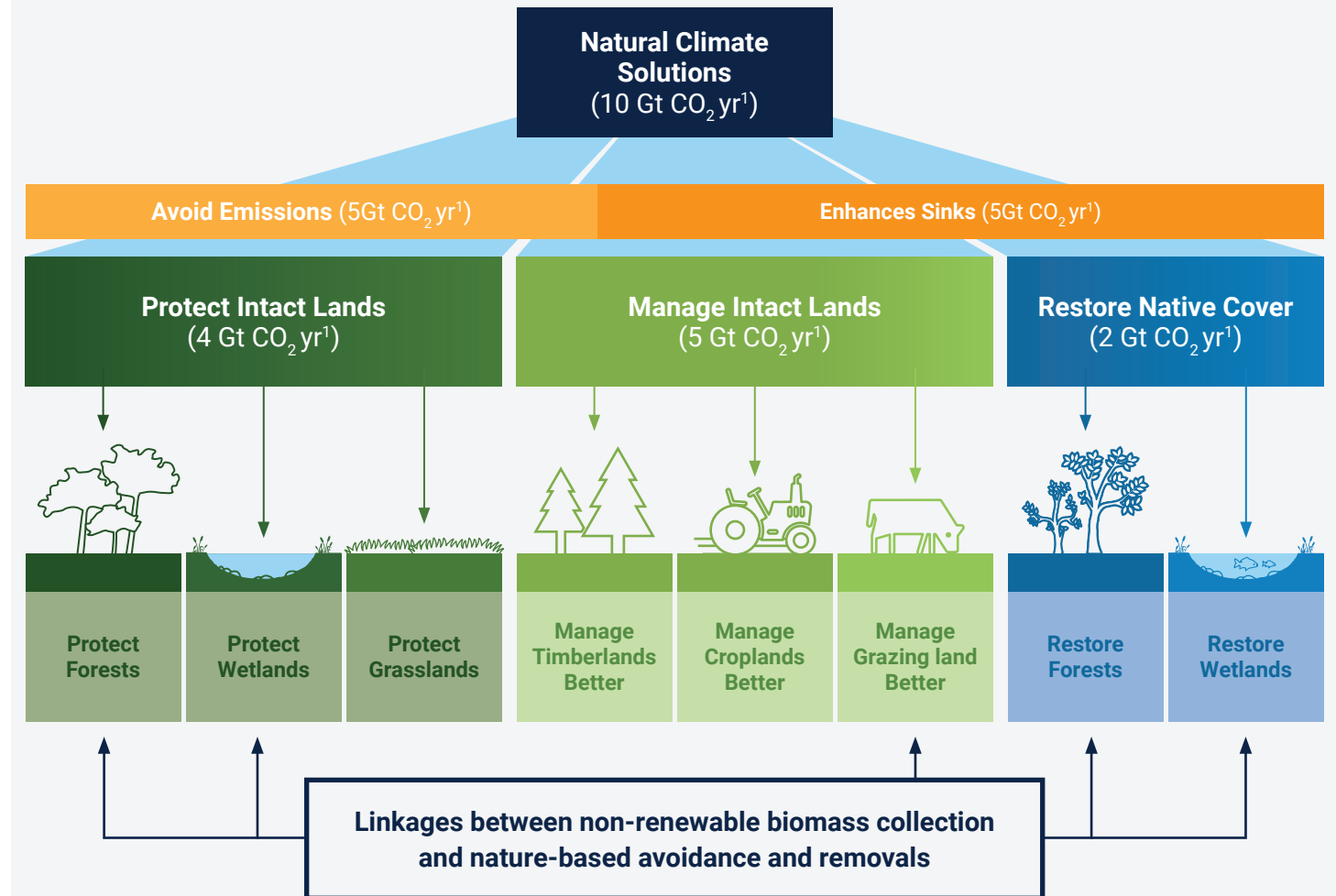
funds, and an estimated US\$4.1 trillion financing gap needs to be closed by 2050.<sup>12</sup>

Companies and investors are starting to realize the value of nature-based solutions to address the interlinked climate and biodiversity crises in their operations, supply chains, and investments. For example, SwissBiz4Nature, a multistakeholder initiative composed of Swiss-based businesses and organizations, plans to implement 100 projects to protect, manage, and restore nature by 2030, using the IUCN Global Standard for NbS<sup>TM</sup> to design and benchmark their progress.<sup>13</sup>

**Despite the challenges, now is the time to leverage intensified**



**FIGURE 2**  
**Clean cooking plays an important role in emissions avoidance and removals from restoration, conservation, and improved management of natural ecosystems**



Source: Giardin et al (2021). Natural Climate Solutions are an inter-related, but more limited, term to NbS, referring just to conservation, restoration and improved land management actions to increase carbon storage and/or avoid greenhouse gas emissions.<sup>17</sup>

**interest in nature to align finance for nature-based solutions and clean cooking to transform sustainable rural livelihoods.** New research from the World Resources Institute estimates that just 1.5% of total international climate finance – US\$8.7 billion – supports nature-based solutions for adaptation in developing countries.<sup>14</sup> Yet by comparison, this dwarfs the level of investment into the clean cooking sector that falls

well short of the annual US\$20 billion investment required for universal access by 2030. Investment into clean cooking access in 2019 amounted to just US\$133 million.<sup>15</sup> The growing investment case and interest in the carbon markets and nature offer an opportunity for investors to align finance for nature-based solutions and clean cooking as a means to de-risk these investments, improving their permanence while multiplying

the positive impacts for local communities and global climate stability. In addition, investor interest is growing beyond the carbon markets. In particular, exchange-traded funds that are linked to environmental, social, and governance concerns and to other forms of results-based finance, market, financial, and capital market instruments can be harnessed for clean cooking and nature-based solutions.<sup>16</sup>



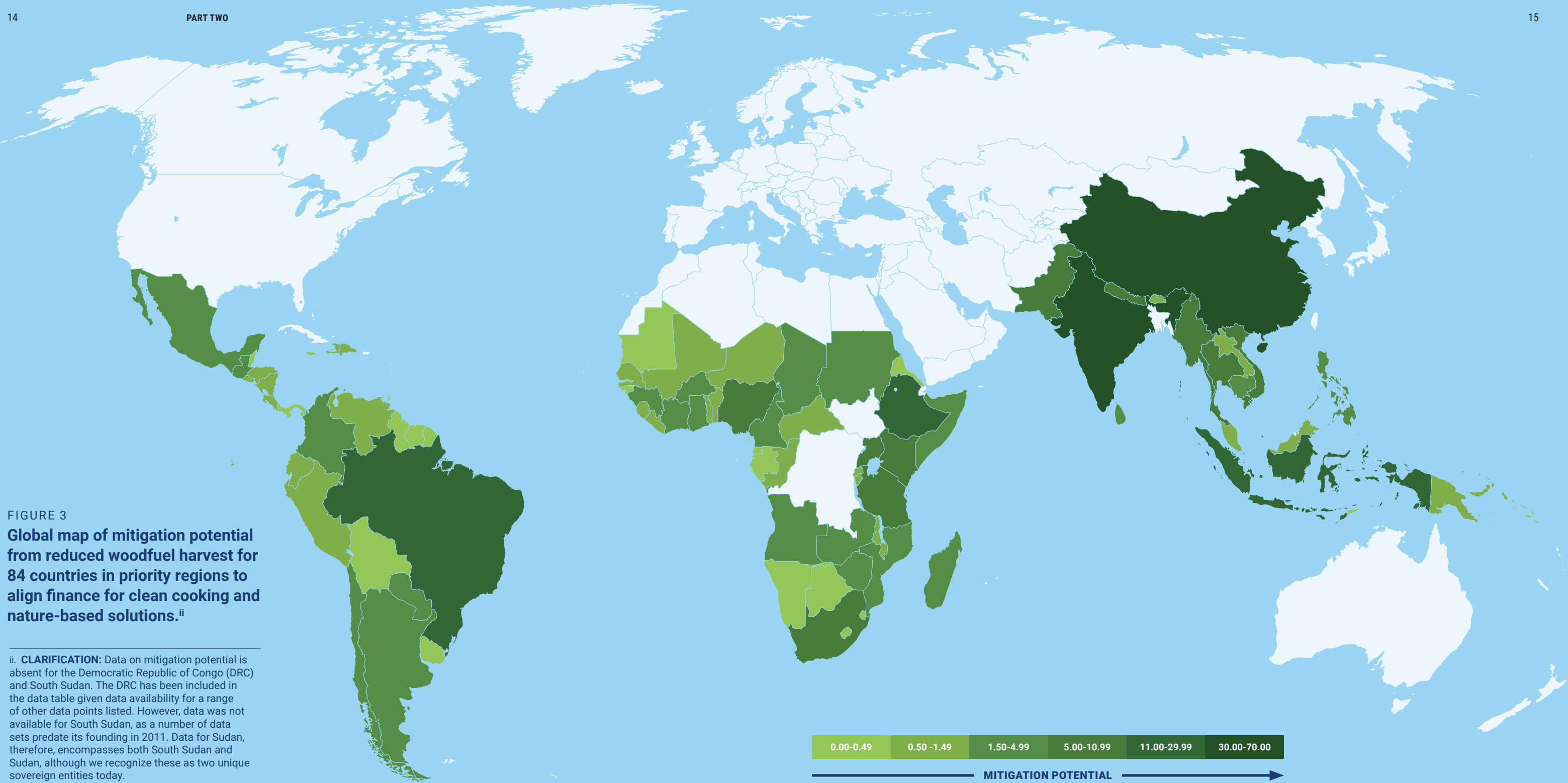
**PART TWO**

# The energy-nature nexus: Forest degradation

Tropical forests are some of the most biologically diverse ecosystems on the planet. Their influence locally and globally on weather patterns, freshwater, desertification, floods and landslides, biodiversity, food, and human health is more profound than any other terrestrial biome. Tropical rainforests cover an estimated 5% of global land surface, regulating local and global precipitation (they return to the atmosphere up to 90% of the rainfall they receive), as well as soil stability and quality, runoff, and global carbon fluxes.<sup>18</sup>

**Left: A father and son prepare a kiln to make charcoal on a swathe of deforested land near the village of Rusayo on the edge of Virunga National Park just north of the eastern Congolese city of Goma. Guerchom Ndebo pour la Fondation Carmignac.**





**FIGURE 3**  
**Global map of mitigation potential from reduced woodfuel harvest for 84 countries in priority regions to align finance for clean cooking and nature-based solutions.<sup>ii</sup>**

ii. **CLARIFICATION:** Data on mitigation potential is absent for the Democratic Republic of Congo (DRC) and South Sudan. The DRC has been included in the data table given data availability for a range of other data points listed. However, data was not available for South Sudan, as a number of data sets predate its founding in 2011. Data for Sudan, therefore, encompasses both South Sudan and Sudan, although we recognize these as two unique sovereign entities today.

**Some 275 million people live in “hot spots” of unsustainable woodfuel depletion, mainly in the tropical forest areas of South Asia and East Africa.<sup>iii</sup>** Of these, nearly 60% live in Asia, 34% in Africa, and 6% in Latin America.<sup>19</sup>

In 74 countries that account for 2.2 billion hectares of forest, unsustainable fuelwood harvesting drives, on average, 30% of forest degradation emissions – 2.1 billion tCO<sub>2</sub>e annually.<sup>20</sup> Globally, unsustainable harvesting and

incomplete biomass combustion contribute an estimated 1.9–2.3% of global emissions (carbon dioxide, black carbon, and other short-lived climate pollutants).<sup>21</sup> The share of emissions from woodfuel for many of the

countries in these hot spots can be sizable, in some cases the largest single source of emissions.

**In 12 nations – Belize, Burundi, Eritrea, Ethiopia, Guinea-Bissau, Haiti, Kenya, Lesotho, Liberia, Nepal, Rwanda, and Uganda – emissions from woodfuels are**

**estimated to account for more than 50% of the country’s total emissions.<sup>22</sup>**

The destruction and degradation of diverse tropical forests have significant consequences for global climate change, biodiversity loss, and human well-being. In addition to forest carbon losses,

the removal of trees leads to soil erosion, can increase water temperature by up to 4°C, and lowers oxygen levels in streams. This in turn depletes aquatic fauna, reduces water quality for local wildlife and communities, increases sediment by up to 550 times, and enhances the risks of landslides and flooding.<sup>23</sup>

iii. **DEFINITION:** Woodfuel “hot spots” are regions in which expected fraction of nonrenewable biomass utilization (fNRB) exceeds 50%, that is, regions in which most harvested woodfuel is unsustainable.”



TABLE 1

### The linkage between hot spots for unsustainable woodfuel use and mitigation through nature-based solutions

Country	Mitigation potential (reduced woodfuel harvest) <sup>24</sup>	Range of woodfuel contributions to total emissions <sup>25</sup>	Growth of CO <sub>2</sub> derived from national charcoal & biomass demand <sup>26</sup>	Fraction of nonrenewable biomass utilization <sup>27</sup>	Share of population lacking access to clean cooking <sup>28</sup>	Inclusion of clean cooking in NDCs <sup>29</sup>
	million tCO <sub>2</sub> e / year	% (2009)	tCO <sub>2</sub> (2020–40)	fNRB (2009)	% (2019)	Yes / No
Angola	2	5% - 16%	1476800	34.87	50.4	Yes
Argentina	2	1% - 2%		na	0.2	No
Bangladesh	4.49	9% - 10%	-6248957	50.85	77	Yes
Belize	0.02	2% - 12%		na	17.6	Yes
Benin	1.01	3% - 5%	671525	19.31	96	Yes
Bhutan	0.82	50% - 64%		na	20.9	Yes
Bolivia	0.41	0% - 1%	-199308	22.24	14.5	No
Botswana	0.18	2% - 11%	4849	17.01	47.2	No
Brazil	25.12	2% - 5%	-546378	17.36	4.1	No
Burkina Faso	2.04	23% - 38%	1890531	47.12	89.9	Yes
Burundi	0.83	56% - 66%	2449648	55.54	99.8	Yes
Cambodia	1.61	1% - 4%	-254037	23.14	68.8	No
Cameroon	2.41	3% - 16%	185125	9.03	78.1	Yes
Central African Republic	0.5	0.1% - 0.3%	365117	35.24	99.5	Yes
Chad	1.5	7% - 14%	1083505	23.65	96.2	Yes
Chile	2.58	3% - 3%		na	0	Yes
China	65.2	1% - 1%	-15649415	16.50	35.6	No
Colombia	1.8	1% - 3%	-464875	29.66	5.7	Yes
Costa Rica	0.56	7% - 12%		na	4.5	No
Cote d'Ivoire	2.95	2% - 4%	597170	35.24	69.7	Yes
Democratic Republic of the Congo	NA	2% - 4%	8902829	35.24	95.5	Yes
Dominican Republic	0.9	5% - 9%	-43804	33.02	95.5	Yes
Ecuador	0.82	2% - 12%		na	6.1	Yes
El Salvador	0.61	9% - 19%		na	10.9	No
Equatorial Guinea	0.07	2% - 9%		24.10	76.1	No
Eritrea	0.48	47% - 55%	755030	67.61	90.7	Yes
Ethiopia	16.53	64% - 79%	11214365	60.92	93.4	Yes
French Guiana	0.02	2% - 3%		na	N/A	No
Gabon	0.18	2% - 2%		na	12.1	No
Gambia, The	0.18	28% - 39%	363879	41.39	98.6	Yes
Ghana	4.16	6% - 16%	37883	27.66	77.4	Yes
Guatemala	2.91	8% - 21%	297465	31.71	51.2	Yes
Guinea	2.28	0.6% - 1.4%	1099630	24.10	98.4	Yes
Guinea-Bissau	0.42	23% - 55%	156889	27.78	98.9	Yes
Guyana	0.16	1.2% - 1.4%		na	23.2	No
Haiti	1.19	70% - 77%	708665	66.34	95.7	Yes
Honduras	1.41	10% - 39%	-106680	19.92	55.1	Yes
India	53.88	4% - 5%	-40764471	23.17	35.8	Yes
Indonesia	27.42	2% - 4%	-7148439	41.10	17.6	No
Jamaica	0.3	3% - 6%		na	16.8	No
Kenya	6.13	47% - 56%	2135786	36.65	83	Yes
Laos	1.02	4% - 9%	121007	25.74	92.1	Yes
Lesotho	0.34	65% - 79%	-38619	52.44	60.6	Yes

Country	Mitigation potential (reduced woodfuel harvest)	Range of woodfuel contributions to total emissions	Growth of CO <sub>2</sub> derived from national charcoal & biomass demand	Fraction of nonrenewable biomass utilization	Share of population lacking access to clean cooking	Inclusion of clean cooking in NDCs
	million tCO <sub>2</sub> e / year	% (2009)	tCO <sub>2</sub> (2020–40)	fNRB (2009)	% (2019)	Yes / No
Liberia	1.1	48% - 118%	381527	23.01	99.8	Yes
Madagascar	3.15	9% - 24%	2455146	26.64	99.1	Yes
Malawi	1.33	17% - 48%	2398925	32.78	98.1	Yes
Malaysia	0.9	0.3% - 1.0%		na	3.9	No
Mali	0.86	2% - 5%	3401471	28.52	99.1	Yes
Mauritania	0.28	3% - 8%	-47080	69.08	56.6	Yes
Mexico	4.8	1% - 2%	817399	25.92	15.2	No
Mozambique	3.52	21% - 44%	3685574	39.56	95.1	Yes
Myanmar	6.24	2% - 3%	-178886	4.35	69.7	Yes
Namibia	0.08	2% - 3%	63548	45.27	53.7	No
Nepal	5.23	48% - 55%	-1375744	52.43	69	Yes
Nicaragua	0.6	5% - 20%	-122564	31.92	44.6	No
Niger	0.96	14% - 29%	5966299	48.96	97.6	Yes
Nigeria	10.07	5% - 21%	5544437	18.79	87	Yes
Pakistan	10.37	16% - 17%	-9760311	83.28	50.9	Yes
Panama	0.19	1% - 5%		na	0	No
Papua New Guinea	1.05	4% - 9%	401554	31.25	90.7	No
Paraguay	2.07	7% - 20%	-194862	29.14	31.9	No
Peru	1.2	5% - 5%	-386232	26.13	16.7	Yes
Philippines	3.29	3% - 5%	-26371	21.79	52.6	No
Republic of Congo (ROC)	0.52	2% - 2%	8902829	35.24	66.5	No
Rwanda	1.14	82% - 86%	1845104	58.92	98.5	Yes
Senegal	1.39	8% - 21%	2040848	33.31	75.5	Yes
Sierra Leone	0.89	6% - 14%	417531	21.70	99.3	Yes
Solomon Islands	0.02	1% - 4%		na	91	No
Somalia	1.88	21% - 40%	3443851	52.39	97	Yes
South Africa	6.46	2% - 4%	-689228	23.79	13.7	No
Sri Lanka	1.88	9% - 17%	-337638	na	68.8	No
Sudan	4.74	6% - 9%	-1763585	25.74	46.8	Yes
Suriname	0.03	1% - 2%		na	5.9	No
Swaziland	0.17	7% - 12%		na	N/A	No
Tanzania	8.94	21% - 35%		17.62	N/A	Yes
Thailand	5.67	2% - 2%	-129044	3.01	20.5	No
Timor-Leste	0.02	3% - 17%	28527	23.69	87.4	Yes
Togo	1.02	9% - 16%	571129	na	90.7	Yes
Trinidad and Tobago	0.01	0.0% - 0.1%		na	0	No
Uganda	6.37	50% - 66%	11783632	61.13	99.5	Yes
Uruguay	0.36	1% - 1%		na	0	Yes
Venezuela	0.67	0.3% - 1.0%		na	2.9	No
Vietnam	6.76	2.6% - 3.4%		na	35.3	No
Zambia	3.11	6% - 14%	2196014	33.83	84.3	No
Zimbabwe	2.93	16% - 43%	801020	33.08	70	Yes





A Gabra woman returns to her Kenyan village with enough wood to make the evening meal.

© 2022 Rascona/Indiastock.

**Reducing demand for fuelwood and charcoal is key to addressing forest degradation, which is a significant source of emissions.** Traditional woodfuels — both firewood and charcoal used for cooking and heating — represent approximately 55% of global wood harvest and 9% of primary energy supply. If the removal of wood for fuel exceeds an ecosystem's natural ability to regrow, unsustainable harvesting can contribute to forest degradation and deforestation.<sup>30</sup> Recent estimations suggest that as much as 30% of global emissions from forest degradation is derived from woodfuel harvest. Woodfuel emissions are estimated to be highest in South Asia and East Africa. Furthermore, in an

analysis of 74 countries, forest degradation accounts for 25% of total emissions from deforestation and forest degradation, and emissions from forest degradation exceed those from deforestation in 28 of the 74 countries. This underlines the urgency of addressing unsustainable woodfuel harvesting.<sup>31</sup>

**These hot spots mirror where people are most heavily dependent on nature for their basic needs — energy, water, housing materials, and livelihoods.** Sub-Saharan Africa is home to the largest proportion — 478 million — of highly nature-dependent people for all their basic needs. Populations are concentrated in the Congo basin and East Africa and have

a particularly strong reliance on wood and charcoal as fuel for cooking. More than a quarter of the population of the Asia-Pacific region — 278 million people — are highly nature-dependent. Populations are concentrated in New Guinea, the lower Mekong basin, and the Ganges River basin, where ecosystems are critical for energy and housing materials. As populations continue to grow in these areas with a high dependence on nature and unsustainable fuelwood harvesting, it will be increasingly critical to ensure that communities are at the center of nature-based solutions, aligning projects with inclusive development and sustainable resource management as well as climate and environment benefits.<sup>32</sup>

Girl harvesting in the mountains of Nepal.  
© CIFOR.



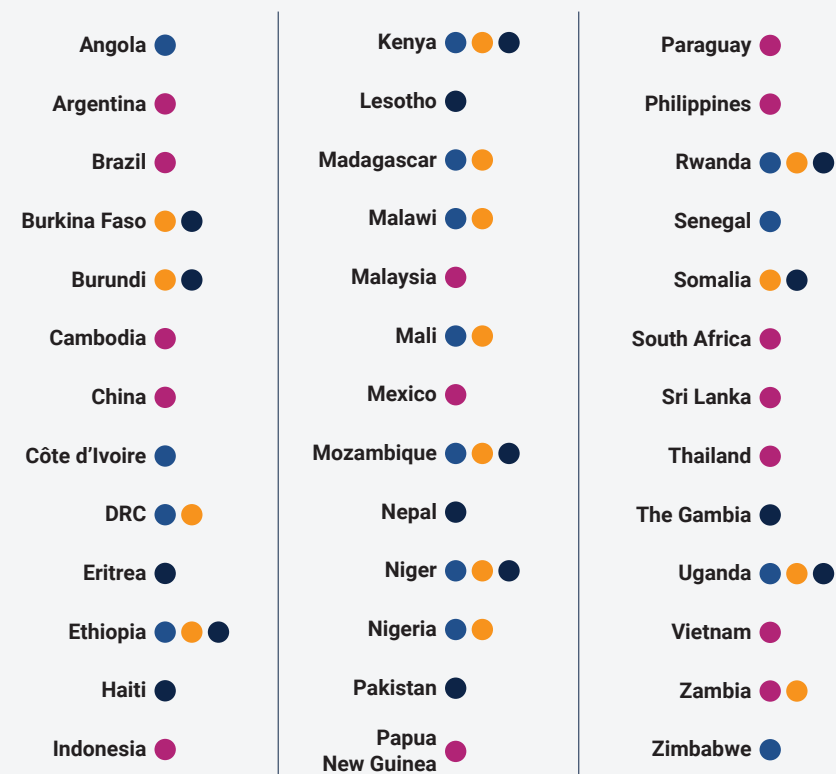


Defining engagement on clean cooking and nature-based solutions is location-specific, but national data profiles can focus key policy messages at the regional and country levels. Figure 4 outlines a typology of countries based on their mitigation potential, policy commitment, level of access, and level of growth of fuelwood emissions.

FIGURE 4.

### Defining the engagement focus for country profiles from their data profiles in Table 1<sup>iv</sup>

- 1 Countries with highest mitigation potential from clean cooking, but with no mention of clean cooking in their NDC
- 2 Countries with highest projected growth in woodfuel use (2020–40), with clean cooking integrated into their NDCs
- 3 Countries with the lowest share of population with access to clean cooking with highest projected rates of emissions increase from fuelwood (2020–40)
- 4 Countries with the highest rates of fNRB and the largest % emissions (above 15%) from woodfuel emissions



**1** Almost 40% of countries with mitigation potential from reduced fuelwood harvest lack clean cooking targets in their nationally determined contributions (NDCs). Of the 85 countries with mitigation potential from reduced fuelwood harvest, 52 have included goals related to household energy or clean cooking in the NDCs they submitted to the United Nations Framework Convention on Climate Change.<sup>33</sup> Many of the countries without targets have relatively low mitigation potentials. However, several countries without targets, including Brazil, Cambodia, Indonesia, Mexico, Paraguay, Papua New Guinea, South Africa, and Zambia have high mitigation potentials and unsustainable fuelwood harvest. Of the 20 countries with mitigation potential above 500,000 tCO<sub>2</sub>e annually that have not included clean cooking within their NDCs, 17 are in Asia or Latin America. A regional focus for policy engagement is needed to encourage countries in these two regions to better integrate clean cooking within their national climate commitments.

**2** At the same time, African countries have more proactively recognized the role of clean cooking in achieving their NDCs. Countries that have integrated clean cooking into their NDCs and have the highest growth projections for biomass and charcoal use between 2020 and 2040 are the DRC, Ethiopia, Kenya, Madagascar, Malawi, Mozambique, Niger, Nigeria, Senegal, and Uganda. For these countries, donors and multilaterals should support governments to transform clean cooking plans into action, and encourage the alignment of programs and investment for environment, climate, and household energy. For example, the Clean Cooking and Climate Consortium (4C) brings together the Clean Cooking Alliance, United Nations Framework Convention on Climate Change, U.S. Environmental Protection Agency, and the Climate and Clean Air Coalition to work with countries to implement clean cooking within their NDCs.<sup>34</sup>

**3** 26 of the 30 countries with the largest increase in charcoal and fuelwood demand and emissions between 2020 and 2040 are in Africa.<sup>v</sup> The share of population with access to clean cooking is lowest in this region, and rapid population growth is expected to continue to increase fuelwood emissions, particularly in the DRC, Ethiopia, Niger, Nigeria and Uganda. It can take up to 10 tons of wood to produce just 1 ton of charcoal.<sup>35,36</sup> In urban areas, where charcoal is the predominant fuel, population growth will exacerbate the challenge and have significant environmental impacts that will need to be addressed by more remote nature-based solutions. For example, in the Atsimo-Andrefana and Menabe regions of Madagascar, 100% of fuelwood needs are met by natural forests. In 2016, the consumption of charcoal in these regions was estimated at 61,000 tons in aggregate, representing an area of 28,000 hectares of natural forests that are unsustainably harvested each year.<sup>37</sup> Two-thirds of fuelwood consumption was accounted for by urban residents, reinforcing the importance of nature-based solutions to address both rural and urban cooking transition needs.<sup>38</sup>

**4** Unsustainable woodfuel and charcoal use is a climate and biodiversity action priority. Nature-based solutions will therefore need to consider clean cooking value chain approaches to address drivers of both degradation and deforestation. The success of African reforestation and REDD+ frameworks will depend on how centrally access to clean cooking access is considered. For example, the DRC holds the second-largest stretch of tropical forest cover globally – 130 million hectares – and is third in line globally for levels of forest loss. This is due in large part to slash and burn agriculture and charcoal needs. In recognition of this linkage, the Central African Forest Initiative is directly requesting projects on clean cooking to apply for funding through the DRC's National REDD+ Fund – funded by the UK Government – that would direct US\$500 million to halt deforestation and restore degraded lands.<sup>39</sup>

iv. **CLARIFICATION:** Please note that values are missing for a number of countries in Table 1. Therefore, the lists of top 15 countries per type of engagement category are based on available data only.

v. Countries likely to experience reductions in charcoal and fuelwood demand are predominantly in Asia and Latin America. China, India, and Indonesia are expected to have the largest declines, due to a combination of shifting to cleaner cooking sources and reduced population pressure.





### Levels of unsustainable fuelwood harvesting<sup>40</sup>

#### Africa

East Africa is the largest hot spot for unsustainable woodfuel depletion, with a stretch of heavily affected landscape from Eritrea through to western Ethiopia, Kenya, Uganda, Rwanda, and Burundi. In these regions, almost 50% of woodfuel harvesting is unsustainable, across an area inhabited by 26% of the region's population. Other hot spots in the region are less contiguous but found in western and southern Africa (including Angola, Cameroon, Central African Republic, the DRC, Mali, Mozambique, Nigeria, South Africa, Tanzania, Zambia, and Zimbabwe).

#### Asia

In Asia, hot spots occur in parts of Bangladesh, Bhutan, Indonesia, Nepal, and Pakistan. Pakistan has the highest share of nonrenewable biomass – 79% – and in two subnational districts the share of nonrenewable biomass harvesting exceeds 90%. Meanwhile, although China and India are the largest woodfuel-consuming nations, both experienced net afforestation in recent years. At a national level, the share of nonrenewable biomass is 10–22% in China and 23–24% in India.

#### Latin America

Latin America hosts the lowest traditional woodfuel consumption, with Haiti as the only country in the region where over 50% of woodfuel is collected from nonrenewable biomass. Other pressure points in the region (where the share of nonrenewable biomass exceeds 30% in many subnational units) includes Bolivia, Colombia, Dominican Republic, Ecuador, El Salvador, Mexico, Paraguay, Peru, and Venezuela.

### Clean cooking and nature-based solutions in action

The Kulera REDD+ and Cookstoves project in Malawi surrounds three wildlife reserves and national parks with some of the largest forest areas in the country. The project has combined forest protection with the distribution of clean cookstoves to conserve approximately 170,000 hectares of forest. Fuel-efficient cookstoves were delivered to every household in the project zone, a total of 45,000 households, to reduce fuelwood use. In addition, 8.5 million trees were planted as an alternative source of fuelwood, supporting 32,000 households to develop sustainable livelihoods. The project is delivering approximately 210,000 tonnes of emission reductions each year. In addition, 30,000 people received training on sustainable natural resource and biodiversity management to produce sustainably harvested nontimber forest products such as honey, coffee, and macadamia, shifting livelihoods away from subsistence.<sup>41</sup>

In the aftermath of the Rohingya crisis, more than 700,000 refugees from Myanmar took refuge in Cox's Bazar in southeastern Bangladesh. The camp itself has encroached into 2,000 hectares of forest, mangrove, and agriculture land. Additionally, daily firewood consumption amounted to 700 metric tons, exacerbating the scale of environmental degradation, deforestation, and conflict with host communities. To improve health conditions and reduce degradation and deforestation, a number of UN agencies distributed improved and clean cookstoves (LPG, rice husks, fuelwood) to over 125,000 households.<sup>42,43</sup> Since 2016, IUCN has also partnered with the local NGO Community Development Centre to improve the resilience of coastal ecosystems in the area around Cox's Bazar. The program has paired the installation of cookstoves with the distribution of indigenous saplings to households. The joint efforts have helped to protect the mangroves and help families save US\$19–25 per month on woodfuel.<sup>44</sup>

Sustainable Harvest International provides long-term training to farming families and communities in Belize, Honduras, and Panama to encourage their adoption of regenerative agricultural practices, wood-conserving stoves, and water filtration systems in order to improve food security, regenerate agricultural land, and reduce the drivers of forest degradation and deforestation. Communities are supported to adopt diversified forestry and agroforestry systems, forest monitoring, regenerative and sustainable agriculture, and wood-conserving stoves. With the new wood-conserving stoves, the same amount of firewood that traditional stoves consumed in 4 days can be used for up to 3 weeks. Since 1997, Sustainable Harvest International has worked with over 3,000 farmers, who have planted more than 4 million trees and regenerated more than 10,500 hectares.<sup>45</sup>

Women and children bear the brunt of collecting firewood.  
© DelAgua

TABLE 2  
Zooming in on key hot spots for unsustainable woodfuel use



## PART THREE

# The value of clean cooking for nature-based solutions

Clean cooking must be the foundation on which nature-based solutions are built in regional hot spots for unsustainable woodfuel consumption. Integrating clean cooking into broader conservation and restoration activities can yield multiple benefits for local biodiversity and ecosystem recovery, regenerative livelihoods, clean air and community health, and female empowerment.

Ensuring clean cooking activities are in place is key to addressing the need to cut down trees in the first place, and thus avoiding further forest degradation and emissions while laying the foundation for successful carbon removal through reforestation and revegetation.

It is also an opportunity to tap into the growth of a rural market that generates multiple economic, social, and environmental benefits from the production and sale of stoves and renewable fuels, as well as the development of manufacturing capacity and alternative jobs.

Left: A farming family in India with their biogas system that turns agricultural waste into cooking gas. © Systema.bio.





# 10 KEY CO-BENEFITS OF CLEAN COOKING FOR CLIMATE, NATURE AND COMMUNITIES



## REDUCING DIRECT EMISSIONS OF CLIMATE POLLUTANTS.

Globally, domestic cooking emissions contribute 1.9–2.3% of global GHG emissions and up to 25% of the annual anthropogenic black carbon emissions.<sup>46,47</sup> Highly efficient stoves can reduce fuel use by 30–60%, cutting both carbon dioxide and black carbon emissions.<sup>48</sup> For example, in India, the nongovernmental organization (NGO) Seva Mandir is working with rural and tribal populations in the Udaipur and Rajsamand districts of southern Rajasthan state to replace inefficient traditional cookstoves for 19,500 households with improved stoves based on rocket stove design. The reduction in fuelwood requirements will reduce 2.35 tCO<sub>2</sub>e per family each year, preventing 42,956 tCO<sub>2</sub> emissions annually – a total of 429,556 tCO<sub>2</sub>e over 10 years.<sup>49</sup>

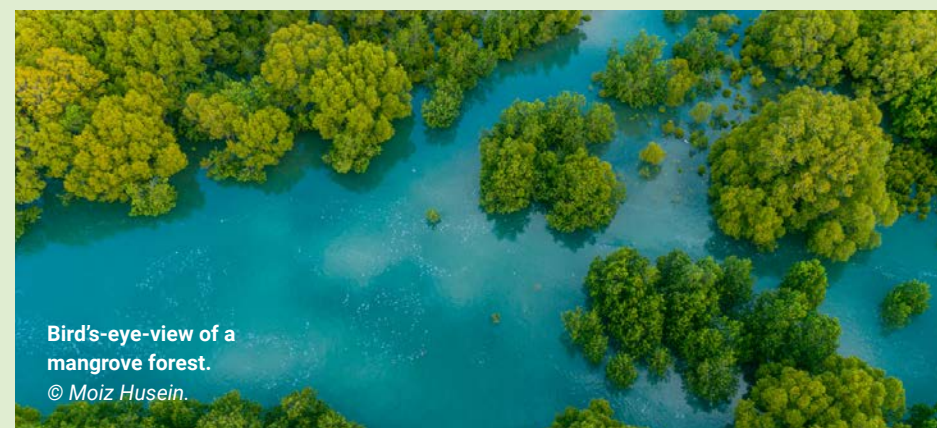


## AVOIDING EMISSIONS FROM FOREST DEGRADATION.

Switching from traditional three-stone open fires to clean cookstoves can reduce or remove the pressure on local terrestrial and mangrove forests. As fewer live trees are cut down, more permanent regrowth of woodland and forests occurs. Many high-efficiency stoves allow the burning of small diameter wood – branches, twigs, and crop residue – that reduces the need to source larger pieces of wood from deeper in the forest.<sup>50</sup> In terms of charcoal, estimates range from 5 to 10 tons of wood to produce just 1 ton of charcoal depending on the type of kiln used.<sup>51,52</sup> In Zambia, which has one of the highest deforestation rates globally, the Global Environment Facility is funding a community-based natural resources management program in and around Kafue National Park and West Lunga National Park. As part of the program, 5,000 households have been provided with improved cookstoves in central, western, and northwestern Zambia to reduce forest loss and designated firewood collection zones.<sup>53</sup>

### CASE STUDY:

## Integrating clean cooking into blue carbon investments and mangrove replanting programs reinforces climate and social benefits



In coastal areas, illegal charcoal production is one of the primary drivers of mangrove destruction – a key blue carbon ecosystem (carbon storage in coastal and marine ecosystems) and critical natural infrastructure for coastal protection. Mangroves can store up to 10 times as much carbon per unit area as terrestrial forests. Restoring mangroves can be five times as cost-effective as building “gray infrastructure” – engineered structures such as flood walls and dykes. However, over 67% of mangroves have been lost or degraded due to agriculture, aquaculture, pollution, coastal development, and logging for timber and fuelwood.<sup>54</sup> In Myanmar, an estimated 90% of charcoal production is sourced from coastal mangrove forests for domestic consumption and illegal export to China and Thailand.<sup>55</sup> The potential to generate “charismatic” carbon credits from blue carbon

projects with multiple benefits is driving demand for blue carbon credits. Blue carbon platforms, such as the Blue Carbon Initiative and International Partnership for Blue Carbon, and blue carbon investors should ensure that clean cooking solutions are adequately integrated into mangrove protection and restoration efforts.

As part of the **Mangroves for the Future regional initiative**, the NGO Community Development Centre (CODEC) has combined coastal ecosystem restoration with clean cooking in the Teknaf peninsula of Cox's Bazar in Bangladesh. CODEC has distributed approximately 9,000 indigenous saplings (bamboo, fruit-bearing trees) to over 400 community members to plant in households and institutional plantations to reduce the community's reliance on mangrove fuelwood for cooking. It has

installed improved cookstoves in 150 households; these cookstoves require 40% less wood, protecting mangrove plants in the area and preventing them from being cut down in the first place.<sup>56</sup>

**The Rimba Raya Project**, run by InfiniteEARTH, is located in a 64,000-hectare tropical peat swamp forest on the southern coast of central Kalimantan, Borneo. It is one of the most highly threatened ecosystems in the world, home to the Bornean orangutan, Clouded Leopard, Gibbon, Proboscis Monkey, Asian Sun Bear, and other endangered species. Rimba Raya is one of the world's largest REDD+ projects, with more than 120 million tons of avoided emissions over the 30-year life span of the project. The project intends to protect the integrity of the adjacent Tanjung Puting National Park by creating a physical buffer zone on the eastern border of the park, which is about 90 km long. To support forest protection, the project distributed fuel-efficient, smokeless cookstoves to 100 households in the Rimba Raya Biodiversity Reserve and is planning on introducing a gas stove initiative where microfinance supports local shop owners to supply the gas. The distribution of enhanced water filters has also helped to reduce pressure on the reserve's forests from the daily collection of fuelwood used for boiling water. So far, the project has reduced more than 7.7 million tCO<sub>2</sub>e by protecting 47,237 hectares of native ecosystem and planting over 18,000 mangroves.<sup>57</sup>



### 3

#### ENABLING CARBONS REMOVALS BY SUPPORTING REGENERATION AND REFORESTATION.

Reducing forest extraction can generate passive regeneration of forest ecosystems at lower cost-benefit ratios and less disturbance to existing ecosystems.<sup>58</sup> Active restoration can enable the restoration of agroforestry and forest systems at a larger scale. In Uganda, where over 400,000 hectares of trees are cut down for charcoal production annually, Divine Bamboo and Kijani Forestry and other companies are developing nursery hubs and agroforestry solutions for more sustainable charcoal production. Kijani Forest has also developed a more efficient kiln and production techniques to produce 80% more charcoal from the same amount of biomass than through traditional methods.<sup>59</sup> In Malawi, C-Quest Capital has combined stove programs with the development of sustainably managed woodlots to produce alternative woodfuels. It estimates that switching 1,000 households from charcoal to direct burning of stick wood produced by active restoration and sustainably managed woodlots can lead to an additional 1,000–2,000 tCO<sub>2</sub>e sequestered annually in above- and below-ground carbon, net of the wood harvested for fuel.<sup>60</sup>



Training village residents near Amboseli National Park in Kenya to install and use improved cookstoves. © C-Quest Capital.

#### CASE STUDY:

### Integrating clean cooking and agroforestry solutions for a sustainable and clean cooking value chain

Since 2018, **C-Quest Capital** has been integrating agroforestry solutions into its clean cooking program in the Central Region of Malawi, providing bamboo seedlings for its stove-using households: 650,000 bamboo seedlings and other nitrogen-fixing trees have been distributed to support the development of small-scale agroforestry, generating a sustainable fuel source as well as other potential source of building materials or income generation. The bamboo can grow to a harvestable size within six months and provide firewood within three years, reducing the impact of and time for foraging firewood. The carbon removal benefits provided by growing the seedlings have been registered for carbon credits to offset the cost of bamboo seedlings over the long term. Furthermore,

women will be supported to sell bundled bamboo wood to former charcoal users in urban areas that are switching to modern fan-assisted burning cookstoves.<sup>61</sup> Currently, the carbon avoidance and removals benefits are accounted for in separately registered projects, but the company is exploring solutions to reduce the transaction costs of stacking carbon avoidance and removals from soil carbon, agroforestry, and clean cooking to account for a fuller range of project impacts. The Lilongwe Project now aims to halve charcoal consumption for 100,000 households over five years, under a Mitigation Outcome Purchase Agreement between the Swiss and Malawian governments. The project will provide highly efficient stoves, along with the production and distribution of sustainably harvested fuels and pellet production. It will also distribute 6 million bamboo seedlings to growers within 50 km of Lilongwe to support women bamboo producers and smallholder farmers to switch to high-yield agroforestry systems to supply the Lilongwe market.<sup>62</sup>

**Khmer Green Charcoal**, which is part of the Singapore-based holding company **Otago**, produces and sells eco-friendly charcoal briquettes and sustainable charcoal in Phnom Penh. Its char-briquettes are made from coconut shells and other biomass wastes from existing agriculture and industrial waste streams. The company reaches up to 6,500 households in the

Cambodian capital with daily sales of 4 tons of char-briquettes, meeting approximately 1.5% of the city's daily charcoal demand. The company estimates that it has so far avoided 42,000 tCO<sub>2</sub>e and saved about 1,000 hectares of forest area from deforestation caused by charcoal production.<sup>63</sup> Given supply chain constraints for its char-briquettes, Otago also established KjuonGo, a sustainable charcoal product produced from sustainable wood from tree plantation residues and managed community forests. To establish a sustainable supply chain for KjuonGo, Otago has worked with the Cambodian Forestry Administration to establish off-take agreements and partner with 11 community forests to improve the sustainable management of 4,000 hectares of managed forests. The program involves replanting 1,000 hectares, reintegrating bio-char into the soil of the community forests, and introducing agroforestry practices to diversify production and incomes. The Forestry Administration has further committed to scale the approach to an additional 80,000 hectares, working with Otago as the private sector partner and off-taker of biomass residues. Otago has also implemented the KjuonGo app to trace the volume of biomass and charcoal across the entire chain of custody.<sup>64</sup> So far, climate finance grant funding from the Nordic Climate Facility has enabled Otago to build a more sustainable business model. Going forward, Otago is looking to supplement its revenue by securing carbon finance to scale up the business within Cambodia,

as well as in Southeast Asia and sub-Saharan Africa.<sup>65</sup>

Climate change is exacerbating existing vulnerabilities in northern Uganda, particularly in tropical savanna areas where rainfed agriculture is prevalent, rainfall is unpredictable, and drought risk and intensity are increasing. These trends directly affect the productivity of Uganda's agriculture sector, risking higher rates of poverty and further disadvantaging already marginalized groups (women, refugees, and people living with disabilities). And, as ecosystem services are depleted by draining of wetlands for agricultural use, deforestation, and soil erosion, entire communities face the increased risk and impact of climate hazards. **Mercy Corps**, with funding from the UK's Foreign, Commonwealth & Development Office, is implementing the Restoring Ecological Vitality In Vulnerable Ecosystems (REVIVE) program to regenerate and improve ecosystem services (including clean cooking stoves and fuels) at landscape level to improve the resilience and climate adaptive capacity of smallholder farmers, refugee communities, and women. Through an incentives-based model, Mercy Corps aims to increase forest cover over 10,000 hectares of degraded landscape and work with smallholder farmers to implement agroforestry and woodlots over 2,000 hectares. The organization expects to sequester approximately 1.8 million tCO<sub>2</sub>e over 10 years.<sup>66</sup>





#### REDUCING THE THREATS TO BIODIVERSITY.

Over time, the reduction of forest extraction and reduced pressure have been proven to lead to both an increase in forest biomass and higher levels of diversity and abundance of seedlings of indigenous tree species.<sup>67</sup> For wildlife conservation, habitat loss is often the primary driver of species loss, and encroachment into conservation parks or habitats can lead to conflict with wildlife.<sup>68</sup> In China, the bamboo forests in Sichuan province are a critical habitat for pandas and also serve as the main source of firewood for local communities. Since 2013, Swiss supermarket Coop, WWF, and South Pole have partnered to reduce the levels of deforestation threatening the local panda population. More than 2,800 efficient wood stoves have been built for ethnic minority communities in Liangshan, next to Mamize National Park. Initial upfront project financing from Coop enabled the Mamize project to become the first WWF voluntary carbon project fully paid for through carbon offsets.<sup>69</sup> The stoves have cut fuelwood use by 50%, saving approximately 624 hectares of forest each year and avoiding 45,000 tCO<sub>2</sub>e annually.<sup>70</sup>



Silverback gorilla in Bwindi Impenetrable Forest, Uganda.  
© Skyler Bishop for Gorilla Doctors.

#### CASE STUDY:

### Leveraging carbon finance for clean cooking to protect Mountain Gorilla habitat in Rwanda and Uganda

In 2010, there were just 400 mountain gorillas left in the wild. Although the species is still on the IUCN Red List as endangered, the population has grown due to conservation successes. Still, just 1,060 Mountain Gorillas remain, living in small habitats 8,000 to 13,000 feet above sea level in a stretch of land across the DRC, Rwanda, and Uganda. More than half of the population lives in the Virunga mountain range that borders the three countries, and the rest can be found in Bwindi Impenetrable National Park in Uganda. Gorilla populations remain threatened by poaching and loss of habitat, driven by agriculture and fuelwood harvesting for

illegal charcoal and biomass.<sup>71</sup> Conservation organizations, clean cooking companies, health networks, and government are increasingly working together as an informal coalition to scale clean cooking to communities that border these parks in order to support conservation of this iconic species.

**DelAgua's Tubeho Neza project**, in partnership with the Government of Rwanda, has been providing free, innovative, high-performance stoves since 2012. So far over 750,000

stoves have been distributed, the most efficient of which use 71% less wood than traditional 3 stone fires. DelAgua has established a network of 5,000 local community health care workers to mobilize a concerted engagement, education, and monitoring program that has helped the company achieve a usage rate of 90% of stoves in daily use (2 years post distribution). The project is the largest of its kind in the world, aiming to benefit 2.6 million rural Rwandan households, including remote communities that encircle some of Rwanda's most precious national parks, and helping to conserve critical wildlife habitats for a number of species, including the endangered Mountain Gorillas. DelAgua estimates that this will avoid 8.6 million tons per year of CO<sub>2</sub>e, as verified through Verra's SD VISTA standard.<sup>72</sup> DelAgua focuses exclusively on the rural poor who are in critical need of access to clean cooking but for whom a stove is unaffordable. DelAgua developed a free issuance model, using carbon financing, which funds the stoves, education programme and ongoing support for recipient families. Individual stove usage is then tracked and recorded on the DelAgua smartphone app at the twice-yearly visits to every household by community health workers. This maximizes carbon issuance, ensures correct stove usage, builds carbon revenues and investor confidence, allowing DelAgua to fund 560,000 more stoves across Rwanda.<sup>73</sup> DelAgua has targeted distributions to integrate with reforestation

programmes critical to restoring important ecosystems. Examples include the Rugezi Marsh, supporting the restoration of water levels and biodiversity and the Nyungwe Forest. One of the oldest rainforests in Africa and home to a remarkable diversity of plant and animal species, Nyungwe Forest had been severely reduced by harvesting of trees but is now a designated National Park. DelAgua has been distributing stoves to adjacent Districts since 2014, reducing wood consumption and breaking the cycle of destructive harvesting of trees for wood fuel.<sup>74</sup>

In Uganda, **Gorilla Habitat, Singing Gorilla, C-Quest Capital, and Conservation for Public Health** are in the early stages of collaborating to install over 1,000 rocket stoves around the Bwindi Impenetrable Forest Park. Local conservation groups are focused on identifying community groups in the area that have the ability to train more than 5,000 households to make and install the stoves in their communities. The stoves will lower biomass usage by an estimated 70%, significantly reducing requirements and expenses for wood, charcoal, kerosene, and clean water and easing pressure on gorilla habitat in the national park. It will also free up women's time to engage in agroforestry and reforestation efforts. C-Quest Capital is expecting to install 1,000 total stoves by the end of 2022 and an estimated 10,000 stoves by the end of 2023, with project financing secured based on the issuance of carbon credits.





An African woman prepares food over a portable, clean, and efficient LPG stove.  
© World LPG Association.

## 5

### IMPROVING CLEAN AIR AND REDUCING NEGATIVE HEALTH IMPACTS OF AIR POLLUTION.

Globally, exposure to smoke from cooking fires causes an estimated 3.2 million premature deaths each year and remains one of the predominant causes of pollution-related disease and death in Africa.<sup>75</sup> For example, in Tanzania, where 96% of the population relies on unclean fuels, household air pollution is the one of the largest risk factors for death and disability.<sup>76</sup> Globally, 16% of ambient air pollution comes from household air pollution.<sup>77</sup> Switching from three-stone open fires to well-designed cookstoves reduces smoke exposure to PM<sub>2.5</sub> and other toxic elements. In addition to reducing premature death – including those of 450,000 children under 5, mainly in Africa and Asia – switching to cooking solutions rated at ISO 19867-1:2018 tiers 4 or 5 for PM<sub>2.5</sub> emissions reduced rates of respiratory infections, ischemic heart disease, stroke, and cancer.<sup>78</sup> Recent research suggest that nearly 0.77 million deaths could be avoidable by eliminating solid biofuel combustion that is primarily used for residential heating and cooking.<sup>79</sup> Building on the work of the Berkeley Air Institute, Gold Standard has released a first-of-its-kind methodology to quantify the health benefits from implementation of technologies that reduce household air pollution from clean cooking and heating technologies using Averted Disability Adjusted Life Years (ADALYs) as the key indicator.<sup>80</sup>

## 6

### INCREASING WOMEN'S TIME AND SAFETY WHILE REDUCING DRUDGERY.

Globally, women conduct 91% of the work to obtain fuel and cook, while women and children account for over 60% of all premature deaths from household air pollution.<sup>81,82</sup> The risks extend to spinal, nerve, and muscle damage while cooking, as well as the risk of rape, abuse, injury, and animal attacks while collecting wood.<sup>83</sup> Women and girls can spend up to 10 hours a week on fuel collection and four hours a day cooking over traditional stoves – effectively keeping them from higher-value, income-generating activities and perpetuating gender inequality and economic poverty while trapping them in a life of drudgery. In Kenya, one study showed a reduction of seven hours per week in time spent collecting fuel after switching to an improved stove, freeing up women's time and energy to pursue economically productive tasks.<sup>84</sup> The Clean Cooking Alliance and Duke University are developing a framework to allow clean cooking interventions to monetize these benefits. A results-based finance instrument, the emPOWERment bond, will produce actionable guidance to quantify, verify, and monetize gendered time-use and productivity benefits of improved biomass cookstove initiatives.<sup>85</sup>

## 7

### ENABLING SUSTAINABLE RURAL LIVELIHOODS.

Time savings from improved cooking practices can potentially be used for leisure or income-generating activities.<sup>86</sup> For example, some organizations have supported women to diversify income by planting managed woodlots for the supply of stick wood bundles, pellets, or briquettes to replace charcoal in rural and urban markets. Agroforestry and village woodlots can support fuel switching to sustainable crop residues, other natural wastes, and small-diameter farm wood, enabling local production of fast-growing, high-yield wood for fuel.<sup>87</sup> In India, the Global Himalayan Expedition is working with myclimate in the Garo Hills in Meghalaya to provide 10,000 households with access to more efficient cookstoves that use up to 60% less fuel and require 50% less cooking time. The project aims to generate 25,000 tonnes of wood fuel savings annually, as well as enable communities to free up time and resources to develop sustainable and homestay tourism for the nearby national parks.<sup>88</sup>





### SUPPORTING SUSTAINABLE ECONOMIC GROWTH.

Accelerating access to clean cooking can support local employment and economic growth. The household purchase of a US\$40 Jikokoa (a Burn-designed stove) has been found to generate more than US\$1,000 in economic return for society.<sup>89</sup> Burn has also established an industrial manufacturing facility in Ruiru, Kenya, that employs more than 400 people and more than 200 other people across operations in sales, marketing, distribution, and monitoring. It plans to set up another manufacturing facility in Ghana.<sup>90</sup> Koko Networks, which manufactures stoves in India and sells them and the fuel in Kenya, has employed 1,100 across its operations.<sup>91</sup> In Uganda, the Danish cookstove company Pesitho is investing in local product assembly through locally owned and managed cooperatives as well as local sales, distribution, and post-sale networks for the product to improve trust and uptake of the ECOCA solar cookstove. Pesitho is also developing Paycom technology to improve accessibility for people with low incomes or those who lack access to financial services.<sup>92</sup>



Iris Maza Perez has started a small baked goods business using her wood conserving stove in Santa Cruz del Dulce, Honduras

© Sustainable Harvest International.



### IMPROVING FOOD SECURITY.

A transition to clean cooking solutions can improve food security by reducing land degradation from fuelwood harvest, increasing the amount of time and money available to grow alternative, higher-value, and nutrient-dense foods such as maize, potatoes, and beans, and by improving the nutrient retention of cooked foods.<sup>93</sup> In Madagascar, more than 90% of the energy for cooking comes from local wood. Climate change impacts and ecosystem degradation in the forests and mangroves of the protected areas of Menabe Antimena, Kirindy-Mite, Amoron'i Onilahy, and Tsimanampetsotse have forced local farmers and fisherfolk to turn to charcoal activities and further degrade the system. WWF is working along the fuelwood value chain to install 62,350 efficient cookstoves, improve the management of almost 20,000 hectares of forest, and reforest almost 3,000 hectares for fuelwood production. Agroforestry systems with vegetable crops will also be developed to improve food security and income generation for communities.<sup>94</sup> In Bangladesh, the Bangladesh Biochar Initiative is using top-lit updraft gasifier stoves to make biochar as a byproduct of cooking to both transition rural households to clean cookstoves and improve soil organic matter to increase crop yields.<sup>95</sup>



### ENHANCING COMMUNITY COHESION AND PEACE BUILDING.

There are over 102 million forcibly displaced people, the vast majority of whom do not have access to affordable, reliable, sustainable, and modern sources of energy.<sup>96</sup> The Food and Agriculture Organization of the United Nations and UNHCR, the UN Refugee Agency, estimate that more than four out of five forcibly displaced people worldwide use woodfuel for cooking and heating, making it the main driver of forest degradation and deforestation in these areas.<sup>97</sup> For example, in Yumbe, Uganda, women in the Bidibidi Refugee Camp have to spend on average two to three hours each day collecting fuelwood. This has exacerbated unsustainable consumption of local natural resources and increased tensions between host and refugee communities. Mercy Corps partnered with Pesitho to set up a local assembly station at the settlement, which has generated employment opportunities for both host communities and refugees.<sup>98</sup>





Caption TK

## PART FOUR

# Finance: Challenges and opportunities to align clean cooking and nature-based solutions

Investments in nature-based solutions and clean cooking face a distinct and common set of core challenges that limit their ability to tap into the much larger pools of blended, commercial finance and other forms of near-commercial social finance at scale.

Left: A BURN employee manufactures a durable and efficient charcoal stove. © Nick Wambugu / Clean Cooking Alliance.





A woman in Laos cooks with a biogas stove.  
© Savannket Biogas.

Both are challenged by the relative complexity of cash flows, their long-term and upfront investment needs, lack of long-term track record, and high perceived risks when trying to attract finance.

Add to the mix that investments in nature can be illiquid and characterized by inherent complexity related to the governance of land

use and community engagement, and the challenges could seem insurmountable.<sup>99</sup>

However, a window of opportunity has arrived as investment interest in nature-based solutions grows, the nature-related carbon market accelerates, and biodiversity impact has increased. This is providing a key source of transition finance,

to help both sectors grow, scale, and eventually diversify to other funding sources. Additionally, innovative and blended finance solutions as well as advancements in data and technology solutions have positive implications for addressing challenges relating to significant transaction costs and an unmet need for upfront finance that is hampering growth.

## 4.1 NATURE-BASED SOLUTIONS AND CLEAN COOKING ARE BOTH CHARACTERIZED BY SIZABLE FINANCE GAPS AND CHALLENGES

**The nature-finance gap is significant – US\$4.1 trillion needing to be closed by 2050 – but investment is set to grow rapidly over the coming decade.**

The collective investment needs of meeting the world's climate change, biodiversity, and land degradation targets by 2050 amounts to US\$8.1 trillion and will be over US\$536 billion annually.<sup>100</sup> Currently, an estimated US\$133 billion flows into nature-based solutions each year. While this is a significant increase over the estimated US\$52 billion per year in 2012, it still falls well short of the estimated needs.<sup>101</sup> Global finance for nature will need to be tripled by 2030 and quadrupled by 2050 to meet these targets.<sup>102</sup> Despite the enormous challenge, there are early signs of hope. In addition to the growing finance and business commitments to investing in nature, return-seeking finance in nature grew significantly from 2020 to 2021, when it was estimated to reach US\$1.33 billion.<sup>103</sup>

**Public finance dominates, but private finance will need to be unlocked at scale to mobilize the finance needed to cover the costs of conservation and restoration of nature.** Today, more than 80% of the US\$133 billion comes from public sources and just 14% from private finance. Government budgets comprise the largest share of public finance, while public overseas development assistance – provided by donors and development finance institutions (DFIs) – account for just 2% of overall financing.<sup>104</sup> A recent review of tracked international climate finance for nature-based solutions showed that funding comes primarily through grants, which diminishes the ability of utilizing public concessional finance to crowd in and catalyze private capital through a broader range of instruments.<sup>105</sup> Conversely, private finance accounts for the majority (56%) of climate finance overall, reaching an average annual amount of US\$326 billion in

2017–18.<sup>106</sup> Private finance and funding is concentrated through biodiversity offsets, carbon markets, philanthropy, and sustainable supply chain finance.<sup>107</sup>

**Investment in clean cooking has remained insignificant in comparison to the challenge of achieving universal access, and it has even stagnated in recent years.** In 2019, tracked finance for clean cooking access amounted to US\$133 million. Even with the launch of the US\$500 million World Bank Clean Cooking Fund, the US\$70 million Spark+ Africa Fund and the EUR 30 million Modern Cooking Facility for Africa, this still falls well short of the estimated US\$4.5 billion required annually to achieve universal access to clean cooking.<sup>108</sup> Despite the proven health impacts of switching to improved cookstoves, the total amount of clean cooking funding is less than US\$30–250 for every household air pollution death, compared with US\$2,000–4,000 for each death caused by



diseases such as malaria and HIV/AIDS.<sup>109</sup> However, in contrast to the public sector dominance in nature-based solutions, nearly half of finance for clean cooking comes from private sources, primarily in the form of carbon finance. While grants remain an important instrument in the clean cooking space (52%), the range of instruments and commercial finance is also diversifying with more debt funding through investment funds, foundations, and crowdfunding platforms.<sup>110</sup>

**Clean cooking financing is highly concentrated in a small number of countries, technologies, and ventures.** In 2019, 25 clean cooking companies raised a reported US\$70 million in capital, with the top 10 companies raising 81% of that amount.<sup>111</sup> There is a similar concentration at the country level. Clean cooking projects in Bangladesh and Kenya represented 62% of all tracked finance in 2019. By contrast, DRC, Madagascar, and Mozambique — where on average 96% of the population lacks access to clean cooking solutions — each received less than US\$1 million in 2019, or less than 1% of the annual investment each of them needed. DFIs are key providers of concessional and long-term capital but have played a small role in recent years, committing just US\$4.5 million in direct finance to enterprises in 2019, or 7% of total public finance.<sup>112</sup>

**A common set of core challenges relates to cash flows, upfront finance needs, risk perceptions, transaction costs, and data.**

In areas where forest degradation is linked to woodfuel and charcoal production, clean cooking companies have a significant role to play in nature-based solutions. However, companies face higher upfront capital expenditures and costs for sales and distribution. This requires more diversified business models, as well as new forms of partnership and de-risking, since people lack basic infrastructure and ability to pay. These challenges have been well documented for both investment areas, but a confluence of developments means that solutions are more readily available than at any other time.

#### **Core challenge 1**

Both nature-based solutions and clean cooking have business models that can rely on revenue that is quite novel or complex (i.e., payment for ecosystem services, biodiversity, carbon credits, low-income customers paying for stoves or fuel) or may be at an insufficient scale to produce an attractive risk/return profile for larger-scale investors. This revenue can then take many months, or in the case of nature-based solutions, years, to kick in, creating long lead times that require upfront long-term finance to implement projects, grow, and scale.

#### **Core challenge 2**

Transaction costs of business and investment in both markets are high, while the availability of data and track records tends to be low, undermining investor confidence and leading to high perceived risks.



Mother and children cooking outdoors in Ethiopia.  
© UNICEF.



TABLE 3.1

### Common challenges for nature-based solutions and clean cooking finance

#### NBS CHALLENGE

##### CORE CHALLENGE 1

The development of cash flows from nature-based solutions has typically not been a priority for many conservation groups and project developers, and projects have traditionally relied on grants. As more projects look to tap into the larger pools of private return-seeking finance, identifying bankable business models is key. The emergence of new biodiversity credits and the increasing price for nature-related carbon credits are helping projects to tap into alternative revenue, but the cost and complexity of certification schemes can still be a high barrier for many programs. It can also take 5–10 years until breaking even through the issuance of carbon credits or other revenue, given the complexity of setting up projects, and lead times needed to transition practices, grow trees, and reestablish species. Shifting to sustainable and regenerative management can lead to downtime or short-term decreases in productivity. New natural asset investment models are also unfamiliar to investors and so come with a high perceived risk and unattractive risk/return profile. Conservation groups or NGOs developing projects may also lack documentation to demonstrate project bankability to attract investors.<sup>113</sup> Upfront and long-term finance is critical to helping get projects off the ground and operational to achieve results over initial years, before being able to verify and claim revenue for emissions reductions. However, this long-term risk-taking finance is scarce, leaving many projects lost in the “valley of death,” unable to move past initial conceptual phases.<sup>114</sup>

##### CORE CHALLENGE 2

Investing in nature-based solution can be complex and time-consuming, and it can require a range of new expertise and partnership capabilities to assess environmental conditions and outcomes, highly complex land ownership and governance arrangements, and stakeholder engagement. As projects need to follow ecosystem rather than jurisdictional boundaries, this also requires project developers and investors to work with multiple administrative or political jurisdictions. Projects are often implemented in remote locations with unclear tenant rights or a lack of enforceability, driving up project risks and uncertainty, and requiring more intensive due diligence processes to ensure that the rights (both land and carbon revenue sharing) of landowners, communities, and other beneficiaries are adequately mapped and formally recognized. Projects and pilots are also often quite small and not at a sufficient investment size unless bundled together. Traditional measurement, reporting, and verification (MRV) technologies have also been resource intensive, time-consuming and expensive. Increasingly, these are being supplemented with the use of drones, remote sensing and digital MRV solutions to increase transparency and reduce costs.

#### CLEAN COOKING CHALLENGE

In rural and remote settings, the economics and business case for clean cookstoves is much harder to make than in urban and peri-urban contexts. In areas where customers are very poor and have high price sensitivity, the sales and costs of fuels have typically had to grow quickly enough to recoup low margins from the sale of stoves. These factors also mean that the most commonly relevant technology for the context tends to be improved stoves, rather than advanced fuels and technologies such as electric, gas, ethanol, or biogas that are key investment targets for the sector. At the same time, last-mile distribution in rural and remote areas is very expensive. Carbon credits and other forms of smart grants and outcome and impact-based finance are becoming an increasingly important funding source to improve the investment case and provide transition finance to strengthen local markets.<sup>115</sup> The sale and distribution of clean cookstoves requires high upfront costs for hardware, distribution, and ongoing education and monitoring. Unit costs for cookstoves range from US\$20 to US\$100 depending on the technology and tend to be sold on a cash basis. Furthermore, distribution in remote high conservation value areas can cost 5 times as much as in urban and peri-urban areas. In these contexts, many of the poorest households also cannot afford the upfront cost of modern energy cooking devices — underlining the need for consumer credit and payment models above.<sup>116</sup> Pre-financing for initial distribution costs in exchange for a share of downstream impact-linked revenue is critical to bridge the time between the sale of stoves and the issuance of carbon credits or other impact outcomes.

The additional transaction costs of delivering clean cooking solutions to remote and rural locations most relevant to nature-based solutions at scale have in many cases limited the rural delivery business case for clean cooking enterprises beyond urban and peri-urban areas.<sup>117</sup> Implementation costs are estimated at potentially 3 to 5 times as high as in less remote rural areas where small-scale agriculture is likely to be prevalent, population density is higher, and roads are in better condition. Higher transaction costs and lower ability to pay underline the need for innovative consumer credit and payment models, such as automated pay-as-you-go (PAYGO), energy-as-a-service, and asset financing for these areas.<sup>118</sup> Furthermore, the lack of advanced monitoring and standardized impact metrics for different clean cooking technologies drives up transaction costs and erodes the attractiveness of clean cooking among investors and carbon investors. Adoption and usage tracking has traditionally been tracked through qualitative user information — with risk of collection bias and human error. Sensor solutions, such as StoveTrace devices, and smart data and impact measurement solutions for clean cooking are seen as key to reducing MRV costs, especially in remote settings, and to facilitate access to carbon credits and results-based finance.<sup>119</sup>



TABLE 3.2

### Solution areas for nature-based solutions and clean cooking finance

#### A RANGE OF INNOVATIVE FINANCING SOLUTIONS USED IN BOTH SECTORS TO ADDRESS THESE CHALLENGES INCLUDE:<sup>vi</sup>

##### CORE CHALLENGE 1

- Diversification of funding streams and stacking revenue (carbon credits, payment for ecosystem services, commodities, certified production, impact-linked payments).
- Consumer finance/asset financing models for last-mile distribution that can meet the needs of the rural poor (e.g., Bidhaa Sasa).<sup>120</sup>
- Direct upfront pre-purchase agreements between project developers and a carbon investor to provide upfront finance in exchange for a share of downstream carbon revenue (e.g., DelAgua and Base Carbon).
- Cryptocurrency pre-finance of carbon projects listed on a blockchain platform (e.g., Offset Farm, Biome.Finance).<sup>121</sup>
- Carbon revenue improving credit worthiness of companies.
- Funds with equity and carbon returns to corporate and financial investors in a fund (e.g., Livelihoods Funds).
- Early-stage patient equity funding, equity crowdfunding campaigns and equity de-risking instruments (e.g., Spark+ Fund).
- Concessionary and first-loss capital, debt funds, loan guarantees, first loss debt facilities to de-risk both consumer and venture financing, catalyze commercial debt investments.<sup>122</sup>
- Revolving funds and concessions to increase access to clean cooking in displacement contexts, de-risking private sector actors for the initial capital investment and operational costs (e.g., Mercy Corps Revolving Fund in Ethiopia).<sup>123,124</sup>

##### CORE CHALLENGE 2

- Smart data technology to track usage and emissions metrics for modern energy cooking appliances, generating more reliable and transparent usage information.<sup>125</sup>
- Results-based finance programs that focus on or include clean cooking components (e.g., KOSAP, Kenya; BRILHO, Mozambique; US\$500M World Bank Clean Cooking Fund; Village Enterprise's development impact bonds) in order to diversify cash flows from the range of benefits, beyond just carbon.<sup>126</sup>
- Impact-linked conservation finance where investors share the upside of increased biodiversity metrics such as pre-agreed increases in wildlife populations (e.g., Wildlife Conservation Bond).<sup>127</sup>
- Blockchain solutions to improve transparency and access to markets (Earthshot Labs, Biome.Finance)

<sup>vi</sup> **CLARIFICATION:** While a range of different financing instruments and examples are illustrated here, it is recognized that innovative financial instruments are at different levels of maturity, values, and risk.

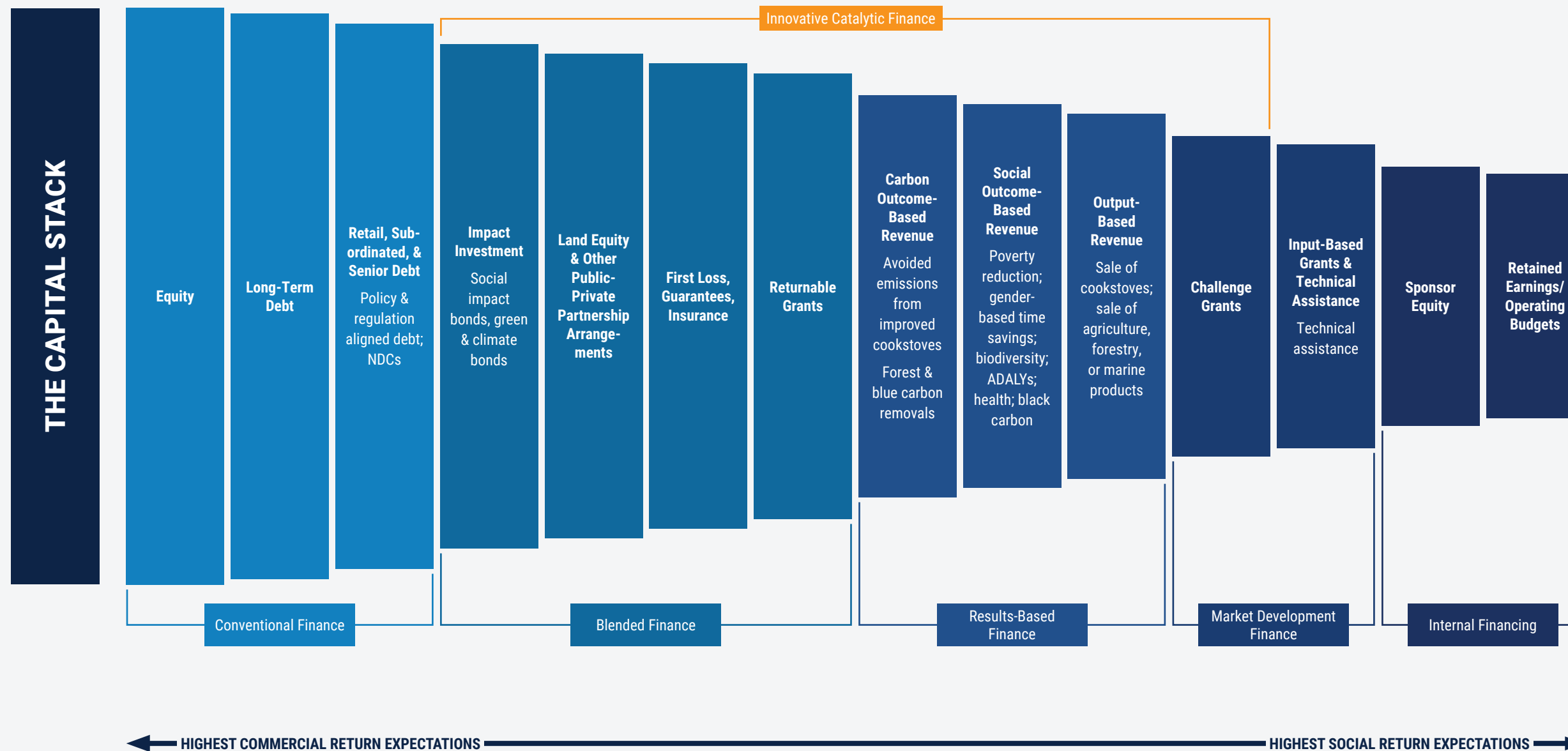


A woman in India uses an improved biomass stove from Greenway Appliances.  
© Bhmesh Bharti / Clean Cooking Alliance.



**FIGURE 5**  
**Aligning innovative finance instruments for nature-based solutions and clean cooking through the capital and revenue stack.<sup>vii</sup>**

Source: Adapted from Colenbrander, S. & Lindfield, M. (2018).<sup>128</sup>



Aligning finance for nature-based solutions and clean cooking can generate and reinforce shared financial, economic, environmental, and social outcomes that can be packaged to a range of investors – public and philanthropic funds, financial and capital markets, carbon markets, and emerging biodiversity markets. Figure 5 illustrates the range of financing instruments and sources of capital that can potentially be combined, with each layer in the capital stack catalyzing the next layer of capital and helping projects and enterprises leverage a variety of commercial and social returns that can unlock a range of capital streams for clean cooking and nature-based solutions.

vii **CLARIFICATION:** The capital stack is the structure of all capital that is invested into a company. It represents the tiers of financing sources in an investment, such as grants, equity, and debt. Sources of finance include public and private, and each set of investors has a different risk/return profile. Each of the instruments encompasses different terms and conditions to suit a particular investor type.





The dramatic boundary between Volcanoes National Park and neighbouring farms illustrates the conservation challenge of human impact on wild spaces.

© Skyler Bishop for Gorilla Doctors.

## CASE STUDY:

### Coordinating and financing action at the park level

National parks across Africa provide protected areas for some of the continent's most iconic species, including elephants, lions, gorillas, and rhinos. There are over 50 national parks, many in priority countries for clean cooking and mitigation potential. Servicing the remote communities that live adjacent to these parks is significantly more expensive and challenging due to local infrastructure and economic conditions. However, these communities are at the front line of conservation and are critical to the long-term existence and sustainable management of protected areas. Not only must

local communities derive benefits from these parks, upon whose resources they are often reliant, but they must also be better served by local clean cooking markets, in turn reducing reliance and pressure on park habitats.

In Uganda, more than 100,000 families live in the area around **Mgahinga Gorilla National Park** and just across the border from **Volcanoes National Park** in Rwanda. LIKANO, myclimate foundation, International Gorilla Conservation Programme, and Fondation Artisans de la Paix et du Développement au Rwanda partnered to deliver efficient

cookstoves to households to reduce deforestation pressure by the steadily growing population around the parks. The project aimed to reduce fuelwood use by 70% and save families an estimated EUR 180 each year. The sale of carbon offsets has been used to finance the local production of the stoves and their subsidized sale to households. So far, 8,930 subsidized stoves have been sold, benefiting 52,950 people.<sup>129</sup>

In the DRC, 56% of charcoal consumed in Goma originated from the **Virunga National Park** in the mid-2000s. Since 2007, WWF launched the EcoMakala project in Goma to produce charcoal from planted trees and thus protect the park by creating a renewable and commercially viable wood

supply sources. At the same time, WWF set up an improved stoves network of women to ensure the production and distribution of stoves to households and sold more than more than 80,000 units from 2008 to 2015. Since then, 20 million trees have been planted around Virunga National Park, leading to 12,000 hectares of afforestation. Furthermore, farmers have been supported to practice intercropping between rows of trees, planting beans, corn, and sweet potatoes. Once tree coverage became too dense for intercropping, WWF launched a project to initiate and supervise tree planters to develop beekeeping and produce quality honey; 136 new beekeepers have been trained in 14 apiaries established across North Kivu. WWF credits the success of EcoMakala to

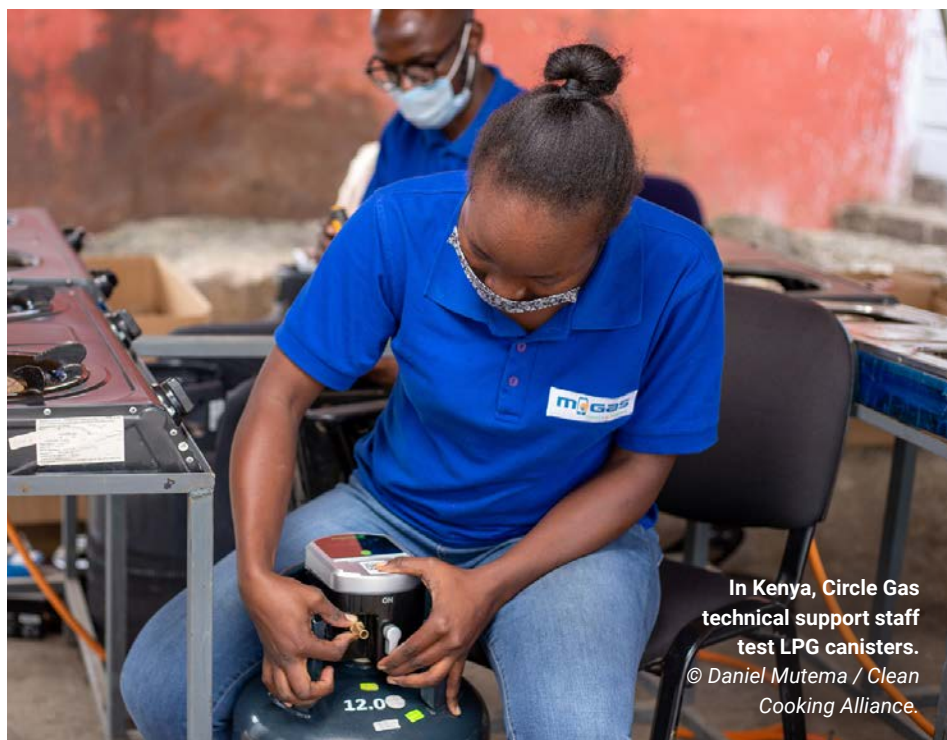
the synergy created between reforestation and production of cooking stoves with improved energy efficiency in the same area. In 2016, funding from WWF-Switzerland helped to transform the artisanal production of cookstoves into a real company — Goma Stove — that is able to bring production to a semi-industrial level by acquiring new machines to further standardize and speed up manufacturing processes.<sup>130</sup>

C-Quest Capital is working with more than 100,000 households within or along the boundaries of national parks in eight countries in sub-Saharan Africa: Angola (**Cangandala National Park**), Kenya (**Amboseli National Park**), Malawi (**Liwonde National Park**, **Majete Wildlife Reserve**, **Kuti Wilderness Reserve**),

Mozambique (**Gorongosa National Park**), Tanzania (**Serengeti National Park**), Uganda (**Bwindi Impenetrable Forest**), Zambia (**Kafue National Park**, **South Luangwa National Park**), and Zimbabwe (**Gonarezhou National Park**, **Hwange National Park**, **Mana Pools National Park**, **Nyanga National Park**). This includes a formal cooperation with Africa Parks to deliver about 500,000 improved cookstoves to over 250,000 households in or near their concessions in the Liwonde and Majete parks between 2022 and 2025. It is working with Peace Parks to replicate the Africa Park model to households within a 4 km radius in transborder parks in Malawi, Namibia, and Zambia.<sup>131</sup>



## 4.2 TRENDS AND OPPORTUNITIES TO ALIGN FINANCE FOR CLEAN COOKING AND NATURE-BASED SOLUTIONS



Scaling blended nature-based solutions and clean cooking approaches will require significant risk capital together with improved data and methodologies for quantifying the range of carbon and other social and environmental benefits. Solutions will need to address the core financing challenges for both clean cooking and nature-based solutions. This means addressing the lack of upfront finance required to scale clean cooking in an integrated manner with nature-based solution programs, leveraging innovations in the digital economy to scale data and tech to increase investor confidence, access new pools of finance, and better capture the enhanced value of servicing communities

in high conservation value areas. Given the growing interest in nature-related mitigation projects and the rapid technology advancements for monitoring and finance in the space, now is the time for ambitious and collective action.

**1 Net-zero and nature-positive commitments by governments, business, and finance are improving access to upfront and long-term carbon finance to achieve climate, biodiversity, and social impact.**

Carbon finance is becoming an increasingly significant source of finance for clean cooking companies and is likely to be a

significant transitional finance tool in the most remote markets that coincide with high conservation value areas. Revenue from carbon credits for clean cooking companies rose 21-fold from 2017 to 2020, as carbon credit sales revenue grew to 29% of total revenue in 2020 from just 1% in 2017.<sup>132</sup> Customers in these markets are even more sensitive to price, while operating costs can be many times higher than in peri-urban markets. To enter, grow, and scale in these markets, clean cooking ventures will need to identify a range of alternative revenue streams beyond the sale of stoves and fuels to demonstrate the financial viability to investors and build attractive risk/reward profiles. This requires investors that are willing to take on longer-term investments, pre-financing, and an interest in paying for impact. Blended finance, in particular the provision of guarantees and technical assistance, would go a long way to help companies attract finance.

Demand for and issuance of Agriculture, Forestry and Other Land Use (AFOLU) carbon credits are growing exponentially.<sup>133</sup> At the same time, clean cooking credits still fetch a lower price and have struggled reputationally in the market. While high-quality AFOLU projects with multiple benefits are starting to move toward US\$30 per tonne (in some cases much higher), clean

cooking projects still fetch closer to US\$10 per tonne. Projects that can prove positive impacts and linkages to nature-based solutions, either to conservation areas, national parks, or the co-development of agroforestry as alternative fuelwood sources, can tap into this higher value market and growing investment interest. Carbon financing offers potential to scale up investment in clean cooking solutions and provide a critical and hard-to-access source of pre-financing for sales and distribution of cookstoves. Despite the considerable costs of project development, verification, and ongoing monitoring and certification costs,<sup>134</sup> carbon credit revenue plays an important role in lowering the cost of cookstoves for low-income households. It can also serve as collateral for lenders to attract debt investors to the sector or to share a portion of carbon revenue with last-mile sales and distribution agents, or even the households themselves. In turn, increased returns and demand certainty linked to carbon finance can allow companies to invest in upgrading production technology and capacity, lowering unit production costs and product prices.<sup>135</sup>

Furthermore, government-government cooperation in line with the Paris Agreement's Article 6 is creating new opportunities to mobilize large-scale finance

for emissions reductions. After years of little progress, clearer parameters were set in Glasgow on Article 6 that provide for how Parties to the Paris Agreement can collaborate through international carbon markets to achieve the climate targets set out in their NDCs. Specifically, Article 6.2 sets out guidelines for internationally transferred mitigation outcomes (ITMOs) between two governments.<sup>136</sup> Half of countries' initial NDCs – which covered 31% of global emissions – intended to use international cooperation through carbon markets to finance and support domestic emissions reductions. The International Emissions Trading Association estimated that this cooperation under Article 6 could reduce the total cost of implementing NDCs by more than half (about US\$250 billion per year in 2030) or facilitate the removal of 50% more emissions (about 5 GtCO<sub>2</sub> per year in 2030), at no additional cost.<sup>137</sup>

Article 6 deals are beginning to emerge. Canada, Japan, Liechtenstein, Monaco, New Zealand, Norway, South Korea, Sweden, and Switzerland have all stated that they plan to use ITMOs to meet their targets or have already initiated the process to acquire ITMOs. In 2021, Sweden's Energy Agency partnered with Gold Standard to set up a public procurement process to facilitate the government's acquisition of quality



ITMOs in the Dominican Republic and Ghana.<sup>138</sup> However, clear rules and credible methodologies will be key to ensuring that climate action is in addition to existing host-country plans, supports increased ambition, and avoids double-counting across countries and carbon markets.<sup>139</sup> Developed governments are being encouraged to shift their focus to “high-hanging fruit” of mitigation action, unlocking finance for the hard-to-abate emission sources that remain largely unaddressed. The additional costs and challenges of scaling clean cooking solutions to remote areas should be considered one of these high-hanging fruits for future ITMOs.

Clear rules and methodologies will also be key to ensuring that clean cooking is a central part of NDCs and a core part of future ITMOs. To increase the inclusion of clean cooking in NDC-related actions, the Clean Cooking and Climate Consortium provided technical support and an improved set of MRV tools and resources to implement clean cooking and household energy projects. The aim is to support countries to include bolder commitments in their NDCs and improve their ability to track impact.<sup>140</sup> This in turn will not only help to strengthen domestic action but also to clarify cooperation priorities where additional support and ambition are required.

#### CASE STUDY:

### Swiss-Peru carbon offset integrates clean cooking into landscape scale conservation

In 2020, Switzerland and Peru became the first countries to conclude an international carbon offsetting deal under Article 6 of the Paris Agreement. Under the accord, projects financed by Switzerland in Peru will count toward Switzerland’s GHG reduction target in its NDC. Switzerland has since signed similar cooperation agreements with Dominica, Georgia, Ghana, Senegal, Thailand, and Vanuatu.<sup>141</sup> Despite criticism of the need for more ambitious domestic action, Switzerland’s agreement in Peru demonstrates where ITMOs can provide critical upfront finance for transitioning remote areas to clean cooking. The Swiss government has mandated the Swiss Climate Cent Foundation to invest up to CHF 20 million in pilot activities with interested countries and the private sector until 2032. The first mitigation activity to be funded under the Swiss-Peru bilateral agreement was the Tuki Wasi clean cookstoves program in the central highlands of Peru, managed by French developer Microsol. Local stove producers distributed 1,000 carbon-efficient cookstoves in 2020 to over 100 poor households in remote areas of La Libertad and in Huánuco, with each stove estimated to offset 2.5 tonnes of CO<sub>2</sub> annually. The Swiss investment, targeting the most remote and underserved areas of Peru, was in addition to a clean cooking program already supported by the Peruvian government. Furthermore, the stoves were distributed during the COVID-19 pandemic to areas that had the highest mortality rate in Peru. Although progress had been challenging due to the pandemic and lack of clarity on Article 6 rules, once formal guidelines are approved by Peru’s Environment Ministry on how to register carbon offsets nationally, the program is expected to mitigate approximately 100,000 tonnes of CO<sub>2</sub> emissions between 2020 and 2030. In the long term, the Swiss government aims to finance biogas plants, solar panels, and geothermal energy in Peru.<sup>142</sup>



These small seedlings are being prepared for a tree planting in Uganda.  
© Dennis Wegewijs.

## 2 A clean cooking conservation mitigation bond to scale clean cooking at the landscape level.

A range of blended debt finance instruments can help to address the gap of long-term upfront finance, including the emerging use of “mitigation bonds” — zero- or very low-interest rate bonds, where proceeds are invested in mitigation loans to a range of carbon avoidance, reduction, and removal projects. As a return on investment, the bonds provide

a share in the mitigation results obtained, transferred as ITMOs.<sup>143</sup> Mitigation bonds are an innovative structure that combine green bonds and carbon credits, aiming to attract a large and diverse pool of investors.<sup>144</sup> These bonds can crowd in private sector investment to support additional and ambitious action, in this case helping countries scale clean cooking in areas that are hardest to reach, and they can create multiple benefits. They are particularly attractive when considering interventions around national

parks and protected areas. The US\$150 million five-year Wildlife Conservation Bond recently issued by the World Bank demonstrates the opportunity for impact-linked finance to drive conservation outcomes at the landscape level. It also underlines growing investor appetite to invest in a range of environmental, climate, and development objectives beyond carbon. The bond included a potential performance payment from the Global Environment Facility for increasing rhino populations in Addo



Elephant National Park and Great Fish River Nature Reserve in South Africa. In the case of the Wildlife Conservation Bond, investors are foregoing the coupon payments — which will be directed to finance rhino conservation activities — and instead receive a success payment at maturity in addition to the principal redemption of the bond.<sup>145</sup>

The Swedish Energy Agency is conducting a virtual pilot of mitigation bonds in Nigeria, where the proceeds from the bond are earmarked for eligible mini-grids, and directly on-lent in the form of concessional loans to project developers. The aim is to improve the risk-return profile of mini-grid investments to attract more commercial finance to the sector and exceed the mini-grid implementation benchmark derived from the NDC target. The bond offers a claim on generated mitigation outcomes in return for lower coupon rates throughout the duration of the bond, with the ability to exercise those claims at year 5 and year 10 on maturation in accordance with regulations on the international transfer of mitigation outcomes.<sup>146</sup> Similar virtual pilot studies have been conducted by the Swedish Energy Agency in Colombia, Chile, and Kenya.<sup>147</sup>

This type of innovative instrument could be used for a clean cooking conservation mitigation bond to help countries exceed the targets in their clean cooking NDC targets, while improving

the permanence of nature-based carbon avoidance and removals projects. Such a bond could also serve to attract a broader range and larger pools of private and public investors that are looking for green bond issuances, rather than direct ITMO deals between governments. Depending on the strength of the local capital markets, additional de-risking mechanisms such as partial credit risk guarantees or political risk insurance may be required to improve the terms of finance. While the returns from carbon credits are at present the least risky, an issuance could also draw on impact metrics where results-based finance is increasingly being used for poverty reduction,<sup>148</sup> gender-based time savings,<sup>149</sup> increases in biodiversity,<sup>150</sup> ADALYs,<sup>151</sup> and improvements in health indicators,<sup>152</sup> and it also could potentially be used for black carbon certificates. It would be critical for proceeds of such a bond to support direct on-lending to clean cooking and nature-based solutions project developers (i.e., clean cooking companies and conservation organizations) to scale the distribution of clean cookstoves to specific areas of high conservation value. Proceeds would also need to support integrated programs to shift to a more sustainable clean cooking value chain through the development of sustainable woodlots and agroforestry systems that address both local woodfuel use and charcoal production.



A woman in Nepal uses an electric induction cooker.  
© Pratik Shrestha / Clean Cooking Alliance.

### 3 Connecting to the digital economy can reduce transaction costs, improve transparency on impact, ensure climate equity for carbon owners, and enhance the sector's reputation.

The rapid expansion of the digital economy and technology solutions — including digital MRV, remote sensing, and PAYGO — will be key to reducing transaction costs and improving impact credibility and consumer access to finance. Innovation in climate and nature tech space has exploded over the past five years. Of the US\$85 billion invested in climate tech in 2020, only US\$400 million was directed to geospatial data generation and emissions data monitoring and management.<sup>153</sup> Part of this boom in investment includes technology platforms, such as Pachama, Regen Network, Earthshot Labs, Geotree, Satelligence, and Earth Blox, that are advancing remote sensing data solutions and machine learning to dramatically improve transparency and reduce the MRV costs of demonstrating climate impacts. Many of these platforms also aim to create a more efficient and transparent marketplace for projects and carbon investors, cutting out the dominance of carbon brokers that have benefited from information asymmetries, often to the detriment of those toiling to achieve the carbon benefits on the ground. Just as this technology revolution is helping to transform investment

in nature-based solutions, it will be key to accelerating investment and confidence in clean cooking solutions to support them.<sup>154</sup>

Technology and data improvements are also important to developing more accurate and cost-effective generation of impact metrics. Smart data features can remotely track the usage of fuels and improve the accuracy of tracking fuel consumption and streamlining impact measurements and reporting on issues relating to health, gender, livelihoods, and environment, while reducing transaction costs. In the clean cooking sector, metering technology products are being developed to track real-time consumer usage data, which in turn informs existing carbon accounting methodologies. For example, Gold Standard recently approved a new carbon certification methodology for metered clean cooking devices that uses smart usage data to improve and simplify emission measurement and reporting requirements.<sup>155</sup> The generation and provision of timely, clean, accurate data is also key to the accurate and timely disbursement of revenue-based finance. Smart metering and other digital solutions could even support improved accounting of the full range of positive impacts, including ADALYs, time savings, and black carbon.<sup>156</sup> It is likely that improved data and MRV of carbon savings will become increasingly important to unlock access to carbon finance.<sup>157</sup>



Better integrating clean cooking with nature-based solutions will also require companies and project developers to stack methodologies for carbon avoidance and removals — in part to provide assurance that there is no double-counting between energy-related and forest-related emissions. Improving the connection between avoidance and removals will also be important for clean cooking companies seeking carbon finance, given that leading net-zero standard settings, such as the Science Based Targets initiative, have prioritized removals over avoidance for the use of offsetting in net-zero claims.<sup>158</sup> Standards will be key to the digital transformation — both

Verra and Gold Standard have initiated digital MRV initiatives in 2022 — and to advancing the development of methodologies that improve how to capture and bundle multiple beneficial impacts of project activities.

Smart data features and metering technologies that can remotely track the usage of fuels also enable companies to offer consumers digital pay-as-you-go solutions, improving affordability for low-income consumers.<sup>159</sup> For example, African Clean Energy (ACE) has developed a solar-biomass hybrid energy system that can burn any dry solid biomass fuel (animal waste, crop residue, small sticks) while providing solar

electricity to charge a phone or plug in an LED light attachment. It also connects to an ACE app that links to payment and use data.<sup>160</sup> Smart data can also be used to reduce the transaction costs of measuring impact to unlock new sources of results-based and impact-linked finance for clean cooking providers.<sup>161</sup>

Finally, decentralized finance (DeFi) and regenerative finance (ReFi) solutions are picking up speed in the climate tech sector and are starting to emerge in the clean cooking space. For example, Biome Finance, a blockchain system, is looking to provide upfront finance to a range of nature-based solution projects (including clean cooking) and then issuing tokens that are linked to the underlying USD intangible asset instead of the tradeable carbon credits.<sup>162</sup> According to the Clean Cooking Alliance's 2022 Industry Snapshot, some clean cooking companies are beginning to leverage real-time tracking to get instant funding from carbon credit buyers, integrating blockchain technology to remotely generate unfalsifiable usage data for validation purposes.<sup>163</sup>

#### **4 A dedicated digital innovation fund would focus attention on the need to accelerate the advancement of digital MRV and DeFi solutions for nature-related clean cooking premiums.**

Dedicated support to clean cooking companies to better link to the rapidly developing digital economy is fundamental

#### **CASE STUDY:**

### **Driving digital innovation for the carbon markets**

Google.org has committed US\$1 million to Gold Standard to pioneer collaborative digital solutions for carbon market standards and MRV. In the carbon market today, most project development, MRV, and certification processes remain manual, disjointed, and complex, limiting access to a small number of market participants, mostly in the Western world.

To address this, Gold Standard will work with open collaboration partners ClimateCHECK, IOTA Foundation, and Cosmos Partners to identify how new technology and governance innovations can be leveraged to unlock highest-quality impact data and channel an increased amount of carbon finance more directly to communities.

The program seeks to develop an open, global collaboration on digital solutions for carbon market standards and MRV governance innovation. It also seeks to build and integrate a range of technologies including digital methodologies and workflows, Internet of Things for data gathering, distributed ledger technology, and smart contracts to improve impact data quality, reduce time and costs, and increase access to less experienced project proponents.<sup>165</sup>

to improving transparency and reducing transaction costs of MRV for a range of usage, emissions, social, and environmental benefits. It would also support the development of more transparent and joined-up accounting across energy, forest, and soil carbon benefits to attract a diversified range of investors that are focused on nature-positive investments. In turn, improving the accounting

and transparency of impact metrics would allow companies to secure results-based finance for a more diverse range of benefits and potentially achieve a premium carbon price for clean cooking solutions with a proven link to reduced deforestation and reforestation. The accuracy of these claims has been an issue in past projects, in part driving lower prices. More accurate data on distribution and positive impacts

on local ecosystems and biodiversity could allow companies to demonstrate real linkages and secure higher prices for credits linked to high conservation value areas that could cover the supplementary costs of reaching remote areas.

Increasing the transparency of information can also have a knock-on effect for enabling clean cooking companies to more directly access carbon finance. This will require an ecosystem of key players from technology, standards, clean cooking, and conservation organizations to come together to develop appropriate, affordable, and scalable digital solutions to reduce costs, improve accuracy, and simplify access to carbon finance at scale for clean cooking. This improved transparency can also help carbon credit sellers attract premium prices through association with impact that is reliable and cannot be double-counted. Not only can digital, blockchain smart contracts and other distributed ledger technologies improve company access to carbon and impact-linked finance, but they also have the power to connect the carbon owners — the women and households themselves — to carbon finance. Although these direct linkages may still be a few years in the making,<sup>164</sup> a dedicated digital finance initiative for clean cooking could help to speed up innovation and pilot new applications for scaling nature-positive climate equity outcomes.



An electric induction cooktop in Nepal.  
© Pratik Shrestha / Clean Cooking Alliance.





## PART FIVE

# Recommendations

This report highlights the foundational and reinforcing role that clean cooking plays in nature-based solutions as well as wildlife and forest conservation programs. Transitioning to sustainable and cleaner sources of fuelwood is central to placing communities at the heart of nature-based solutions and addressing the core drivers of forest degradation and deforestation in the first place.

Investment — especially upfront long-term finance — needs to be radically increased for nature-based solutions and clean cooking to support climate change mitigation at scale and to the benefit of local communities and biodiversity. This report outlines two distinct opportunities to scale and unlock finance for clean cooking with nature-based solutions. At the same time, coordinated action from all stakeholders is needed to radically scale finance and action in this area.

This report highlights examples of successful companies and projects that have aligned finance and programs for clean cooking and nature-based solutions. While we recognize that clean cooking and nature-based solutions require highly localized approaches, these cases demonstrate the range of models and solutions from which other companies, conservation organizations, and investors can take inspiration.

However, time is running out to shift the needle on global climate change and biodiversity loss. Governments, investors, companies, and NGOs need to dramatically accelerate action for clean cooking as an integral component of nature-based solutions. Furthermore, funders and investors need to dramatically scale finance for the clean cooking sector and improve incentives that enable enterprises to serve remote and vulnerable populations.



## Governments

**Developing countries with significant opportunities to align clean cooking and nature-based solutions should integrate clean cooking into NDCs and environment and climate programs.**

- Integrate clean cooking into NDCs to clarify cooperation priorities where additional support and ambition are required.
- Integrate domestic cooking emissions as well as forest degradation in national and international GHG accounting as a first step to better understand and manage their emissions exposure from the sector.
- Integrate emissions from domestic cooking and forest degradation in national and international GHG accounting to set baselines and targets in countries where charcoal and fuelwood demand are expected to grow the most – the DRC, Ethiopia, Mali, Nigeria, Uganda.
- Integrate clean cooking into national programs and funds to monitor, measure, and address forest degradation and climate change (e.g., REDD+) and conservation programs.<sup>166</sup>

**Developed country governments must recognize the interrelationship between clean cooking and nature-based solutions in cooperation programs.**

- Support initiatives, such as 4C, that are supporting countries to implement clean cooking within their NDCs, transforming their plans into action. This must also include strengthening the financial policy and regulatory environment to encourage capital to flow to clean cooking and nature-based solutions.
- Invest in systems that can improve access to discovery and de-risking to catalyze the growth of integrated clean cooking and nature-based solutions.
- Support large-scale clean cooking programs in areas of high conservation value through ITMOs and Article 6 cooperation agreements. These agreements should aim to strengthen local banking and investment capacity for the clean cooking industry.
- Pilot innovative finance mechanisms for both carbon-based outcomes (e.g., mitigation bonds), and other environmental and social outcomes (e.g., conservation bonds) that can diversify public and private finance for a broader range of benefits across climate, social, and environmental impacts.



Women cooking with a biogas stove.  
© Sistema.bio.





### Multilaterals & concessional capital providers

**Step up multilateral and DFI involvement in the sector and link clean cooking more tightly into their growing investment portfolios on nature-based solutions and forest conservation.**

- Pilot blended finance mechanisms, e.g., mitigation bonds and conservation bonds, to increase national ambition to scale clean cooking in areas critical to nature-based solutions; encourage on-lending and investment by local banks and investors to the sector; and reward multiple benefits, stacking methods, impacts, and revenue.
- Adopt a range of transitional finance to enable companies to diversify their capital stack, advancing on the journey from sponsor equity and grants to commercial finance and more senior debt.

- Diversify the range of instruments to improve the terms of finance for clean cooking companies that are scaling operations to more remote areas. This can include increasing the use of partial credit risk guarantees, first loss capital, political risk insurance, foreign exchange risk, and private sector loan guarantees. These instruments will also help to increase appetite to provide upfront risk-taking finance, which is critical to address the lack of a pipeline containing investable projects.
- Pair investments with technical assistance funds to advance the use of enhanced data-driven MRV solutions that can better reward clean cooking companies and projects able to access remote communities that come with a higher price tag and value.

Above: KOKO Networks delivers ethanol fuel local KOKO Points where customers can refill canisters. © Carol Gathigia / Clean Cooking Alliance

### Investors

**Diversify finance solutions and investment screening to identify where clean cooking can help to de-risk nature-related investments and generate returns beyond carbon.**

- Screen nature-related investments to understand where clean cooking is a cost-effective and powerful risk mitigation tool to safeguard and ensure the permanence of return-seeking investments in nature.
- Work with clean cooking companies to advance other forms of innovative finance solutions for impact-linked and results-based finance (beyond carbon credits) for positive impacts on health, gender, and poverty.

**Work with investees, clean cooking companies and projects to identify opportunities to diversify the capital stack and attract innovative finance for a range of commercial, environmental, and social outcomes.**

- Collaborate with clean cooking companies to identify where existing relationships and programs can be scaled to other areas of outcome-based revenue, including forest carbon or blue carbon landscape-scale programs, as well as a range of other noncarbon impacts.

### Corporates

**Integrate clean cooking into strategies for nature investment funds and programs, as well as environmental, social, and governance standards and targets.**

- Ensure a screening process is in place in sustainable agriculture supply chain programs that engage smallholder farmers to identify where unsustainable woodfuel collection requires investments in clean cooking solutions, alongside other agro-ecological interventions.
- Recognize that investing in the avoidance of emissions through the transition to clean cooking solutions will safeguard nature-based removals and ensure they deliver for climate, environment, and people. Corporates should also consider aligning with the IUCN Global Standard for Nature-based Solutions, which places addressing local societal challenges and interactions with nature at the core of nature-based solutions.



From left to right: © Mauro Vombe / Clean Cooking Alliance. © KM Asad / Clean Cooking Alliance..

### Clean cooking companies

**Partner with conservation organizations, national parks, and other environmental groups to leverage clean cooking value chains for nature-based solutions.**

- Work with conservation organizations to identify scalable opportunities where the delivery of clean cooking solutions could accelerate conservation and reforestation efforts.
- Integrate delivery models into other sector-access strategies (e.g., health care) to reach these areas.<sup>167</sup>
- Develop and adopt new methodologies and monitoring solutions that better capture the full range of positive impacts, enable avoidance and removal carbon credits to be stacked, and avoid double-counting of energy-related and forest-related emissions.
- Support the transition to a more sustainable woodfuel and charcoal value chain by using agroforestry to reduce the pressure on forests and diversify income streams for both the companies and their community stakeholders. Establishing new value chain partnerships will be key, as not all clean cooking companies will be well suited to entering the agroforestry sector as well.

### Conservation organizations

**Align conservation with clean cooking value chains to achieve inclusive and regenerative rural development that reduces pressure on critical ecosystems.**

- Act as a powerful and critical link to identifying and connecting to communities that are most crucial to improving conservation outcomes, supporting last-mile delivery, and providing an on-the-ground feedback loop to clean cooking companies when programs need to be adapted.
- Extend cooperation on both reducing demand for biomass from local communities and identifying opportunities and new partners to address fuel value chains, establishing partnerships with local small-scale timber and agroforestry businesses.





A woman making tea on her Jikoka improved charcoal stove.  
© Nick Wambugu / Clean Cooking Alliance.



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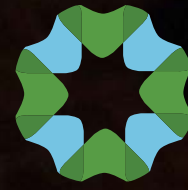
## REFERENCES

- Pearson et al (2017). Greenhouse gas emissions from tropical forest degradation: An underestimated source. *Carbon Balance and Management* (12).
- Clean Cooking Alliance (2021). *Clean Cooking Critical to Achieving COP26 Climate Goals*.
- Clean Cooking Alliance (2021). *Climate and Environment Factsheet*.
- Gill-Wiehl et al (2021). What's in a stove? A review of the user preferences in improved stove designs. *Energy Research & Social Science* (81).
- World Health Organization (2016). *Burning Opportunity: Clean Household Energy for Health, Sustainable Development, and Wellbeing of Women and Children*.
- IEA, IRENA, UNSD, World Bank, WHO (2022). *Tracking SDG 7: The Energy Progress Report 2022*.
- Clean Cooking Alliance (2022). *Clean Cooking Industry Snapshot: Third Edition*.
- Roe et al (2021). Land-based measures to mitigate climate change: Potential and feasibility by country. *Global Change Biology* (27).
- Neal Spackman (2021). *Regenerative Resources Co.*
- IUCN (2020). *Global Standard for Nature-based Solutions*.
- Nature4Climate (2021). *Nature-based solutions: A summary of announcements and developments during the UN Climate Action Summit and Climate Week*.
- UN Environment Programme (2021). *The State of Finance for Nature*.
- IUCN (2022). *Swiss-based companies pledge to deliver 100 Nature-based Solutions by 2030*.
- World Resources Institute (2021). *Public International Funding of Nature-based Solutions for Adaptation: A Landscape Assessment*.
- Sustainable Energy for All & Climate Policy Initiative (2021). *Energizing Finance: Understanding the Landscape 2021*.
- World Bank (2020). *Mobilizing Private Finance for Nature*.
- Girardin et al (2021). *Nature-based solutions can help cool the planet – if we act now*.
- Brandon, K. (2014). *Ecosystem Services from Tropical Forests: Review of Current Science*. CGD Climate and Forest Paper Series #7.
- Bailis et al (2015). The carbon footprint of traditional woodfuels. *Nature Climate Change* (5).
- Pearson et al (2017). Greenhouse gas emissions from tropical forest degradation: An underestimated source. *Carbon Balance and Management* (12).
- Bailis et al (2015). The carbon footprint of traditional woodfuels. *Nature Climate Change* (5).
- Bailis et al (2015). The carbon footprint of traditional woodfuels. *Nature Climate Change* (5).
- Brandon, K. (2014). *Ecosystem Services from Tropical Forests: Review of Current Science*. CGD Climate and Forest Paper Series #7.
- Griscom et al (2020). National mitigation potential from natural climate solutions in the tropics. *Philosophical Transactions of the Royal Society B: Biological Sciences* (375).
- Bailis et al (2015). The carbon footprint of traditional woodfuels. *Nature Climate Change* (5).
- Floess et al (2022). *Climate & Health Implications of Adopting Modern Household Cooking Fuels on a Global Scale*. In Preparation.
- Bailis et al (2015). The carbon footprint of traditional woodfuels. *Nature Climate Change* (5).
- World Health Organization: *Proportion of population with primary reliance on polluting fuels and technologies for cooking (%)*.
- Clean Cooking Alliance (2021). *Clean Cooking Critical to Achieving COP26 Climate Goals*.
- Bailis et al (2015). The carbon footprint of traditional woodfuels. *Nature Climate Change* (5).
- Pearson et al (2017). Greenhouse gas emissions from tropical forest degradation: An underestimated source. *Carbon Balance and Management* (12).
- Fedele et al (2021). *Nature-dependent people: Mapping human direct use of nature for basic needs across the tropics*. *Global Environmental Change* (71).
- Clean Cooking Alliance (2021). *Clean Cooking Critical to Achieving COP26 Climate Goals*.
- Clean Cooking Alliance (2021). *Achieving Climate Goals Through Clean Cooking*. Webinar, March 30, 2022.
- Clean Development Mechanism: AMS-II.G.: *Energy efficiency measures in thermal applications of non-renewable biomass – Version 12.0*.
- Renshaw, C. (2021). *Wood to charcoal conversion rates in sub-Saharan Africa*. C-Quest Capital Technical Note.
- WWF (2020). *Solutions for a sustainable fuelwood energy sector in Madagascar*.
- WWF-Madagascar (2020). *Entrepreneurship and Reforestation for a More Sustainable Development in Madagascar*.
- Central African Forest Initiative (2022). *CAFI and the DRC have launched their joint Call for Expressions of interest under the 2nd letter of intent*.
- Bailis et al (2015). The carbon footprint of traditional woodfuels. *Nature Climate Change* (5).
- Natural Capital Partners. *Kulera REDD+ and Cookstoves, Malawi*.
- Tran et al (2021). *Landscape Analysis of Modern Energy Cooking in Displacement Settings*. Modern Energy Cooking Services Programme.
- International Organization for Migration (2018). *UN Agencies, Government Distribute LPG Stoves to Rohingya Refugees, Bangladeshi Villagers to Save Remaining Forests*.
- IUCN (2017). *More mangroves, less smoke: Enhancing resilience of coastal ecosystems and communities in Cox's Bazar*.
- Correspondence with Sustainable Harvest International.
- Edenhofer et al (2014). *IPCC: Summary for policymakers*.
- Bond et al (2013). *Bounding the role of black carbon in the climate system: A scientific assessment*. *Journal of Geophysical Research: Atmospheres* (118).
- Clean Cooking Alliance (2021). *Clean Cooking Critical to Achieving COP26 Climate Goals*.
- Gold Standard: *Improved Woodstoves in Udaipur – Helping Women and Environment*.
- C-Quest Capital (2022). *Clean Cooking Avoidance Removals Nexus*.
- Clean Development Mechanism: AMS-II.G.: *Energy efficiency measures in thermal applications of non-renewable biomass – Version 12.0*.
- Renshaw, C. (2021). *Wood to charcoal conversion rates in sub-Saharan Africa*. C-Quest Capital Technical Note.
- Global Environment Facility (2019). *Wood-saving cookstoves are helping Zambia cut forest loss*.
- Global Mangrove Alliance (2021). *The State of the World's Mangroves 2021*.
- Woods, K. (2020). *Charcoal production in Myanmar: Links to illegality, deforestation, and rural livelihoods in Tanintharyi region*. *Forest Trends*.
- IUCN (2017). *More mangroves, less smoke: Enhancing resilience of coastal ecosystems and communities in Cox's Bazar*.
- Verra: *Rimba Raya – Central Kalimantan, Indonesia*.
- Ghoshal et al (2017). *Impact of biogas interventions on forest biomass and regeneration in southern India*. *Global Ecology and Conservation* (11).
- Kijani Forestry. <https://kijaniforestry.com/>
- C-Quest Capital (2022). *Clean Cooking Avoidance Removals Nexus*.
- C-Quest Capital (2022). *Clean Cooking Avoidance Removals Nexus*.
- Interview with C-Quest Capital.



- 63 Otago: <https://otago-global.com/impact/>
- 64 Interview with Otago.
- 65 Carruthers (2021). Cleaning up Cambodia's kitchens could curb deforestation, climate change. Mongabay.
- 66 Interview with Mercy Corps.
- 67 Agarwala et al (2017). Impact of biogas interventions on forest biomass and regeneration in southern India. *Global Ecology and Conservation* (11).
- 68 WWF-Switzerland (2020). Protecting the climate and tigers with Fairtrade rice.
- 69 WWF-Switzerland (2020). Small stoves protect giant pandas.
- 70 South Pole (2021). Clean cookstoves saving the Giant Panda with WWF.
- 71 WWF (2022). [Mountain Gorilla](#).
- 72 United Nations Carbon Offset Platform: [DelAgua Public Health Program in Eastern Africa](#).
- 73 DelAgua. Project Rwanda: <https://www.delagua.org/project-rwanda/>
- 74 DelAgua. Nature-based Solutions: Preserving Rwanda's forestry means saving the remarkable diversity of plants, insects, birds and mammals found there.
- 75 IEA, IRENA, UN, World Bank, and WHO (2022). Tracking SDG7 progress across targets: Indicators and data.
- 76 Clean Cooking Alliance (2019). Tanzania.
- 77 McDuffie et al (2021). Source sector and fuel contributions to ambient PM<sub>2.5</sub> and attributable mortality across multiple spatial scales. *Nature Communications* (12).
- 78 World Health Organization (2018). Burden of disease from household air pollution for 2016: Summary of results.
- 79 McDuffie et al (2021). Source sector and fuel contributions to ambient PM<sub>2.5</sub> and attributable mortality across multiple spatial scales. *Nature Communications* (12).
- 80 Gold Standard (2022). Health Impacts: Averted Disability-Adjusted Life Years (ADALYs).
- 81 Gill-Wiehl et al (2021). What's in a stove? A review of the user preferences in improved stove designs. *Energy Research & Social Science* (81).
- 82 World Health Organization (2016). Burning Opportunity: Clean Household Energy for Health, Sustainable Development, and Wellbeing of Women and Children.
- 83 Clean Cooking Alliance (2021). Gender and Clean Cooking.
- 84 Jagoe et al (2020). Sharing the burden: Shifts in family time use, agency and gender dynamics after introduction of new cookstoves in rural Kenya. *Energy Research & Social Science* (64).
- 85 Clean Cooking Alliance (2021). Clean Cooking Can Empower Women: A New Financial Tool Could Help Determine What That's Worth.
- 86 Burn: [Our stoves have impacted 7M+ lives](#).
- 87 Agarwala et al (2017). Impact of biogas interventions on forest biomass and regeneration in southern India. *Global Ecology and Conservation* (11).
- 88 Myclimate (2019). Forest Conservation through Efficient Cook Stoves in the Himalayas.
- 89 Berkouwer, S. & Dean, J. (2022). Credit, attention, and externalities in the adoption of energy efficient technologies by low-income households.
- 90 Burn: [Our stoves have impacted 7M+ lives](#).
- 91 Sguazzin, A. (2022). KOKO Aims to Replace Charcoal in \$47 Billion Cooking Fuel Market. *Bloomberg Green* (26 January 2022).
- 92 ELRHA: [ECOCA end-to-end: Installations, distribution, network](#).
- 93 Burn: [Our stoves have impacted 7M+ lives](#).
- 94 WWF-Switzerland (2020). Entrepreneurship and reforestation for a more sustainable development in Madagascar.
- 95 Winter, J. (2021). Cookstove-Biochar Ecosystems for Clean Cooking and Soil Restoration in Bangladesh.
- 96 UNITAR (2022). The State of the Humanitarian Energy Sector: Challenges, Progress and Issues in 2022.
- 97 FAO & UNHCR (2018). Managing forests in displacement settings: Guidance on the use of planted and natural forests to supply forest products and build resilience in displaced and host communities.
- 98 ELRHA: [ECOCA end-to-end: Installations, distribution, network](#).
- 99 Coalition for Private Investment in Conservation (2020). Scaling private investments in conservation: Five barriers and five solutions.
- 100 United Nations Environment Programme (2021). State of Finance for Nature.
- 101 Tobin-de la Puente, J. & Mitchell, A.W. (2021). *The Little Book of Investing in Nature*. Global Canopy.
- 102 United Nations Environment Programme (2021). State of Finance for Nature.
- 103 Coalition of Private Investors for Conservation (2021). Conservation Finance 2021: An Unfolding Opportunity.
- 104 United Nations Environment Programme (2021). State of Finance for Nature.
- 105 World Resources Institute (2021). Public International Funding of Nature-based Solutions for Adaptation: A Landscape Assessment.
- 106 Climate Policy Initiative (2019). Global Landscape of Climate Finance.
- 107 Tobin-de la Puente, J. & Mitchell, A.W. (2021). *The Little Book of Investing in Nature*. Global Canopy.
- 108 Sustainable Energy for All & Climate Policy Initiative (2021). *Energizing Finance: Understanding the Landscape 2021*.
- 109 Climate & Clean Air Coalition (2020). Groundbreaking Study Set to Measure the Multiple Benefits of Clean Cookstoves.
- 110 Sustainable Energy for All & Climate Policy Initiative (2021). *Energizing Finance: Understanding the Landscape 2021*.
- 111 Clean Cooking Alliance (2021). *Clean Cooking Industry Snapshot 2021*.
- 112 Sustainable Energy for All & Climate Policy Initiative (2021). *Energizing Finance: Understanding the Landscape 2021*.
- 113 Coalition of Private Investors for Conservation (2021). *Conservation Finance 2021: An Unfolding Opportunity*.
- 114 Spackman, N. (2022). *The Valley of Death*.
- 115 Modern Energy Cooking Services & Energy 4 Impact (2022). *Modern Energy Cooking: Review of the Funding Landscape*. Report 5 of the Financing Clean Cooking Series.
- 116 Modern Energy Cooking Services & Energy 4 Impact (2022). *Clean Cooking: Financing Appliance for End Users*. Report 2 of the Financing Clean Cooking Series.
- 117 Clean Cooking Alliance (2021). *Clean Cooking Industry Snapshot 2021*.
- 118 Modern Energy Cooking Services & Energy 4 Impact (2022). *Clean Cooking: Financing Appliance for End Users*. Report 2 of the Financing Clean Cooking Series.
- 119 Modern Energy Cooking Services & Energy 4 Impact (2022). *Clean Cooking: Results-based Financing as a Potential Scale-Up Tool for the Sector*. Report 4 of the Financing Clean Cooking Series.
- 120 Modern Energy Cooking Services & Energy 4 Impact (2022). *Clean Cooking: Financing Appliance for End Users*. Report 2 of the Financing Clean Cooking Series.
- 121 Bu, P. (2022). Here's how DeFi startup OffsetFarm is addressing climate action through NFT tokens.
- 122 Modern Energy Cooking Services & Energy 4 Impact (2022). *Clean Cooking: Financing Appliance for End Users*. Report 2 of the Financing Clean Cooking Series.
- 123 Mercy Corps (2020). *Energy Access: Mercy Corps' Approach*.
- 124 Energy 4 Impact. *Clean Cooking: Structuring Concessions for Displaced People*.
- 125 Modern Energy Cooking Services & Energy 4 Impact (2022). *Modern Energy Cooking: Review of the Funding Landscape*. Report 5 of the Financing Clean Cooking Series.
- 126 Modern Energy Cooking Services & Energy 4 Impact (2022). *Clean Cooking: Results-based Financing as a Potential Scale-Up Tool for the Sector*. Report 4 of the Financing Clean Cooking Series.
- 127 Reuters (2022). World Bank sells first 'rhino' bond to help South Africa's conservation efforts.
- 128 Colenbrander, S. & Lindfield, M. (2018). *Financing Low-Carbon, Climate-Resilient Cities*. IPCC Cities and Climate Change Science Conference. March 2018.
- 129 Myclimate (2022). Efficient Cook Stoves save habitat for the last of the Mountain Gorillas in Rwanda.
- 130 WWF (2019). *Agroforestry and Sustainable Energy Production at the Heart of WWF's Success Story in Eastern DRC*.
- 131 Interview and correspondence with C-Quest Capital.
- 132 Clean Cooking Alliance (2022). *Clean Cooking Industry Snapshot 2022*.
- 133 Ecosystem Marketplace (2021). *State of the Voluntary Carbon Markets 2021*.
- 134 Pachama (2021). Why technology is needed to scale forest carbon accreditation.
- 135 Clean Cooking Alliance (2022). *Clean Cooking Industry Snapshot 2022*.
- 136 IISD (2021). *The Paris Agreement's New Article 6 Rules*.
- 137 IETA (2019). *The Economic Potential of Article 6 of the Paris Agreement and Implementation Challenges*.
- 138 Argus (2021). Sweden enlists climate certifier for Article 6.
- 139 World Resources Institute (2019). *What You Need to Know About Article 6 of the Paris Agreement*.
- 140 Clean Cooking Alliance (2021). *Clean Cooking Critical to Achieving COP26 Climate Goals*.
- 141 Argus (2021). Switzerland forms two more Article 6 agreements.
- 142 Dupraz-Dobias, P. (2021). Swiss carbon offsetting project adds spark to global debate on credits. *Swiss Info*.
- 143 ClimaSouth (2017). *Policy Brief: Mitigation Bonds and Mitigation Loans*.
- 144 Climate Finance Innovators (2019). *Moving towards next generation carbon markets: Observations from Article 6 pilots*.
- 145 World Bank (2022). *Wildlife Conservation Bond Boosts South Africa's Efforts to Protect Black Rhinos and Support Local Communities*.
- 146 Climate Finance Innovators (2019). *Moving towards next generation carbon markets: Observations from Article 6 pilots*.
- 147 IISD (2019). *Current Status of Article 6 of the Paris Agreement: Internationally Transferred Mitigation Outcomes (ITMOs)*.
- 148 Village Enterprise (2021). *Village Enterprise Closes Investment for First Development Impact Bond for Poverty Alleviation in Sub-Saharan Africa*.
- 149 Clean Cooking Alliance (2021). *Clean Cooking Can Empower Women: A New Financial Tool Could Help Determine What That's Worth*.
- 150 World Bank (2022). *Wildlife Conservation Bond Boosts South Africa's Efforts to Protect Black Rhinos and Support Local Communities*.
- 151 Gold Standard (2022). *Health Impacts: Averted Disability-Adjusted Life Years (ADALYs)*.
- 152 Bergman et al (2021). *Results-Based Financing for Health: A Case Study of Knowledge and Perceptions Among Stakeholders in a Donor-Funded Program in Zambia*. *Science and Practice* (9).
- 153 PWC (2021). *State of Climate Tech 2021: Scaling breakthroughs for net zero*.
- 154 Uearthed (2022). How middlemen carbon brokers take a cut from money meant to help offset emissions.
- 155 Modern Energy Cooking Services & Energy 4 Impact (2022). *Modern Energy Cooking: Review of the Funding Landscape*. Report 5 of the Financing Clean Cooking Series.
- 156 Clean Cooking Alliance (2021). *Climate and Environment Factsheet*.
- 157 Modern Energy Cooking Services & Energy 4 Impact (2022). *Modern Energy Cooking: Review of the Funding Landscape*. Report 5 of the Financing Clean Cooking Series.
- 158 Impact Advisors Capital (2021). *Balancing the Carbon Books: Failings in Additionality and Measurability*.
- 159 Modern Energy Cooking Services & Energy 4 Impact (2022). *Modern Energy Cooking: Review of the Funding Landscape*. Report 5 of the Financing Clean Cooking Series.
- 160 African Clean Energy: [The ACE One](#).
- 161 Modern Energy Cooking Services & Energy 4 Impact (2022). *Modern Energy Cooking: Review of the Funding Landscape*. Report 5 of the Financing Clean Cooking Series.
- 162 Biome.Finance: <http://biome.finance/>.
- 163 Clean Cooking Alliance (2022). *Clean Cooking Industry Snapshot 2022*.
- 164 Clean Cooking Alliance (2022). *Clean Cooking Industry Snapshot 2022*.
- 165 Gold Standard (2022). *Google.org backs Gold Standard to build digital solutions to help carbon markets work for climate justice*.
- 166 Clean Cooking Alliance (2021). *Climate and Environment Factsheet*.
- 167 Gill-Wiehl, A. & Kammen, D. (2022). Now we are cooking with gas: How interdisciplinary solutions and local outreach can light a fire under clean stove adoption.





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