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100% RENEWABLES SOLUTIONS PACKAGE

Harnessing renewable energy for clean cooking



This solution is part of a package of solutions meant to guide local and regional governments in implementing a local renewable energy transition by providing guidance on mechanisms, applications or technologies that can help accelerate their climate and energy action.

It was produced as part of the 100% Renewables Cities and Regions Roadmap project, which supports nine cities and regions across Argentina, Indonesia and Kenya to develop bankable renewable energy projects and in-depth local strategy and action plans to achieve one hundred percent renewable energy. The 100% Renewables Cities and Regions Roadmap project is implemented by ICLEI – Local Governments for Sustainability and funded through the International Climate Initiative (IKI), which is implemented by the Federal Ministry for Economic Affairs and Climate Action (BMWK) in close cooperation with the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV) and the Federal Foreign Office (AA).

DISCLAIMER

All cities are unique. The Solutions Gateway has been developed as an advanced knowledge catalogue to provide an overview of possible Low Emissions Development Solutions. The Solutions and Packages it contains provide guidance on general conditions, which may not correspond to the existing conditions in your city or jurisdiction. The consultation and use of the Solutions Gateway does not waive the need for the Local Government to assess the feasibility of a Solution or Package in the local context in its city or jurisdiction, prior to implementation. Please note that the impacts, benefits and co-benefits indicated are generally valid but may not materialize in particular circumstances.

ABOUT SOLUTIONS GATEWAY

[Solutions Gateway](#) is an online resource platform for Local Governments where they will be able to find possible Low Emissions Development (LED) Solutions for their cities. In the context of the Solutions Gateway, Solutions are processes, or groups of actions, which Local Governments can implement to deliver climate change mitigation results and enhance local sustainable development. Taking an integrated approach, and focusing on Local Governments usual responsibilities and roles, Solutions include core actions as well as enabling and multiplying actions essential to maximize their effectiveness and efficiency. These include policy, regulatory, governance, capacity building, awareness raising, stakeholder engagement, etc.

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ICLEI – Local Governments for Sustainability is a global network working with more than 2,500 local and regional governments committed to sustainable urban development. Active in 125+ countries, ICLEI influences sustainability policy and drives local action for low emission, nature-based, equitable, resilient and circular development. ICLEI's Members and team of experts work together through peer exchange, partnerships and capacity building to create systemic change for urban sustainability.

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1. INTRODUCTION

Access to clean cooking is essential for leading a healthy and productive life. Clean cooking solutions comprise fuels and technologies that cause very little or no household air pollution. While the definition of ‘clean cooking’ varies, they all broadly include technical aspects (type of fuel, stove efficiency), environmental (exposure, ventilation, etc.) and social aspects (access). Various sources also define certain clean fuels based largely on their emissions of pollutants and greenhouse gases (GHG), including solar, biogas, natural gas, liquefied petroleum gas (LPG), ethanol-based fuels [1] [2]. Other measures include other multi-dimensional factors, including [3] **exposure, fuel efficiency, safety, convenience, affordability, and availability**. The focus of this solution is renewable sources and enablers that can be used for clean cooking, excluding fossil fuels such as natural gas and LPG that might meet the definition of clean cooking, but are not renewable.

1.1 RELEVANCE

According to the tracking SDG7 report published in 2023, the percentage of the global population in 2021 having access to clean cooking has increased to 71%. Nonetheless, approximately 2.3 billion people, mostly in Sub Saharan Africa (SSA) and Asia, still cook with polluting biomass fuels. Current trends suggest that by 2030, 1.9 billion people will still rely on the use of inefficient stoves paired with polluting biomass fuels [2][4]. While the clean cooking access deficit has decreased consistently in other low access regions like Eastern and South-eastern Asia (since 2000) and Central and Southern Asia (since 2010), SSA is witnessing an upward trend in the deficit, as access to clean cooking has failed to keep pace with growing populations. Urban areas have historically had greater access to clean cooking than rural areas; however, the gap has narrowed over time [3].

This reliance on inefficient and polluting technologies for cooking contributes to negative health, gender, economic, environmental and climate challenges. Providing access to clean and modern energy services for cooking must become an economic, environmental and political priority, and it is imperative that local and national governments support this through policies, enabling framework conditions, innovative and inclusive finance mechanisms, investments and multi-sector partnerships [5].

1.2 SDGs ADDRESSED

SDG 1 | No Poverty: Clean cooking is part of basic services necessary to lead a healthy and productive life and saves households time and money.

SDG 3 | Good Health and Well-being : Reducing smoke emissions from cooking decreases the burden of disease associated with household air pollution and improves well-being, especially for women and children.

SDG 4 | Quality Education: Children, particularly girls, are often kept out of school so that they can contribute to household tasks like cooking and collecting fuel.

SDG 5 | Gender Equality: Unpaid work, including collecting fuel and cooking, remain a major cause of gender inequality; the impact of unclean fuels disproportionately affects women.

SDG 7 | Affordable and Clean Energy: Clean cooking is essential to addressing energy poverty and ensuring sustainable energy access.

SDG 8 | Decent Work and Economic Growth: Energy, particularly clean cooking access enables enhanced productivity and inclusive economic growth. The clean cooking sector offers many job opportunities for manufacturers, distributors, retailers, technicians, repairers, vendors, marketers, microfinance institutions etc.

SDG 11 | Sustainable Cities and Communities: Clean cooking addresses household and ambient air pollution, resource efficiency and climate vulnerability.

SDG 13 | Climate Action: Up to 25% of black carbon emissions come from burning solid fuels for household energy needs. Clean cooking solutions address the most basic needs of the poor, while also delivering climate benefits.

SDG 15 | Life on Land: Up to 34% of wood harvested for cooking is unsustainable, contributing to forest degradation, deforestation and climate change

1.3 MAIN IMPACTS

The reliance on inefficient and polluting technologies for cooking presents negative effects on health, the environment, climate and gender inequality.

HEALTH

Cooking indoors or in poorly ventilated spaces with open fires, harmful fuels and inefficient stoves causes indoor or household air pollution. Breathing in toxic smoke produced from burning unclean fuels leads to severe health problems such as respiratory illnesses, eye diseases, cancers and heart conditions. Wood and charcoal stoves emit particulate matter, and coal contains carcinogens such as mercury, cadmium and lead, which are released during combustion [5]. As a result, this causes a significant 3.2–4.3 million premature deaths yearly worldwide [1] [6] [2], the loss of an estimated 86 million healthy life years [2] and 91.5 million disability adjusted life years [7].

GENDER

Women and children are disproportionately affected as they are usually responsible for the preparation of food for their families [5] [2]. Inhalation of smoke by pregnant women and by young children in the care of women who have to multitask between childcare and cooking can also lead to poor growth and development in the children [7]. Time poverty is also related to the use of traditional fuels due to the time taken for the collection of fuelwood and longer cook times with traditional stoves, which could otherwise be spent on income-generation activities, leisure, education and rest. The cost for lost time in productivity was estimated to be around 1 trillion USD per annum [6].

CLIMATE AND ENVIRONMENT

The contribution to climate change is also significant. Cooking with traditional fuels contributes to emitting 120 Mt to 1 Gt of climate pollutants per annum [2] [1]. It is also the source of black carbon which has a warming potential 460–1500 times more than carbon dioxide. Further, around 34–50% of wood harvested for cooking is considered to be harvested unsustainably [1].

1.4 BENEFITS

- **Saves time:** Less time spent gathering fuelwood, processing fuel and cooking due to enhanced thermal efficiencies of modern fuels and cookstoves. For example, through the ENACT project being implemented in Kampala by ICLEI Africa and Mercy Corps, households using electric pressure cookers (EPCs) to boil beans are now able to do so in 30–45 mins, instead of the usual 2–4 hours often spent when using wood or charcoal.
- **Health benefits:** The reduction or eradication of household/indoor air pollution results in a reduction in respiratory risks; better growth and development in children; and a reduction in physical health challenges such as red eyes, running nostrils, burns and other forms of injury.

- **Cost savings:** Increased household and business savings due to utilisation of more affordable cooking technologies. Though the upfront cost of some of these technologies are often very expensive, the running costs, especially in terms of fuel purchase, have been found to be cheaper or similar to the cost of inefficient biomass options. These savings are supplemented by improved food security, increased access to educational opportunities, reduced healthcare costs and disruptions, etc.
- **Environment and climate benefits:** The reduction in the use of traditional fuels results in reduced deforestation, thus improving the ability of forests to sequester carbon, and support climate change protection. This also leads to the protection of forest habitats which are important for many species and biodiversity impacts, as well as livelihoods. It also leads to a reduction in carbon emissions and other pollutants from domestic cooking.
- **Gender equity:** Access to clean cooking leads to increased health, time savings and productivity, especially for women and children, thus allowing them time to undertake other activities such as to attend and finish school, undertake hobbies, rest, play and socialise, etc.
- **Economic benefits:** Improving clean cooking access leads to an expansion of the clean cooking sector and employment creation for communities through sustainable livelihood options (e.g. designers and manufacturers of clean cooking stoves, sales agents, etc.) as well as small businesses.

1.5 SUGGESTED INDICATORS FOR MONITORING RESULTS

The indicators to track progress should be related to the 6 tiers and 6 attributes of access as per the MTF framework as summarised below:

- Overall indicator:
 - Percentage of the population using primarily clean fuels and technologies for cooking (%).
 - Percentage of population using clean cooking fuels as a secondary alternative (%).
- Fuels and stove efficiency:
 - Efficiency of the stoves used for cooking (%).
 - Moisture content of the fuel used for cooking, where applicable (%).
- Safety:
 - Number of chronic diseases reported as a result of using the stove (number/year).
 - Number of fire accidents reported as a result of using the stove (number per year).
- Affordability:
 - Percentage of household income spent on fuel for cooking each month (amount/month).
 - Number of households willing to pay for a switch to clean cooking fuels and technologies (number).
- Availability:
 - Percentage of the time fuel is available at point of sale when needed by the user (%/month or %/week).
- Exposure
 - Amount of pollutants (PM2.5 and CO) produced per day in the users place of cooking (mg per day).
 - Speed of air flow in the users cooking area (m/s).

- Convenience
 - Amount of time spent to prepare/start the stove each time (mins).
 - Amount of time spent in purchasing/fetching fuel by the user each time (mins).
 - Distance between user and closest point of collection/purchase of fuel (km).
- Others
 - Number of jobs created as a result of transitioning to clean cooking in a community.
 - Amount of GHG emissions abated as a result of transitioning to clean cooking alternatives in a community.
 - Number of new businesses in the clean cooking sector (number per year, city, country).

1.6 TYPICAL LOCAL GOVERNMENT ROLES

- Planner
- Policy maker
- Legislator/regulator
- Coordinator
- Consumer and procurement
- Operator of municipal facilities and infrastructures
- Role-model
- Mobilization and stakeholder engagement
- Education and awareness raising



Woman cooking with biogas

2. INTEGRATED SOLUTION OVERVIEW

	Enabler Actions	Required Actions	Multiplier Actions
Policy	<ul style="list-style-type: none"> • Develop suitable policies to improve availability, affordability, investment, research and development, and implementation of clean cooking interventions in the community/ city/country, in a way that is inclusive and sustainable. • Formulate policies and regulations that promote the adoption of clean cooking technologies and fuels, informed by the assessment findings. • Establish standards for clean cookstoves, emissions limits, and incentives for cleaner fuels to drive the transition to cleaner cooking practices. 	<p>The local and national governments can improve clean cooking access by:</p> <ul style="list-style-type: none"> • Raising awareness and deliver relevant training around the benefits of clean cooking among different tiers, agencies and departments in government, so as to increase political will and political buy-in. • Develop a clean cooking strategy/roadmap/action plan for the city or country. • Define clean cooking access goals for the city and mainstream into other relevant policies and plans. • Develop policies, standards and regulations to guide the implementation of clean cooking 	<ul style="list-style-type: none"> • Local and national political will and buy-in to support initiatives. • Sensitise local government around the benefits of clean cooking and its relevance to their sectoral targets and how they can mainstream this into their sectoral targets. • Inclusion of clean cooking targets in Nationally Determined Contributions (NDCs) and development of localised strategies to contribute to this. • Drive local manufacturing of clean cooking stoves and local clean cooking solutions.
Stakeholders and Awareness	<ul style="list-style-type: none"> • Foster engagement and collaboration across a wide range of stakeholders from the public, private sectors as well as civil society to raise awareness on the importance of clean cooking, assess their cooking context and needs, mobilise funding and enhance multi-sectoral and multi-tier partnerships for increased delivery of clean cooking initiatives. 	<ul style="list-style-type: none"> • Establish a clean cooking working group (made up of representatives from relevant departments) at the national and local government level to spearhead implementation of clean cooking initiatives. • Engagement with the community to ascertain cooking patterns, behaviours and perceptions of switching to clean cooking alternatives. • Facilitate awareness and community demonstrations of clean cooking and the benefits thereof. 	<ul style="list-style-type: none"> • Partner with clean cooking service providers to accelerate awareness raising efforts. • Establish a multi-sectoral and multi-tier clean cooking working group.

	Enabler Actions	Required Actions	Multiplier Actions
Governance	<ul style="list-style-type: none"> Establish regulations and standards for clean cooking technologies to ensure their safety, efficiency, and affordability. 	<ul style="list-style-type: none"> Create working groups to coordinate initiatives and align with targets and goals. Set emission standards for all stove types and fuels mandating the use of cleaner cooking technologies. Regulate the production and distribution of clean cooking fuels. Devolve mandate of planning and implementing energy, especially clean cooking projects, to local governments 	<ul style="list-style-type: none"> Ensure that each department at the local government mainstreams clean cooking considerations into sectoral plans and allocate budget to implement these.
Capacity Building	<ul style="list-style-type: none"> Train and sensitise various stakeholder groups with the necessary tools, expertise, and support to effectively promote, adopt, and sustain the use of clean cooking solutions. Overall, capacity building is essential for building a sustainable ecosystem around clean cooking, enabling stakeholders at all levels to contribute effectively to the transition towards cleaner and healthier cooking practices. 	<ul style="list-style-type: none"> Facilitate awareness and community demonstrations of clean cooking and the benefits thereof. Inclusion of user-friendly manuals in awareness/sales campaigns and training. Conduct training programs to educate community members about the benefits of clean cooking, as well as how to properly use and maintain clean cookstoves and fuels. Provide technical capacity building to enhance the skills and expertise of technicians, engineers, and local artisans involved in the installation, repair, and maintenance of clean cooking technologies. Provide capacity building on policy and advocacy so as to equip stakeholders with the knowledge and skills needed to advocate for supportive policies and regulations that promote the uptake of clean cooking. 	<ul style="list-style-type: none"> Partner with clean cooking service providers to accelerate awareness-raising efforts. Identify key stakeholders from the different departments at the local government and provide them with comprehensive training on clean cooking so that they can in turn provide training in their respective departments on an ongoing basis. Provide entrepreneurial capacity building to individuals or businesses involved in the production, distribution, or sale of clean cooking technologies or fuels. Topics for training could include business training, access to finance, market linkages, and technical assistance to help entrepreneurs establish and scale up their clean cooking ventures. Consider developing official/certified training programs for technicians/service providers to ensure high safety standards and trust.

	Enabler Actions	Required Actions	Multiplier Actions
Technical	<ul style="list-style-type: none"> • Develop hybrid clean cooking systems that can switch between different energy sources based on availability and cost, providing flexibility and reliability to users. • Develop infrastructure for the production, distribution, and storage of clean cooking fuels, such as biogas, ethanol, briquettes, or liquefied petroleum gas (LPG). • Expand access to electricity in rural areas to enable the use of electric cooking appliances powered by renewable energy sources. • Leverage digital technologies, such as mobile applications and IoT (Internet of Things) devices, to monitor and optimise clean cooking systems. 	<p>Equipment and facilities (or “hardware”):</p> <ul style="list-style-type: none"> • Coordinate with distributors of clean cooking technologies for the establishment/ expansion and planning of appropriate distribution networks. • Explore opportunities to integrate clean cooking technologies with other renewable energy solutions, such as solar power or biogas digesters, to enhance energy access and resilience. • Coordinate with network operators for the establishment/ expansion and planning of the grid to provide electrification to the areas that require it. • Promote the use of clean cooking products that adhere to safety and quality standards. <ul style="list-style-type: none"> ◦ Include minimum technical standards, warranties for equipment, energy performance, etc. • Promote equipment testing and proper labelling. • Invest in R&D to develop innovative clean cooking technologies that are affordable, efficient, and tailored to the needs of different communities. • Establish distribution networks or points of sale in strategic locations to make clean cooking technologies easily accessible to residents, especially in rural or underserved areas. 	<ul style="list-style-type: none"> • Develop smart cookstoves equipped with sensors and connectivity features that enable remote monitoring, maintenance alerts, and data collection for performance evaluation. • Explore opportunities for local production and assembly of clean cookstoves to create employment opportunities and support economic development. • Implement pilot projects and demonstrations to showcase the performance and benefits of clean cooking technologies in real-world settings. • Partner with clean cooking technology manufacturers and distributors to ensure the availability and accessibility of clean cookstoves and fuels within the community.

	Enabler Actions	Required Actions	Multiplier Actions
Finance	<ul style="list-style-type: none"> Promote and facilitate financing opportunities for citizens who cannot afford to switch to clean cooking technologies on their own. Promote and facilitate financing opportunities for local clean cookstove manufacturers or start-ups. Develop incentives schemes or partial subsidies for Pay as You Go (PAYG) customers. Collect data on the number of households reached, the amount of funding disbursed, and the outcomes achieved to assess the cost-effectiveness and sustainability of clean cooking finance programs. Mobilise community members, local businesses, and other stakeholders to contribute financially to clean cooking projects through donations, memberships, or equity investments. Provide training and capacity-building support to local financial institutions to enhance their understanding of clean cooking technologies and their potential as viable investment opportunities. 	<ul style="list-style-type: none"> Provide sustainable and context appropriate subsidies to the poorest in the community, to facilitate an inclusive transition. Partner with development and community-based organisations to leverage support for the roll-out of clean cooking solutions. Offer rebates or tax credits to offset the upfront costs of investing in clean cooking solutions, making them more affordable for residents. Establish microfinance programs in collaboration with local financial institutions to offer small loans or credit facilities specifically for the acquisition and use of clean cooking technologies. Provide low-interest loans or revolving funds to support the adoption of clean cooking technologies, particularly for low-income households or small businesses. Seek funding from national governments, international organisations, donor agencies, and philanthropic foundations to support clean cooking initiatives. 	<ul style="list-style-type: none"> Pursue strategic partnerships to facilitate funding opportunities (for example with donor funding agencies, clean cooking service providers, etc., micro-financing facilities, etc.). Remove indirect subsidies for kerosene and diesel and the addition of VAT/duty fees (if applicable) on imported clean cooking products. Partner with private sector entities, including clean cooking technology manufacturers, distributors, and financial institutions, to develop innovative financing mechanisms for clean cooking. Explore opportunities for revenue-sharing arrangements or joint investment schemes to leverage private sector resources and expertise. Implement performance-based financing mechanisms that reward successful outcomes in clean cooking adoption, such as reduced fuel consumption, improved air quality, or increased use of clean cookstoves. Tie funding disbursements to predefined targets and milestones to incentivize stakeholders to achieve measurable results.

3. WORKFLOW /PROCESS PHASES

3.1 ASSESSMENT

- Creation of an internal clean cooking task team or working group that coordinates the clean cooking initiatives and policy alignment that is required.
- Baseline assessments of the status quo of access to clean cooking in the city to understand cooking preferences and the willingness of citizens to transition to clean cooking.
 - Households surveys to monitor usage and verify benefits of clean cooking.
 - Focus group discussions with various stakeholder groups, from both supply side and demand side of clean cooking.
 - Identify areas with the highest need for intervention based on factors such as air pollution levels, energy poverty, and health impacts.
 - Review existing policies on clean cooking at national and local level (if any) or the incorporation of clean cooking into various sector development plans.

3.2 PLANNING

- Mobilise different stakeholder groups and conduct workshops to develop a clean cooking vision for the city, set targets and identify actions that can be implemented to improve clean cooking access.
- Develop an action plan or roadmap for improvement of clean cooking access in the city, primarily to create accountability and identify synergies with other plans.
- Formulate policies and regulations that promote the adoption of clean cooking technologies and fuels, informed by the findings of the baseline assessment.
- Mobilise support from stakeholders and communities to proceed with the implementation of clean cooking solutions.

3.3 IMPLEMENTATION

- Establish standards for clean cookstoves, emissions limits, and incentives to drive the transition to clean cooking.
- Consider developing certification and/or training programs for technicians and installers that may be needed to develop infrastructure, service cookstoves, etc.
- Mobilise resources (including financial) from a variety of sources to implement actions in the clean cooking action plan developed.
- Implement demonstration projects to showcase the benefits and impacts of clean cooking interventions.
- Partner with the private sector for implementation of large-scale clean cooking projects.
- Launch public awareness campaigns to educate residents about the benefits of clean cooking and the risks associated with the alternative.
- Promote and facilitate financing opportunities for low income users and support local clean cookstove manufacturers/start-ups.
- Enforce clean cooking policies and regulations, particularly for institutional users.

- Contribute to industry best practice guidelines and technical documents of clean cookstoves for all city-owned facilities.
- Forge partnerships with government agencies, NGOs, private sector entities, and community-based organisations to leverage resources and expertise.
- Engage with international organisations and donor agencies to access funding, technical assistance, and knowledge sharing opportunities.

3.4 MONITORING

- Establish monitoring and evaluation mechanisms to track the progress and impact of clean cooking interventions.
- Collect, evaluate and report data on adoption rates, usage patterns, and health and environmental outcomes to inform programmatic adjustments and ensure accountability to the community and overall implementation targets.

4. REALITY-CHECK

This solution is applicable when:

- The local government wants to promote and deploy clean cooking through the use of improved and efficient cookstoves.
- Governments want to improve the livelihoods of people and communities, especially of women and children.

4.1 REQUIRED PRE-CONDITIONS

- Willingness of the community to use clean and modern energy cooking services.
- Clean cooking is seen and communicated as a cross-cutting priority for the city.
- Strategy developed for the city that outlines clean cooking access vision, targets and actions.

4.2 SUCCESS FACTORS

- Engaged communities who are able to voice their opinions and concerns which form the basis for strategies for a clean cooking transition.
- Understanding the rationale for why a household might want to make the switch (e.g. saving time, money, improvement of health, etc.) and marketing/communicating benefits accordingly.
- Understanding that the switch to clean cookstoves is a form of behavioural change [1], and will take time for people to make the switch.
- Access to helpful user manuals, capacity building and after-sales support.
- Enabling policies and strong political will.

4.3 FOLLOW-UP NEEDED/RECOMMENDED

- Monitoring and evaluation.
- Collect data on adoption rates, usage patterns, and health and environmental outcomes to inform programmatic adjustments and ensure accountability to set targets and the community.

4.4 BARRIERS

- Limited access to locally produced or affordable clean alternatives.
- Poor reliability of clean fuel delivery and availability (e.g. inadequate feedstock for biogas stoves, scarcity of LPG).
- Financial liquidity constraints for some citizens who may not be able to afford clean cookstoves and fuels.
- Lack of knowledge about the availability of alternate clean cooking technologies and its benefits.

4.5 RISKS

Slow uptake or inconsistent usage of clean cooking technologies due to:

- Difficulties in changing mindsets and perceptions about using certain technologies that may be seen as dangerous (e.g. LPG). To mitigate this, there is need for continuous tailor-made awareness creation and sensitisation at scale. Pilot/demonstrations can also help support this by providing visual/real-world proof.
- As some food may taste different when cooked on an open flame [8], some residents may not want to switch to an alternate way of cooking. To mitigate this, the local government and its service providers can highlight the multiple health and economic benefits of switching to clean cooking.
- Persistent dirty fuel stacking, which might compromise the benefits of switching to clean cooking [8]. To mitigate this, encourage users to gradually switch to complete reliance on clean cooking alternatives as the primary fuel for cooking.
- Difficulties with troubleshooting and maintenance for certain cookstoves such as biogas stoves. This can be mitigated by the government developing standards around various stove types and enforcing these regulations.
- Low availability of supply of accessories and replaceable parts. The local government can address this by investing or supporting the private sector to improve the production and distribution of the clean cookstoves and fuels.
- Proliferation of unstandardized improved cookstoves in the market, which might be sold at cheaper prices. The government can mitigate this by putting in place relevant standards and ensuring the enforcement of such standards.

5. CLIMATE CHANGE MITIGATION POTENTIAL

This solution is able to offer a clean and more affordable cooking alternative for households and businesses that depend on polluting and inefficient fuels like kerosene, charcoal or fuel wood for cooking. Charcoal and fuelwood produce black carbon which has a warming potential 460–1500 times higher than carbon dioxide.

Furthermore, the reduced use of wood for cooking will assist with ensuring a more sustainable wood supply and protect forests and the environment. It will further mitigate greenhouse gas emissions and stimulate the green economy.

6. FURTHER SCIENTIFIC AND TECHNOLOGICAL INSIGHTS

An overview of various clean cookstoves and fuels:

CLEAN COOKSTOVES

- **Improved Cookstoves (ICS):** Improved cookstoves are designed to burn fuel more efficiently, reducing fuel consumption and emissions compared to traditional open fires or rudimentary stoves. They typically feature insulation, combustion chambers, and airflow systems to optimize combustion and heat transfer, resulting in cleaner and more efficient cooking.
- **Ventilated Improved Cookstoves (VICS):** Ventilated improved cookstoves are a type of improved cookstove that includes a chimney or vent to direct smoke outside the cooking area, thereby reducing indoor air pollution. VICS are designed to provide better ventilation and smoke dispersion while still maintaining fuel efficiency and cooking performance.
- **Biogas Stoves:** Biogas stoves are designed to burn biogas, a renewable fuel produced through the anaerobic digestion of organic waste materials such as animal manure, agricultural residues, or food waste. These stoves are connected to a biogas digester system, which captures and processes organic waste to produce biogas for cooking, providing a clean and sustainable cooking solution.
- **Electric Induction Cooktops:** Electric induction cooktops use electromagnetic induction to heat pots and pans directly, offering a clean and efficient cooking method without combustion or emissions. These cooktops require electricity to operate and are suitable for areas with reliable electricity supply from the grid or renewable energy sources.

CLEAN COOKING FUELS

- **Liquefied Petroleum Gas (LPG):** LPG is a clean-burning fossil fuel composed primarily of propane and butane, typically stored in pressurized cylinders for use in cooking. LPG produces minimal smoke and emissions compared to solid fuels, making it a cleaner and more convenient cooking fuel option for households, especially in urban areas.
- **Biogas:** Biogas is a renewable fuel produced through the anaerobic digestion of organic waste materials, such as animal manure, agricultural residues, or food waste. Biogas can be used directly for cooking in biogas stoves or converted into electricity for cooking appliances, offering a clean and sustainable alternative to traditional biomass fuels.
- **Ethanol:** Ethanol is a clean-burning alcohol fuel derived from renewable biomass sources, such as sugarcane, corn, or cassava. Ethanol can be used as a cooking fuel in specially designed ethanol stoves or as a blend with other liquid fuels such as kerosene.
- **Electricity:** Electricity is a clean and versatile energy source for cooking when generated from renewable sources such as solar, wind, or hydroelectric power. Electric cooking appliances, such as induction cooktops or electric ovens, offer efficient and emissions-free cooking options for households with access to reliable electricity.

7. NATIONAL – SUBNATIONAL INTEGRATION IN THE CONTEXT OF THIS SOLUTION

7.1 BENEFITS TO LOCAL GOVERNMENT

- Opportunities for wide-scale roll-out of clean cooking and contributions towards the achievement of universal energy access.
- Visibility and recognition of local initiatives and success, as well as contributions to national targets and future climate planning considerations.
- Stronger partnerships to access funding for further implementation.

7.2 BENEFITS TO OTHER LEVELS OF GOVERNMENT

- Peer learning and sharing of experiences, lessons learnt, challenges and success factors for collaboration with other local governments.
- Leveraging local initiatives towards the contribution of national targets and goals.
- Opportunities to attract investment into the country.
- Contributions to national targets.

8. RESOURCES/SUPPORT

8.1 CASE STUDIES

CARBON FINANCING FOR CLEAN COOKING AND PROTECTING IMPORTANT FOREST HABITATS, RWANDA

[1] *Clean cooking Alliance, Accelerating clean cooking as a nature-based climate solution, 2022*

Most Rwandans still use traditional means of cooking which contributes to negative health and environmental impacts. Referred to as the Tubeho Neza (Live Well) project, Del Agua together with the government of Rwanda, clean cooking companies, conservationists and healthcare workers are working together to protect forests and support the roll-out of clean cooking initiatives. As of 2012, the project has supported the provision of a million free, efficient and safe stoves to citizens who cannot afford them on their own. This was made possible through carbon financing (i.e. the sale of carbon credits) which covers the cost of the stoves, capacity building programmes and post-distribution support to families.

Healthcare providers worked closely with local communities to distribute stoves, educate them on how to use it, and monitor usage of the stoves, which ensured 99% daily usage rate two years after receiving it. This project is estimated to benefit 2.3–2.6 million Rwandans, mostly those who live in rural areas on the outskirts of national parks and forest habitats. As a result, this not only supports the avoidance of 8.6 million tons of CO₂e per year, but also contributes to conserving critical habitats such as forests where many species, especially the endangered mountain gorilla depend on for their survival. This is one such example of an integrated nature-based solution which has a number of benefits for people and the planet.

PAY AS YOU COOK, TANZANIA

ICLEI Africa, Benchmarking energy access, 2021

LPG is an expensive option for many Tanzanians to cook with. This typically costs between \$60–100 to buy a gas stove, cylinder and accessories, which is approximately 20–30 days of income for a typical household. In addition, the cost to refill a full gas cylinder is the equivalent of 7–15 days of additional income. The usage of LPG for cooking is largely untapped with only around 5% of households using it consistently. For customers that cannot afford the upfront costs, KopaGas and Oryx Energies partnered to come up with a solution that allows households access to clean cooking from \$0.45 a day.

Funded by the Innovation Fund grant awarded by the UK government, the KopaGas project was piloted in 2015 to support low income households with making the switch from charcoal to LPG for cooking. The project makes use of smart meters and a pay as you go, or pay as you cook (PAYC) model using mobile money for payments. The PAYC model is more affordable, making LPG 30% cheaper than other cooking fuels. One of the key successes of the project was to undertake demonstrations and understanding that the target market are primarily women which informed the use of gender specific marketing strategies. Based on the pilot, many customers reported that their quality of life had improved, that they valued the time savings from cooking with gas compared to wood or charcoal, and that they were saving an average \$2.92 a week. Due to the success of the pilot, KopaGas hopes to extend the reach to other households and support the transition to clean and modern cooking.



Source: Del Agua, 2022

8.2 REGIONAL-SPECIFIC GUIDANCE AND INFORMATION

Sub-Saharan Africa is a region of particular concern as it is the only region where lack of access to clean cooking is rather increasing, due to a population growth rate outpacing clean cooking adoption rate [9]. It is therefore important to include transitioning fuels (e.g. improved cookstoves, LPG) as stepping stones to full clean fuels and technologies.

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