ENERGISING RESILIENCE

Climate Co-Benefits from Clean Energy Projects

EEP Africa

NDF NORDIC DEVELOPMENT FUND

CONTENTS

ACRONYMS	ACRONYMS
ADA	Austrian Development Agency
CBD	(United Nations) Convention on Biological Diversity
tCO_2e	Tonnes carbon dioxide equivalent
EEP Africa	Energy and Environment Partnership Trust Fund
ESG	Environmental, Social and Governance (standards)
GHG	Greenhouse gas
Mini-grid	Small-scale electricity generation up to 10MW via a distribution grid
NAP	National Adaptation Plan
NDC	Nationally Determined Contributions
NDF	Nordic Development Fund
ODA	Official development assistance
PAYG	Pay-as-you-go
Pico- or micro-grid	Mini-grids with up to 15kW capacity
PV	(Solar) Photovoltaic
RE	Renewable Energy
SDG	Sustainable Development Goal
SHS	Solar home system
SME	Small and medium-sized enterprises
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	United Nations Framework Convention on Climate Change

KEY DEFINITIONS

Definitions from the International Panel on Climate Change:

Adaptation

The process of adjustment to actual or expected climate change and its effects. Adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. Adaptation actions can be incremental (actions where the central aim is to maintain the essence and integrity of a system or process) or transformational (actions that change the fundamental attributes of a system in response to the climate and its effects).

Co-benefits

Positive benefits related to the reduction of greenhouse gases. Examples include improved energy efficiency, renewable energy uptake and fuel switching projects which might enable a range of co-benefits such as air-pollution impacts, technological innovation, energy-supply security through increased energy diversity, reduced fuel cost and employment possibilities.

Mitigation

A human intervention to reduce the sources or enhance the sinks of greenhouse gases.

Resilience

The capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation.

ACKNOWLEDGEMENTS

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EXECUTIVE SUMMARY

Access to clean energy is widely recognized as one of the pre-conditions for sustainable and inclusive growth. However, a more holistic understanding of the impact of clean energy development on efforts to address climate change is needed. In light of the global disruptions in 2020, this is a vital part of ensuring that the world builds back better and greener.

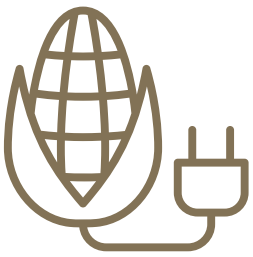
Enhancing access to clean energy is generally approached through the lens of climate change mitigation. It is well-documented that clean energy projects produce a range of climate mitigation and development benefits, including improved health.

The potential for clean energy to also support climate adaptation and resilience is robust and, in some cases, stronger than the impact on mitigation. Yet, these linkages are rarely examined systematically. This report explores the climate adaptation and resilience co-benefits achieved through early-stage clean energy projects financed by EEP Africa.

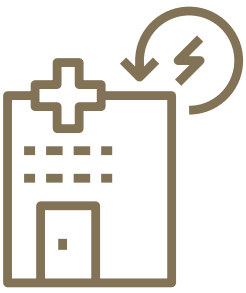
The portfolio analysis conducted for this report found numerous examples of climate adaptation and resilience co-benefits at the community and household levels, which in turn support broader national planning efforts.

Efforts to take a more holistic approach can help stakeholders better understand the linkages and potential synergies between different types of climate funding, and the central role of clean energy. It should be noted though that financing for clean energy contributes to, but does not replace the need for, climate adaptation and resilience financing.

THE ADAPTATION AND RESILIENCE AREAS PARTICULARLY WELL REPRESENTED IN CLEAN ENERGY PROJECTS ARE:



Promoting agricultural resilience and strengthening local value chains through clean energy for irrigation, cold chain, agricultural processing and food preservation.



Building local self-reliance and resilient infrastructure through clean energy for municipalities, communities, households, local production and transportation.

The core conclusions from this analysis are:

Investing in off-grid clean energy is likely to provide adaptation and resilience co-benefits. Off-grid solar home systems (SHS), mini-grids and powering productive uses are the most likely to support multiple climate adaptation and resilience themes. Initial small-scale risk-taking, through clean energy innovation, business model testing, and demonstration projects, is vital for assessing long-term viability.

Developers and funders can maximise climate synergies by assessing the supply chain and local context. It is important to consider the full context of a project, including the long-term supply chain viability and local community needs, to identify potential synergies. This is also critical for reducing the risk of maladaptation by creating a solution at one level that simply shifts the problem elsewhere or locks in suboptimal infrastructure improvements.

Clean energy solutions can support national climate adaptation and resilience efforts. Climate adaptation and resilience co-benefits achieved at individual and community levels supplement planning at national and regional levels. In addition, scaling-up proven clean energy concepts can help deliver the magnitude of impact needed at the national level.

These conclusions highlight the importance of recognizing synergies between mitigation and adaptation in order to fully realize the true value of efforts in both areas and use funds more efficiently.

As climate needs far outstrip the funding available, resources must be leveraged to achieve multi-faceted projects that promote long-term environmental, social, and economic sustainability.

RECOMMENDATIONS TO BETTER INTEGRATE CLEAN ENERGY AND CLIMATE EFFORTS:

- Financiers should take a more integrated and holistic approach to climate funding.
- Financiers should enhance monitoring and evaluation strategies to demonstrate the value of clean energy development.
- Developers should seek to climate-proof clean energy concepts and business models.
- All clean energy stakeholders should share co-benefit success stories and challenges.

ABOUT EEP AFRICA

The Energy and Environment Partnership Trust Fund (EEP Africa) provides early-stage financing for innovative clean energy projects, technologies and business models in Southern and East Africa. The objective is to enhance clean energy access, development and investment, with a particular focus on benefitting vulnerable and underserved groups.

EEP Africa provides developers with investment facilitation and business development support through Investor Forums and targeted actions. It also facilitates knowledge exchange and learning through publications and Knowledge Exchange Forums that offer a platform to network and discuss trends, experiences and lessons learned.

Since 2010, EEP Africa has invested close to EUR 50 million in 250 pioneering projects. As they provide early-stage financing before many other funders are willing to commit, many successful projects go on to either become self-sustaining or receive new funding from other sources less willing to absorb risk.

The 45 projects in the active portfolio reflect a diversity of business models, technologies and social impact profiles. Solar PV (49%), cleaner cookstoves (13%) and hydropower (10%) are the most common. The majority of active projects are off-grid systems (82%). Over one-third of the projects have been initiated by women-led companies and over half are start-up companies.

The overall goal of EEP Africa is to contribute to sustainable and inclusive green growth, as well as to achievement of the Paris Climate Agreement and the Sustainable Development Goals (SDGs).

The primary focus is on five SDG goals: No Poverty (SDG 1); Gender Equality (SDG 5); Affordable and Clean Energy (SDG 7); Decent Work and Economic Growth (SDG 8); and Climate Action (SDG 13). In addition, many projects are designed to also contribute to Zero Hunger (SDG 2), Good Health and Well-being (SDG 3), Quality Education (SDG 4) and Life on Land (SDG 15).

EEP AFRICA'S CROSS-CUTTING INDICATORS

€80M Mobilised climate finance

5 million People with enhanced energy access

45% Women in leadership

8,750 Direct jobs created 40% for Youth & 37% for Women

Savings on energy-related expenditure **€94M**

1.5M tonnes CO_2e emissions reduced or avoided

Doing business during the COVID-19 pandemic

This analysis was conducted in the midst of the global COVID-19 pandemic, which had a significant impact on project developers and highlighted both vulnerabilities and opportunities. The push to build more resilient societies will only increase in relevance in a post-pandemic world.

An EEP Africa survey conducted in April-May 2020 found that an overwhelming majority of companies were experiencing moderate to severe negative impacts due to the COVID-19 crisis. Many had to close operations temporarily and 70% reported insufficient liquidity to sustain the business if the downturn lasted more than six months.

The most common types of impact reported were:

- International and/or regional staff unable to travel to the country or project sites
- Delays in procurement and supply chains
- Financial constraints due to customers being unable to pay and investors cancelling or withholding funds

Yet positive stories also emerged of creative ways in which companies are coping and adapting. Such changes will further strengthen their long-term business models and increase demand as targeted customers recognize the full value of energy services offered in light of the pandemic.

Companies have made a variety of creative financial, operational safety and service adjustments to cope. For example, one developer reported they are "building up capacity for virtual marketing, as well as bringing forward plans for a PAYG platform to enable extended payment terms for their customers."

The most frequently mentioned adjustments to client services that may become permanent are:

- Providing new or additional services to the community
- Offering clients more flexible payment schemes

For more information about the impact of COVID-19, see the EEP Africa **2020 Market Report**.

INTRODUCTION

EEP Africa provides early-stage financing to companies piloting or scaling-up innovative clean energy technologies and business models in Africa.

The broad range of project types includes:

- On-grid power generation using solar PV, concentrated solar power, hydropower, biogas, ocean and wind
- Off-grid solar home systems (SHS), micro- and mini-grids using solar, wind, hydro and biogas
- Direct power for productive uses (commercial and retail, light manufacturing, agriculture and fishing) using liquid biofuels, biogas, solar PV, solar thermal, waste-to-energy and wind
- Energy efficiency from retrofits, smart meters and wastewater treatment efficiency
- Transportation fuel switching to biofuel and solar-powered batteries
- Cleaner cooking through improved fuel options (biomass or biofuel) and improved cookstoves

These projects produce a range of advancements in energy access, climate change mitigation and socio-economic development, such as creating skilled jobs, improving health outcomes and increasing gender equity. The impact of these projects on climate mitigation, primarily via greenhouse gas (GHG) emission reductions, are well monitored and documented. Many projects also support climate adaptation and building resilient societies, but these are not as well known or tracked and are increasing in need and relevance.

This report represents the first systematic portfolio analysis exploring climate adaptation and resilience co-benefits from early-stage clean energy projects. The analysis focuses on project outcomes that contribute to community and household-level adaptation and resilience to climate change impacts. The identified outcomes include supporting agricultural resilience and sustainable farming, strengthening value chains, reducing pressure on forests, and promoting local self-reliance.

The overall goal of EEP Africa is to contribute to achievement of the Paris Climate Agreement and Sustainable Development Goals (SDGs). Many projects in the portfolio also contribute to Nationally Determined Contributions (NDCs), National Adaptation Plans (NAPs), the United Nations Convention to Combat Desertification (UNCCD), and the United Nations Convention on Biological Diversity (CBD).

Climate funding streams are currently separate, with a heavy emphasis on mitigation, and overall climate funding committed to date is insufficient to address identified needs. In 2019, approximately 5% of tracked financial flows went to adaptation, while 93% went to mitigation. Only 2.1% of climate funding addresses both mitigation and adaptation.[1]

This report promotes an evolution away from categorising clean energy and climate mitigation as completely distinct from adaptation and resilience planning. It aims to help funders, impact investors, developers and policymakers better understand the linkages and potential synergies between different types of climate projects and the central role played by clean energy. This will hopefully lead towards more integrated and holistic decision-making regarding climate finance.

The focus of this report was selected before the global COVID-19 pandemic emerged. Yet this unexpected context further illustrates how clean energy projects are supporting community resilience in a variety of ways.

"NDF's newly approved strategy has an increased focus on adaptation. Supporting resilient societies is key for better preparedness to cope with crises, including disasters triggered by natural hazards as well as epidemics and pandemics. Promoting long-term climate and disaster resilience will be vital for sustainable economic recovery after the pandemic." - Karin Isaksson, Managing Director, Nordic Development Fund (NDF), May 2020

Pawame is increasing access to productive use equipment and mobile data, creating a pathway from subsistence agriculture to smallholder farming.

CLEAN ENERGY CO-BENEFITS

CLIMATE CONTEXT

Africa is particularly vulnerable to the effects of climate change. Temperatures are projected to rise faster than the global average during the 21st century. Predicted changes to rainfall regimes indicate that southern Africa will become drier, and eastern and western Africa will become wetter, with more intense rain and increased risk of floods.[2]

Did you know?

The Horn of Africa has been hit by the worst invasion of desert locusts in 25 years, according to the United Nations Food and Agriculture Organization (FAO). The invasion poses an unprecedented threat to food security in the entire sub-region. Irregular weather in 2019, including heavy rains linked to climate change, are suspected to have contributed to the spread.

As a result of climate change, land degradation and losses in biodiversity have become a pressing problem. The degradation of ecosystem services[3] undermines:

- Food security and nutrition
- Water quality and availability
- Human health
- Social and economic development

The effects of climate change interact with existing stressors that are major drivers of vulnerability and poverty, including inefficient bureaucracies, lack of infrastructure, and monopolistic economies. Healthy systems that can withstand disruptions, shocks and stressors are critical in achieving not only environmental benefits but also to serve as a foundation for economic and human development.

Climate adaptation and resilience are vital for vulnerable countries that depend on climate-sensitive natural resources and traditional agricultural practices for subsistence and livelihoods.[4]

While mitigation efforts aim to reduce the severity and frequency of climate change hazards, climate adaptive actions adjust to a changing environment. Adaptative efforts develop in response to climatic stimuli, such as higher average temperatures, changes in precipitation patterns causing more frequent floods and droughts, increased fire and storm intensity, as well as sea level rise.

Climate adaptation seeks to address the effects of these climate stressors, such as desertification, increased crop vulnerability, erosion, salination of soil and fresh water sources and land degradation. As effects are highly localized, climate adaptation strategies must be tailored to the specific context.

Project highlight:
Floating PV for island nations

Swimsol's innovative SolarSea technology will demonstrate the large offshore solar power plant potential in the Seychelles. Part of the project's revenue will be transferred to a fund to finance local social and economic development. This island nation is highly vulnerable to the rise in sea levels, which threatens all their major infrastructure and limits the land area available for solar and wind. Offshore technology offers an attractive solution to provide access to clean energy while taking long-term viability and resilience planning into account.

The importance of gender equity in climate finance

Girls and women are especially vulnerable to bearing the brunt of climate change impact, particularly in terms of managing the household response and missing out on scarce resources. Even climate initiatives that aim to address inequalities can miss the mark if they inadvertently rely on earlier intervention models that simply add more to women's responsibilities.

Policy makers and financiers must understand and explicitly target the underlying drivers of inequity, including gender dynamics such as who within the household will have first access to scarce food. A gender-differentiated approach is necessary to ensure projects that proactively empower women, such as increasing women's access to productive agricultural resources or reducing their time spent on household chores.

EEP Africa has a goal of over 40% women-led projects within its portfolio and asks all developers to document gender impacts, such as disaggregating job creation. Examples of how projects empower women can be found throughout this report. For more in-depth analysis, see ***Understanding the Role of Women in Renewable and Energy Efficiency Projects*** (EEP Africa 2017).

Project highlight:
Responsible hydro serving the local community

East African Power (EAP) develops mini-hydropower plants together with SME business parks as the anchor client to promote local economic development. As part of their mission, EAP proactively seeks to minimize negative environmental impact and protect local watersheds by planting trees and using good geo-tech and slope stability measures. EAP also shows strong commitment to its downstream communities. After devastating floods and landslides near its Rubagabaga hydropower site in Rwanda, EAP launched an economic relief fund that raised over USD 10,000 and worked with families in Shyira to rebuild their homes and repair roads and schools.

Climate resilience emphasizes increasing flexibility, resourcefulness and capacity to cope with local climate stressors in order to bounce back after an adverse event. It also includes the ability to learn, acquire new capabilities, and transform.

There are substantial synergies with adaptation as effective resilience strategies also need to consider evolving contexts and climate stressors. For example, hydropower projects can aid in local watershed protection. Effective climate resilience strategies need to be specific to local contexts as well.

Clean energy projects that recognize and respond to the climate context can create valuable co-benefits.

LINKAGES TO CO-BENEFITS

Clean energy development is an important component of long-term planning for climate change. When assessing the linkages between clean energy and climate adaptation and resilience, there are four distinct levels to consider:

- The *potential* for co-benefits
- The *likelihood* of co-benefits
- The *actual or demonstrated* co-benefits
- The *magnitude* of co-benefits

Based on original analysis for this report, Table 1 indicates different types of clean energy projects and the adaptation and resilience themes each type has the potential to support. It can be seen that all categories of clean energy projects have the potential to support at least one adaptation theme and the potential to support all resilience themes.

Another way to look at the interlinkages is to start with common adaptation and resilience themes and then identify examples of clean energy projects that positively contribute to them (Table 2). This is an important perspective for climate adaptation and resilience planning and policy.

However, it is also important to note that a few project types include the risk of hindering adaptation or resilience if not planned well or when trade-offs are necessary.

Table 1. Linkages from clean energy projects to adaptation and resilience themes

Clean energy projects	Adaptation themes	Resilience themes
On-grid renewable energy (RE)	Infrastructure protection, building design Business continuity planning	Durable/flexible infrastructure and systems Continuous access to essential services Increasing resources to poor/vulnerable Safety/emergency preparedness planning
Off-grid SHS, micro- or mini-grids	Land use changes, relocation Infrastructure protection, building design Business continuity planning Emergency response	
Direct power for productive uses	Land use changes, relocation Business continuity planning	
Energy efficiency	Infrastructure protection, building design	
Transportation fuel switching	Business continuity planning Emergency response	
Cleaner cooking	Afforestation, open space preservation Land use changes, relocation Flood mitigation	

Source: Original analysis conducted for this report

Table 2. Linkages from adaptation and resilience themes to clean energy projects

Theme	Sample roles of clean energy projects
Adaptation	
Infrastructure protection, building design	Energy efficiency and access to reliable clean power that contribute to infrastructure protection and continuity of service and/or building design solutions for wastewater treatment, transportation, or communications.
Continuity of service/business planning	
Land use changes, relocation	Mini-grids, cleaner cooking and productive uses that support supporting agricultural value chains may support more sustainable land use. There is also potential for negative impacts, such as impacting local habitat, reducing the water table, or limiting the land available for uses of higher priority to the local community, e.g. food production or housing.
	There is less potential for clean energy projects to address relocation directly, with the exception of some types of hydropower. But here also there is potential for negative impacts, such as reducing the water table or the land available for uses of higher priority to the local community.
Emergency Response	Projects that facilitate access to reliable clean power (or water) temporarily or permanently covering emergencies are vital. See also infrastructure protection and continuity planning.
Flood mitigation	Water pumping and flow management projects have moderate potential to support this. Reducing pressure on forests through firewood/charcoal replacement can also help mitigate floods.
Afforestation, open space preservation	Some cleaner cooking solutions can reduce pressure on forests, but the impact is limited and indirect.
Migration	Projects that increase local self-reliance and economic activity could reduce drivers for migration and/or increase household resilience when necessary.
Resilience	
Building infrastructure and systems that are sustainable, durable and flexible to address local climate risks	On-grid RE, mini-grids, energy efficiency, and transportation fuel switching have high potential to support these themes.
Ensuring continuous access to essential services: energy, food, water, shelter, healthcare, transportation and communications	On-grid RE, mini-grids, energy efficiency, and transportation fuel switching have high potential to support these themes.
Increasing resources available to poor and vulnerable populations	Mini-grid, productive use, energy efficiency, and cleaner cooking projects, if appropriately targeted to reach the poorest/most vulnerable, play an important role.
Facilitating community safety through emergency preparedness planning	Projects that provide rapidly deployable, isolatable and/or reliable power, e.g. portable power, mini-grids, transportation fuel switching and some types of cleaner cooking, can support this.

Source: Original analysis conducted for this report

LIKELIHOOD OF CO-BENEFITS

While the wide potential for co-benefits is clear, the likelihood of clean energy projects producing noticeable support for climate adaptation and resilience themes is not guaranteed.

Our analysis found that clean energy projects are more likely to actively promote climate adaptation and resilience co-benefits when they directly contribute to one or more of the following:

- Reliability of infrastructure, transportation and essential services, e.g. healthcare, education, clean water, and wastewater treatment
- Energy security and power system resilience
- Productive use and local supply chains
- Efficient irrigation or water purification
- Organic fertiliser by-products for soil fertility
- Food diversity, quality, processing, preservation
- Job creation and individual or household health and self-reliance
- Water, energy and land conservation

Table 3 indicates how strong the likelihood is that certain types of clean energy projects will produce clear co-benefits for the various adaptation and resilience themes.

Project highlight: Community solar hubs for rural health and livelihoods

VAC Solar is installing solar PV hubs at rural health clinics in poor communities and refugee settlements in Uganda. The energy hubs power e-health diagnostic and treatment devices that would otherwise not be available or would rely on diesel generators. The hubs also offer phone charging and distribute smart batteries with sufficient capacity to power basic appliances and low-voltage machinery. The rental batteries bring energy access to bottom-of-the-pyramid housheholds and micro-entrepreneurs, particularly women.

Table 3. Likelihood of co-benefits by type and theme

Project	Land and water conservation & management	Local value chains & diverse livelihoods	Self-reliance (e.g. food and energy security)	Resilient infrastructure (incl. healthcare)	Disaster planning & response
On-grid RE	Moderate	Moderate	Moderate	Strong	Moderate
Off-grid SHS & mini-grids	Moderate	Strong	Strong	Strong	Moderate
Power for productive uses	Moderate	Strong	Strong	Strong	Moderate
Energy efficiency	Moderate	Moderate	Moderate	Strong	Moderate
Transportation fuel-switching	Moderate	Moderate	Moderate	Moderate	Moderate
Cleaner cooking	Strong	Moderate	Moderate	Moderate	Weak

Source: Original analysis conducted for this report

This clinic in a remote mountain viallge in Rwanda has 24/7 electricity from a solar PV mini-grid installed by Ensol. This clean and reliable power enables modern health services for a local population of 10,000.

Depending on the project, these co-benefits may be experienced at the individual, community or national level (Table 4). Off-grid energy projects typically target the individual and community level, while many climate adaptation funders focus on plans at the national or regional level. Ultimately, efforts at all levels are needed and smaller local projects that test and prove concepts can then be scaled-up more broadly.

Table 4. Co-benefits at the individual, community and national levels

Individual 	Health, education and well-being impacts Poverty reduction, energy affordability and access Increased disposable income, time-savings and productivity
Community 	Natural resources management and conservation Expanded community services, e.g. schools, healthcare Job creation, especially for women, and expanded opportunities Diversifying local economy and strengthening supply chains
National 	Energy security Food security Expanded (green) infrastructure Macroeconomic effects Reduced GHG emissions

Source: Adapted from IISD, 2004.

Energy companies recognise and promote co-benefits

Many clean energy companies in Africa are consciously promoting one or more climate adaptation or resilience benefits.

The top measures cited by companies in the EEP Africa portfolio, in a survey conducted in April-May 2020, were, in order of frequency:

- Protecting and/or replenishing forest resources
- Reducing demand through efficiency measures
- Facilitating irrigation of crops in drought areas
- Building green and resilient infrastructure to withstand climate threats
- Relocating energy supply to lower risk areas
- Disaster planning and emergency reponse to extreme events

During follow-up interviews for this report, some companies reported that COVID-19 has increased demand for clean energy projects that boost food security and opportunities for higher income. Farmers and other customers are actively seeking more self-reliance in light of the current uncertainties and disruptions.

A core theme running throughout this analysis is the need to develop new and sustainable infrastructure in off-grid areas. Such projects are highly likely to increase economic options for households and the community, as well as access to, and reliability of, essential services.

In areas with existing power infrastructure, the themes may be similar but the magnitude of any climate adaptation and resilience co-benefits would be much less.

DEMONSTRATED CO-BENEFITS

The project highlights and case studies throughout this report provide examples of actual co-benefits being achieved through the EEP Africa portfolio specifically.

The magnitude of the benefits will depend heavily on project-specific characteristics, which should be assumed to remain modest in the aggregate. In other words, clean energy projects contribute to, but do not replace the need for, local climate adaptation and resilience project financing.

The following sections highlight actual co-benefits found for two themes that are particularly well-represented in clean energy projects:

- Promoting agricultural resilience and strengthening local value chains
- Building local self-reliance and resilient infrastructure

Jaza Energy provides affordable electricity to bottom-of-the-pyramid customers through solar energy hubs in remote viallges across East Africa.

AGRICULTURAL RESILIENCE

THE ISSUE

Africa's agricultural sector must transform to meet the simultaneous challenges of climate change, food insecurity, poverty and environmental degradation. Smallholder farmers need more reliable and diversified income opportunities, as well as value chains that are resilient at every phase from production to processing to market.[5]

A significant share of total energy inputs is embedded in food losses that occur at the harvest and storage stages. Up to 50% of produce is lost due in significant part to a lack of preservation capabilities. Reduction of food loss and waste can not only lower GHG emissions but can contribute to adaptation through reduction in the land area needed for food production.[6]

Did you know?

Six out of ten Africans rely on agriculture for their livelihoods and about 95% of food grown in Sub-Saharan Africa is rain-fed. Solar water pumps can increase smallholder farmer yields by 2-3 times.

THE NEED

As a country develops, its agricultural sector transitions towards higher levels of mechanisation, as well as increased capacity to process and store food, which increases energy needs.

To meet climate goals, this anticipated increase in total energy used for agriculture should be powered by clean energy and be as efficient as possible. This might entail, for example, improving the options for dry and cold storage at decentralized processing and storage centres.[7]

Access to markets is a huge obstacle for farmers. Food producers need technology solutions to better match supply with demand, assistance in grading of produce, and enhanced access to sustainable transport options, such as e-mobility.

Well-functioning agricultural value chains allow farmers to earn more from their goods. Better organisation empowers farmers to negotiate collectively to gain better prices. Higher incomes provide farmers with funds for household needs, education and healthcare. They can also invest in greater productivity, diversify into other business areas, and expand their emergency fund.[8]

HOW CLEAN ENERGY CONTRIBUTES

Clean energy projects can increase resilience and improve agricultural productivity at every phase by increasing farmers' access to:

- Irrigation for crops
- Water pumping for cleaning, cooking, drinking and other household uses
- Drying equipment and storage for fish, fruit or tea
- Electricity for lighting, egg incubators, and other farm and household uses
- Cold storage for produce and dairy preservation or medicine for livestock
- Waste-to-energy biofuels for farm equipment, transportation, heating, cooking, and organic fertilisers
- Marketplaces for buying, selling and trading food and other agricultural goods

In recent years, EEP Africa has seen that project developers are increasingly applying a whole value-chain approach to agricultural projects and collaborating with a wider variety of partners to maximise climate impacts. This generates higher benefits for all parties as compared to applying a narrow focus on only distributing technology.

Table 5 illustrates where energy is used in the agricultural production and processing chain. Enhanced access to clean energy can help farmers multiply yields and increase incomes, including through improved preservation and new product opportunities. For example, cold storage for milk also increases opportunities to produce and sell other dairy products, like yogurt and cheese.

Table 5. Energy needs at key stages of the agricultural processing chain

Primary production	Post-harvesting & handling	Food processing	Storage & refrigeration	Retail
Irrigation Water pumping Mechanization [Organic fertiliser]	Cleaning Drying/smoking Dry storage Cold storage	Milling Evaporation Distillation Fermentation Canning Packing Pasteurization	Warehouses Distribution centres	Markets Food stalls Restaurants [Veterinary clinics]
Local, regional and international transportation at appropriate temperatures for product				

Source: Adapted from IPCC, 2014.

Celfre Energy is a locally-owned company distributing robust and portable solar water pumps in Zimbabwe. Each unit can pump one litre of water per second.

Project highlight:
Portable surface water pumping for irrigation

Celfre Energy offers farmers in Zimbabwe a solar-powered surface water pump that enables them to irrigate crops throughout the year, as well as support other farm and household water uses. This increases yields and significantly eases the burden of fetching water. There is a large market for pumps to supply water for backyard farming in suburban areas. The unit is portable, easy to use and maintain, and has a USB port for phone charging. A PAYG model is being introduced to further enhance accessibility, particularly for women and youth.

At the primary production stage, solar irrigation and water pumping projects are having a dramatic impact on sustainable productivity. However, water usage projects must be implemented carefully, using efficient techniques such as drip irrigation, to avoid depleting local water resources.

Food dryers using low-temperature thermal sources are applicable to many different items, including fish, fruits, vegetables, herbs, spices and tea. The dried food produced is lightweight, easily stored and transported, and has an extended shelf-life.[9]

Clean energy solutions are also being used at community collection points and processing and distribution centres. This includes energy for processing activities such as smoking fish and milling grain, as well as cold storage facilities.

Project highlight:
Portable solar mills powering rural productivity

Agsol is developing a network of solar mills in rural off-grid areas. They are working with mini-grid developers to install mills that provide access to food processing on a community level. They also have smaller portable mills that provide access for households that fall outside of the mini-grid. Agsol's solar mills incorporate the Internet of Things (IoT) technology and cloud computingm which allows for remote monitoring. Agsol is working to develop new markets through local partners in Kenya, Tanzania, Uganda and Zambia.

By-products from waste-to-energy projects also increase agricultural productivity. This farmer in Kenya gets both energy and organic fertiliser from her biodigester.

Project highlight:
Turning city sewage water into biogas and fertilizer

Doranova is developing a biogas plant in Namibia that will provide green electricity to the national grid. Sewage water will be combined with local plant biomass to reduce waste, generate electricity and produce organic fertiliser, which will be sold to customers. Local substrates, such as impure organic waste, king grass and dried wastewater sludge, are not suitable for traditional biogas power plants. Doranova's patented technology is specifically designed to process challenging substrates, greatly expanding the share of waste that can be utilized.

The best long-term cold chain solutions will provide flexibility to address different chilling and storage requirements by product. Recommended storage temperatures for some fresh fruits and vegetables are between 10-15˚C, while others are near 0˚C. Meat and fish call for freezing, flash cooling and chilling capabilities. Ice requires stable freezing capabilities. Vaccines, medications, and biological samples also have varying recommended cooling temperatures.[10]

For improved land and resources management, municipal and agricultural waste can be used for energy. The resulting biofuels can replace wood for cooking, which reduces pressure on forests, or power machinery and transportation. Some waste-to-energy projects, such as those using sewage or livestock manure, can also produce organic fertiliser.

EEP AFRICA CASE STUDY

SOLAR RAIN MAKERS ENHANCE FOOD SECURITY

SunCulture's solar water pumps and irrigation systems enable farmers to access a steady supply of water, engage in precision irrigation, and store energy to power lights and appliances.

Their systems can pump up to 2,500 litres per hour from wells, rivers, or dams instead of requiring farmers to rely on rain or environmentally harmful pumping systems. This helps ensure the stability of the water supply.

Once installed, solar-powered water pumping requires minimal operating and labour costs, making it less costly and labour-intensive for farmers to grow fresh fruits and vegetables.

SunCulture offers a range of irrigation packages with and without energy storage. Their portable option is called 'Rain Maker'. To facilitate success, SunCulture also provides capacity building in farming practices. Their call centres offer advice and support to help ensure the equipment is used to its best advantage in conjunction with changes to standard practices and behaviours.

SunCulture's systems can also power household energy needs, such as phone charging and lighting. They use localised weather and soil data to generate recommendations for farmers, and can be networked to collect other types of data for collective uses.

In 2015, SunCulture received EEP Africa financing to pilot their project. They have since grown from about 50 to about 300 employees and have expanded to several other countries.

This early financing helped them raise additional equity from angel investors, venture capitalists, strategic investors, and the African Development Bank's Facility for Energy Inclusion Off-Grid Energy Access Fund, which is also supported by NDF.

TARGETED OUTCOME AND IMPACT

During the project, SunCulture sold systems primarily in Kenya but also Uganda, Tanzania, and Zambia. SunCulture's customers report significant time savings per day and older customers also report fewer bodily aches from bending and carrying so much water. A recent impact report conducted by 60 decibels found that 87% of customers report increased confidence in growing healthy crops when using the SunCulture system, and 93% of customers report improvements in their quality of life.

Food insecurity is a huge issue in the regions where SunCulture is active. After briefly suspending their Pay-As-You-Grow programme due to the COVID-19 crisis, SunCulture experienced their strongest sales month ever when the programme was restarted in July 2020. The pandemic has further highlighted that people want solutions that increase their autonomy and food security even when access to money is restricted.

SunCulture reports that their irrigation increases agricultural productivity by increasing crop yields by 2-5 times and dairy outputs by 1.5–2 times. It enables farmers to cultivate more land, harvest higher-value crops, and grow during the dry season. As a result, their customers can often see income increase of 5-10 times.

Just in Kenya, scaling solar irrigation to the total addressable market would feed 2.7 million food-insecure people and add EUR 1.5 billion to GDP.[11]

In 2019, SunCulture calculates that they eliminated 4,000 tCO_2e, added 35,000 tons to annual food production, and added USD 7 million to smallholder GDP. In recoginition of this success, SunCulture was awarded EEP Africa Project of the Year in 2019.

Project developer:
SunCulture

Technology:
Solar (irrigation)

Key synergies:

Key linkages:

Adaptation

- Land use changes
- Business continuity planning

Resilience

- Continuous access to essential services
- Increasing resources to poor/vulnerable

Location:
East Africa (Regional)

One 66-year old woman on a smallholder farm in Kenya no longer has to spend 17 hours a week to make 10+ trips per day to her well to fetch water. With her SunCulture system, she now gets 4,000 litres of water per day for her cows, household needs, and crop irrigation. Her cows have doubled their milk production, which earns her USD 7.60/day. By farming just a quarter acre of her land, she is able to earn an additional USD 1,500 per year selling her vegetables locally.

EEP AFRICA CASE STUDY

COLD CHAIN TECHOLOGY REDUCES FOOD LOSS

InspiraFarms developed an innovative and cost-effective technology of cold storage and post-harvest handling facilities, able to operate on and off-grid, with cloud-based remote monitoring. Their solar-powered technology solves some of the teething issues around bringing the cold chain into first-mile distribution, particularly close to production points.

In fruit and vegetable supply chains it is very common that the levels of postharvest losses can be higher than 30%. This is the result of a combination of factors, but a unifying theme is lack of cold chain infrastructure close enough to harvest points and the time lag between harvest and first cold chain access. This causes high levels of over-maturation and dehydration, with further impacts on quality preventing access to valuable markets

Cooling within hours can extend the shelf-life of many fresh products from weeks to months, as well as provide additional flexibility on logistic schedules. Despite this, the cold chain system is still weak or non-existent in some African countries. In rural areas most farmers in the first mile of distribution lack the infrastructure required for developing the cold chain, such as grid connection. Even diesel generators are often unaffordable in the targeted areas.

During 2017, InspiraFarms installed an on-farm, solar-powered dry and cold storage facility to serve as an agricultural technology demonstration centre and commercial facility in a remote rural area of central Kenya. This facility was developed with EEP Africa financing to demonstrate the capabilities of their solar-powered cooling technology and modularity of the structure.

Their facilities, cold rooms and post-harvest handling pack-houses support a variety of post-harvest functions, such as aggregation, processing and cooling for a variety of agricultural products. The modular structure uses high-quality prefabricated components that allow rapid installation and easy future expansion with spaces compliant with food safety standards. They are designed and developed to be installed anywhere, such as rural and remote agricultural areas, and each facility can have the capacity for a large number of farmers.

TARGETED OUTCOME AND IMPACT

The dairy chilling facility set up during the project was intended to benefit more than 150 local households and rural cooperative members, with an estimated reduction of 32 tCO_2e in annual emissions and the expectation that farmers could see their margins increase by 20-50% in the short term.

Currently the demonstration facility is used for retail and agro-veterinary services with separate areas for dairy chilling and collection, vaccine cold storage, dry storage, and a testing lab. InspiraFarms solar-powered dairy chiller increases milk quality while returning higher value to small-scale dairy farmers and minimising waste. The storage capability could also create opportunities for added-value items such as cheese and yoghurt.

In recent years, InspiraFarms has evolved to focus on fruit and vegetables supply chains, offering first-mile on-farm cooling solutions and handling facilities to farmers and agribusinesses needing to upgrade their operations to meet quality standards and reduce post-harvest losses of fresh produce. InspiraFarms has found that on-farm cooling solutions for fruit and vegetables supply chains are more competitive in terms of market opportunities than dairy cold chain solutions.

InspiraFarms currently has more than 60 units, representing more than 8,000 m^2 of cold storage and processing space in the field. They have units operating in Kenya, Mozambique, Rwanda, South Africa, Zimbabwe and Ethiopia. The company is also growing fast in West African countries, especially in Ghana, in diverse export supply chains.

Project developer:
InspiraFarms

Technology:
Solar (cold chain)

Key synergies:

Key linkages:

Adaptation

- Business continuity planning

Resilience

- Durable/flexible infrastructure and systems
- Continuous access to essential services
- Increasing resources to poor/vulnerable

Location:
Kenya

Food products require specific temperatures for chilling & storage:
Milk: Chill to 10°C within 2 hours and to 4°C within 3-4 hours
Fruits & Vegetables: Store tomatoes at 10-15°C but onions at 0-2°C
Fish: Flash cool to -0.9 to 2°C or freeze at -18 to -21°C

EEP AFRICA CASE STUDY

DUNG TO TABLE: BIODIGESTERS FOR SUSTAINABLE FARMING AND COOKING

Sistema.bio's biodigesters enable farmers to convert organic waste into energy and improve food security. Their small-scale units are highly durable, modular, easy-to-install and maintain, and can serve farmers with 2 to 200 cows.

The biodigesters produce biogas to power stoves and burners, as well as high-quality organic fertiliser to produce higher-yield crops. Other potential applications include water heaters, chaff cutters, and milk pasteurisers.

Women are the target beneficiaries as they represent more than 95% of the end users for household cooking. The systems reduce exposure to kitchen smoke and associated health consequences, as well as the time and burden of collecting fuel. By directly engaging women as customers, Sistema.bio empowers them to discuss the technology and process, and to organizs and create new business opportunities in the long run.

Sistema.bio has 100% women leadership in Kenya. EEP Africa financing is enabling Sistema.bio to expand into new regions in Kenya and develop a gender-inclusive approach to the recruitment and training of sales agents and technicians. Women have already proven to be more effective sales agents than men, and they have continued selling throughout the pandemic as they see the substantial benefits the systems bring to their communities.

The unprecedented restrictions of the pandemic have demonstrated how biodigesters can dramatically increase self-reliance as farmers are able to sustainably grow and cook food without leaving their land for food, cooking fuel, or fertilizers.

The necessity to adapt during the pandemic has also led to lasting improvements in operations that will facilitate scale-up. Sistema.bio now uses digital technology to facilitate on-boarding and recruitment at all locations. Bringing a broader group of women together from several areas rather than relying on in-person training has created a stronger sense of belonging to something larger. They have also developed extensive training materials and were able to train a maintenance team entirely remotely.

TARGETED OUTCOME AND IMPACT

Even though the project launched during the pandemic, they have already sold over 830 biodigesters, which translates into direct impacts to over 4,000 people. The project plans to create jobs for more than 80 women as sales agents and technicians.

Based on expected sales during the project, Sistema.bio estimates their systems will generate 17,700 MWh of clean energy per year, save EUR 2.7 million annually in energy-related household expenditure, and reduce 18,400 tCO_2e emissions.

The biodigesters also reduce pressure on forests by replacing wood, charcoal and other non-renewable energy sources as biomass provides over 90% of Kenya's rural household energy needs.

Sistema.bio calculates that their biodigesters offer customers savings of about 30% of their household budget, as well as increased productivity and new income opportunities. With a 10-year warranty for each biodigester, the long-term impact is significant.

Project developer:
Sistema.bio

Technology:
Biogas

Key synergies:

Key linkages:

Adaptation

- Afforestation
- Business continuity planning
- Land use changes

Resilience

- Continuous access to essential services
- Increasing resources to poor/vulnerable
- Safety/emergency preparedness planning

Location:
Kenya

The smallest unit: **1 bucket of waste** per day (2 cows) produces 3 hours of **biogas cooking**, generates 2.1 kWh **electrical energy**, produces 80 litres of **organic biofertiliser** (enough for 40-80 m² of crops) and creates **cash savings** and **income opportunities**.

LOCAL SELF-RELIANCE

THE ISSUE

Only 48% of people in Sub-Saharan Africa, and only 31% of those in rural areas, have access to electricity.[12] Instead, many people rely on firewood, charcoal, kerosene, candles, diesel or simply do without.

Lack of energy access affects all aspects of life, from health to education to earning a living. Within households, women and children are the most affected.

Without energy services, it is very difficult for people to move out of poverty and establish more viable and resilient livelihoods. Unelectrified communities are also more vulnerable to natural and man-made disasters.

Did you know?
Collection times for firewood for rural households range from 30 minutes to over 6 hours per day, with the longest times in Sub-Saharan Africa. Indoor air pollution and fuel collection pose significantly higher risks for women and girls in terms of health and safety.[13]

THE NEED

A core element of household self-reliance and community sustainability is sufficient access to affordable and reliable energy. Electricity helps meet basic needs, diversify income-generating activities, and facilitate broader cultural shifts, such as in gender roles. Electricity access has also been found to promote increased self-determination and less acceptance of domestic violence.[14]

Access to clean energy, especially when combined with productive use appliances and technical assistance for local businesses, serves as a catalyst to create local jobs and socio-economic development by powering agricultural, commercial and industrial activities.

Enhancing local capacity to satisfy the core needs of households, rather than depending on external raw materials or expertise, strengthens the resilience of communities when supply chains are disrupted. This can be vitally important during climate-related and other crises, such as a global pandemic.

HOW CLEAN ENERGY CONTRIBUTES

Examples of clean energy project types that promote local reliance include:

- Micro- and mini-grids, especially with storage capacity, to power essential services
- Direct power for productive uses in commercial, retail, light manufacturing, agriculture, fishing
- Fuel switching to locally-sourced biofuels from waste or agricultural by-products for cooking and transportation

Project highlight:
Mini-grid powering remote island fishing village

Absolute Energy (AE) installed a 230kW solar PV mini-grid on Kitobo Island on Lake Victoria. The system was specifically designed to cater for the local fishing community's cold chain needs. AE also established an ice-making plant in partnership with a local company, which provides an anchor load for the mini-grid and produces ice to order for local fishermen.

Table 6: Off-grid mini-grids provide power for the whole community

Households	Health clinics	Schools	Retail and services	Community infrastructure
Lighting Phone charging Radios/TV Computers Small appliances	Refrigeration for medicine e-Health diagnostics & treatments	Remote study and e-learning Evening classes & self-study	Restaurants Hairdressers Tailors Welding Food processing Battery and vehicle charging	Municipal buildings Wastewater treatment Street lighting Emergency response (e.g. water pumping for fire or flood management)
Clean energy mini-grids can be powered by solar PV, biomass, biogas, hydro and hybrid systems				

Source: Adapted from WRI, 2017.

Table 6 indicates the wide range of benefits that a mini-grid can bring to a rural community. It can provide power for households, health clinics, schools, infrastructure, and a variety of small businesses.

Due to technological improvements and falling costs in solar power and battery storage, mini-grids are a viable option for many rural communities. Indeed, they are often even more reliable than national grids, which are vulnerable to load shedding and remote powerline damage.

Unlike smaller stand-alone power systems, mini-grids can provide AC power, which enables access to a wider range of household and productive use appliances that improve quality of life and income opportunities. With smart meters, PAYG and portable battery charging, power from mini-grids is becoming affordable for more end-users.

Solar PV remains the most common energy source for mini-grids, but there are a growing number of mini-grid projects in Africa that utilise hydropower, biomass and hybrid technologies.

Project highlight: Transforming organic food waste into energy

The Waste Transformers produces a small-scale, modular anaerobic digester that is flexible enough for a variety of locations, such as restaurants, hospitals and prisons. One unit was installed at the N1 City Mall in Cape Town and now generates on-site electricity for the mall, The residual heat can be used for hot water and recovered nutrients can be turned into liquid fertiliser.

Project highlight:
Locally-sourced biofuels for cleaner cooking

- Green Bio Energy makes briquettes out of charcoal dust in Uganda.
- SupaMoto produces pellets out of waste sawdust from sustainable pine and eucalyptus plantations in Zambia.
- Pamoja makes cooking fuel from cashew shells in Mozambique.
- Tiny Totos offers customers bio-ethanol from molasses plants in Kenya through a partnership with KOKO Networks.

Did you know?

There is virtually no access to safe drinking water among the poorest 48% in Africa.[17] Access to clean energy reduces the need for unhealthy energy sources to boil water and can power wastewater treatment plants.

Project highlight:
Options for transportation fuel switching

- Zembo is replacing diesel taxi motorcycles in Uganda with electric models that run on rechargeable batteries and PAYG solar-charging stations.
- iLive is producing biodiesel from used cooking oil collected from local restaurants in South Africa.

A worker at SupaMoto's factory in Ndola, Zambia is producing locally-sourced biomass pellets for cleaner cooking.

Converting locally-sourced waste into energy directly reduces reliance on external supply chains while also reducing pressure on landfills and reducing GHG emissions. The range of waste-to-energy projects in EEP Africa's portfolio has expanded to support mini-grids, productive uses, cleaner cooking, transportation, and other household and community needs.

Clean energy projects that help reduce pressure on forests often provide other benefits to local communities. Healthy forests produce many wood and non-wood products, such as fruits, medicines and honey, all of which can be important for the local economy.

Projects that limit land degradation, reduce soil erosion, increase soil organic matter, or improve land, crop and fertiliser management all benefit farmers and increase resilience.[15]

Clean cooking projects can deliver significant co-benefits, but different clean cooking solutions vary in their impact. For example, reduced fuel costs can be significant, but vary widely by pre- and post-fuel source, as well as the stove type.

Clean cooking alternatives are particularly beneficial for women and children who, because of their roles in the family, typically suffer more from the effects of cooking on open fires and spend more time collecting fuel, especially in Sub-Saharan Africa.[16] However, the market penetration of renewable cooking fuels is low, especially in Africa.

EEP Africa supports a variety of other projects that promote self-reliance, including energy efficiency projects that reduce the overall need for resources and projects that deploy portable energy solutions.

Portable and modular solutions can be particularly helpful for temporary needs, such as emergency and disaster response. For example, containerized solar PV hubs that can be quickly installed and relocated are able to offer electricity, connectivity and even clean water.

EEP AFRICA CASE STUDY

MINI-GRID BRINGING LIGHT, LIFE AND OPPORTUNITY

Ensol installed a 48 kWp solar PV mini-grid with integrated storage capacity in the remote mountain village of Mpale in Tanzania. Commissioned in 2017, the mini-grid provides standard 3-phase, low-voltage electricity through a 5 km overhead distribution network. The system was built at grid standard to align with long-term electrification plans of the Tanzanian Rural Energy Agency (REA).

As a 100% locally-owned company, as well as a founding member of the Tanzania Renewable Energy Association (TAREA), Ensol has a strong focus on community involvement and empowerment. During the planning and construction phases of this project, Ensol developed strong relationships with regulators, Mpale village and Korogwe district authorities, and the local community.

To ensure the system functions reliably and meets customer needs, Ensol employs local operators and an administrator. A five-member village electricity committee was also created to receive and respond to customer feedback.

The system is capable of generating up to 102 MWh annually, which increases energy access at very low rates and replaces the use of polluting kerosene and diesel. Ensol uses a flat rate service model, Energy Daily Allowance (EDA), through mobile money that helps customers plan monthly budgets and guarantees monthly revenues. Electricity dispensers at each user's premise allow easy energy management for both user and developer.

The mini-grid has become an important learning platform for local and international institutions. It has been used as a case study by the World Bank and hosted study visits from University of Dar es Salaam, Open University of Tanzania, University of Sheffield and Harvard University. Officials from Zanzibar and the Ngorongoro Conservation Area Authority have also visited, and the Tanzanian REA awarded the project Results Based Financing.

TARGETED OUTCOME AND IMPACT

This demonstration project brought electricity to Mpale village for the first time. The reliable, renewable and resilient off-grid infrastructure is providing deep and diverse health, economic, and social benefits for this remote community, and local entrepreneurs are exploring new possibilities every day.

Over 250 households are directly connected to the mini-grid, bringing first-time electricity to 4,000 people. A school with 900 pupils is now electrified, leading to higher grades from longer study hours and evening classes for pupils studying for national examinations.

The health clinic serves all surrounding villages and is now able to offer significantly expanded services 24/7 using electric-powered diagnostic and laboratory equipment and refrigerated vaccines and medicine.

Local entrepreneurs and shopkeepers can provide many more services with access to refrigeration, power tools and longer opening hours. The mini-grid is electrifying carpentry and welding workshops, restaurants, printers and groceries, entertainment centres, barbershops and the first women-run hair salon.

The system also supports egg incubators and an investor has approached Ensol about establishing a cardamom spice processing centre. Other possible uses being explored include water pumping for drinking and irrigation, as well as cold storage facilities that would substantially reduce food waste.

The Mpale mini-grid is currently generating 87.6 MWh per year, resulting in 24 tCO_2e reduced annually. In 2018 it was awarded best off-grid project of the year by the Alliance for Rural Electrification (ARE). Ensol is now working on replicating the project in 16 other villages by 2025.

Project developer:
Ensol

Technology:
Solar (mini-grid)

Key synergies:

Key linkages:

Adaptation

- Infrastructure protection
- Business continuity planning
- Emergency response

Resilience

- Durable/flexible infrastructure
- Continuous access to essential services
- Increasing resources to poor/vulnerable
- Safety/emergency preparedness planning

Location:
Tanzania

Dr. Magembe has worked at the Mpale health clinic for over 10 years. For most of that time the facility did not have access to reliable electricity. With the Ensol mini-grid, the clinic now has proper lighting, a refrigerator for vaccines and medicine, sterilisation and laboratory equipment, and internet access. This has transformed the level and quality of health services that Dr. Magembe can offer his patients.

EEP AFRICA CASE STUDY

CLEANER AIR IN SCHOOLS WHILE SAVING TREES

Acacia Innovations is a women-led Kenyan social enterprise that recycles sugarcane waste into low-carbon biomass briquettes. The briquettes are sold under the brand name Kuni Safi, which means 'clean firewood' in Swahili, to schools and children's homes. Each installation can benefit up to 1,200 students and school employees.

The smokeless briquettes displace firewood and charcoal for cooking and industrial use, thereby saving trees and reducing toxic emissions. The resulting cleaner air has been noticed by schoolchildren and staff, with a significant reduction in respiratory illnesses from poor indoor air quality.

Acacia targets institutions that are primarily owned and operated by women entrepreneurs and recently expanded to serve restaurants, hotels and local industry. This successful diversification was accelerated by the pandemic when schools, which had made up 90% of their customer base, were closed.

This kind of small- and medium-sized institutional market is often avoided by cookstove and briquette distributors, which typically target either households or larger-scale businesses.

As the waste material and other inputs are all sourced locally and their customers are local, Acacia's business model is also quite resilient to transportation or other supply chain disruptions.

With EEP Africa financing, Acacia is expanding its production capacity and distribution region, as well as piloting a new type of carbonized briquette for sale to households as an eco-friendly charcoal alternative.

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TARGETED OUTCOME AND IMPACT

Acacia is the largest supplier of clean cooking fuels to schools and small businesses, each serving 20-2,000 people, in Kenya. They currently distribute to more than 500 schools, hotels and industrial customers and sell between 200 and 100,000 kg of briquettes per month.

Kuni Safi briquettes are 35% less expensive than firewood and 60% less than charcoal, which frees up substantial resources for food and other basic needs. By diversifying the customer base both upwards to industry and downwards to households, Acacia managed to achieve its highest monthly production output during the middle of the COVID-19 pandemic.

Acacia estimates that each tonne of briquettes sold saves 25 trees. At this rate, the project will save 1 million trees and reduce about 42,000 tCO_2e in the next five years. Over time, the reduced pressure on local forests will be significant.

New customers report that Kuni Safi briquettes are higher quality than other varieties they have used, in terms of high compaction, high calorific value, low ash content and minimal clinker formation. Acacia aims to scale up to 4,000 small- and medium-sized institutions, resulting in large-scale benefits in health and safety.

All Acacia staff are native Kenyans, except the CEO, and 60% are women. Many of the women were not able to finish high school and this job opportunity, which pays a good wage and includes skills development, can be life changing for them and their families.

Project developer:
Acacia Innovations

Technology:
Solid biomass

Key synergies:

Key linkages:

Adaptation

- Afforestation
- Business continuity planning

Resilience

- Continuous access to essential services
- Increasing resources to poor/vulnerable
- Safety/emergency preparedness planning

Location:
Kenya

1 tonne of Kuni Safi briquettes = **25 trees** saved from firewood

EEP AFRICA CASE STUDY

VERSATILE HUBS FOR SOLAR ENERGY AND CLEAN WATER

OffGridBox is providing off-grid communities with clean water and renewable energy through an all-in-one system that fits into a 2m x 2m x 2m container. With solar PV panels on top and a water purification system inside, these highly portable yet durable boxes have many possibilities to facilitate climate adaptation and resilience.

Each box can supply 400 households with clean water and electricity for lighting, phone charging and small electrical appliances. The power is provided through rechargeable battery packs, with customers able to choose how often they want to recharge the battery for a small fee.

Water purification has been a standout success as clean water is often more critical than lighting in very poor areas. Customers can purchase a PAYG battery + water package in which they can refill jerrycan with purified water each time they recharge. Excess water can be sold in local shops.

Each box provides 5 jobs, including two for local women employed as box keepers and coached in bookkeeping, marketing and maintenance. Being a box keeper can increase women's standing in the community and empower them to take on new roles. OffGridBox provides a forum for the box keepers to communicate with each other for mentoring support and to help brainstorm solutions to issues as they arise.

The boxes can be installed within 3 hours, are easily relocatable and enable communications through WiFi hotspots, making them good solutions for disaster response and humanitarian missions. Each box is built to last up to 20 years and can pay for itself within 5 years at just 20% of installed capacity

TARGETED OUTCOME AND IMPACT

OffGridBox has installed 30 boxes across East Africa, serving 50,000 people. Eighteen of these are in rural villages in Rwanda, including one at a refugee camp and another powering a health clinic. In most locations, customers have been using the service about 2-3 times a week to recharge the battery and get 20 litres of purified water.

Women in the communities have reported that their children have less diarrhea, indoor air is cleaner, and they avoid the time and labour of gathering wood. In addition, access to lighting, phone charging and WiFi has expanded education and economic possibilities for their entire family.

Solar power is about 35% more cost effective than diesel and each box creates enough renewable energy in one year to replace 1.4 tons of diesel fuel, preventing close to 2 tCO_2e annually. Using solar PV instead of wood or fossil fuels to boil water has numerous health, environmental and social benefits. It also reduces pressure on areas that have been heavily deforested as Rwanda already experiences frequent landslides.

OffGridBox is exploring using the boxes for a variety of agricultural and other productive uses, such as irrigation, refrigeration, drying, and power for schools, restaurants and small businesses. The boxes could also be used for desalination or water pumping for fire and flood prevention. They can also power weather stations or serve as a network of climate data collection points.

The company is scaling up rapidly in East Africa and other regions, with over 70 units already installed around the world.

Project developer:
OffGridBox

Technology:
Solar (hub)

Key synergies:

Key linkages:

Adaptation

- Afforestation
- Business continuity planning

Resilience

- Continuous access to essential services
- Increasing resources to poor/vulnerable
- Safety/emergency preparedness planning

Location:
Rwanda

Solar Panel Array

The solar panel array captures and transforms the sun's energy into direct current.

Integrated Inverter

The direct current is converted by the integrated inverter into useable elevtricity.

Battery Pack

The electricity can be used by a commercial grid, local network or building, or stored in batteries for later use.

Water Collection System

Untreated water can be collected by the integrated rain capture system or from external sources such as a river.

Water Storage Tank

The large integrated polyethylene tank stores untreated water to be cleaned when needed.

Water Treatment System

Some electricity is used to filter and sterilise the untreated water and then clean water is distrbuted.

SUMMING UP

This portfolio analysis has confirmed numerous examples of climate adaptation and resilience co-benefits from clean energy projects. Access to electricity, especially when combined with technical assistance, also serves as a catalyst to create local jobs and socio-economic development by powering agricultural, commercial and industrial activities.

It is critically important for financiers, developers and policymakers to fully understand the co-benefits produced by clean energy in order to ensure the post-pandemic world builds back better and greener.

Investing in off-grid clean energy is likely to provide adaptation and resilience co-benefits.

While all clean energy projects have the potential to support climate adaptation and resilience, off-grid SHS, mini-grids and powering productive uses are the most likely to support multiple themes at the community and household levels. Support for resilient agriculture and local infrastructure are the most common examples of demonstrated impact.

Initial small-scale risk-taking, through early-stage financing and support for clean energy innovation, testing new business models, and demonstration projects, is vital for assessing long-term viability.

The pandemic is testing business models in ways that are similar to some anticipated climate impacts. This situation further illustrates promising project types and business models for the way forward.

Developers and funders can maximise climate synergies by assessing the supply chain and local context.

It is important to consider the full context of a project, including supply chain viability and local community needs, to identify potential synergies. This is also critical for reducing the risk of maladaptation, which creates a solution at one level that simply shifts the problem elsewhere.

Project stakeholders should consider the long-term sustainability of the supply chain, especially how climate impact forecasts may shift resource availability, such as access to water supply. Assessing the broader context can create win-wins for all stakeholders by facilitating holistic climate-smart solutions that promote long-term sustainability and avoid locking in suboptimal clean energy infrastructure improvements.

Involving community leaders and government officials is important for understanding local needs and facilitating relationships needed for project success. It may also highlight additional opportunities that can improve the business models for projects, such as additional productive uses, community services, or customer groups.

Clean energy solutions can support national climate adaptation and resilience efforts.

Climate adaptation and resilience co-benefits that are achieved at individual and community levels supplement planning at national and regional levels. In addition, scaling up proven clean energy concepts can help deliver the magnitude of impact needed at the national level.

Appropriately planned and maintained mini-grids that support community, emergency, and entrepreneurial needs in off-grid areas show promise in delivering resilient infrastructure, self-reliance, and productive use benefits at a meaningful scale.

Biodigester projects that produce organic fertiliser deliver self-reliance and sustainable soil benefits at the household level. These projects could have a noteworthy role in broader climate adaptation and resilience strategies if implemented at scale. Clean cooking projects that reduce pressure on forests could have a modest, yet critical, role in a sustainable forest management strategy.

Many clean energy stakeholders already consider projects within the context of the SDGs and Nationally Determined Contributions (NDC). Consideration of National Adaptation Plans (NAPs) and other national development plans will help identify potential linkages as well.

Micro Energy Credits (MEC) is increasing financial inclusion and access to clean energy products in Kenya through its unique Chaguzi mobile data platform.

THE WAY FORWARD

There is increasing recognition of the importance of considering synergies between climate mitigation and adaptation in order to fully realize the potential value of efforts in both areas and enable stakeholders to use funds more efficiently.

The climate needs far outstrip the funding available, which has been heavily weighted towards mitigation. By taking a more holistic approach, limited funds can be better leveraged to achieve multi-faceted projects that promote long-term environmental, social, and economic sustainability and avoid locking in suboptimal strategies.

Based on this analysis of co-benefits, there are four recommendations directed primarily at early-stage financiers and developers of clean energy projects. These may also provide insights for a broader range of stakeholders, such as climate planners and policymakers and civil society organizations.

Financiers should take a more holistic approach to climate funding.

Financiers should adjust their processes to more explicitly consider and emphasise climate adaptation and resilience co-benefits when supporting clean energy development and other mitigation efforts. In the case of off-grid energy projects that introduce electricity to a region, rather than replace diesel generators, the adaptation and resilience benefits may indeed be higher than those for mitigation.

However, it should be noted that the need for climate resilience and adaptation-specifc funding remains and should not by diluted due to co-benefits from mitigation funding.

Financiers should be realistic about their expectations and consider which elements can be addressed at the project level and which must be addressed at a higher level. Projects should not be required to always deliver co-benefits, as there may be more pressing priorities. But it is important to consider any trade-offs and confirm projects are consistent with climate and development priorities. This may require some form of capacity building workshops or guidelines to help developers understand and assess the issues.

Financiers should enhance monitoring and evaluation strategies to demonstrate the value of clean energy development.

To facilitate the shift to more holistic climate funding, it is important to build an evidence base that will help guide developers and inform decision-making. Monitoring and evaluation strategies should be broadened to integrate mitigation, adaptation and resilience metrics and indicators.

It is also important to document the trade-offs being made on the ground and more systematically share experiences and findings through case studies and impact evaluations.

Developers should seek to climate-proof clean energy concepts and business models.

Clean energy project developers should consider long-term viability in light of anticipated climate change impacts. For example, stakeholders should ascertain whether water sources for proposed irrigation or hydropower plants are susceptible to changes in weather patterns, or whether solar or biowaste projects could be impacted by anticipated temperature increases. Off-grid mini-grid projects should address long-term appropriateness and plans for grid connection, as well as how they will power productive uses and/or support community services.

Developers should coordinate with local and national officials as appropriate on how, within the project context, they can support critical local services and goals established in national plans, such as NAPs and NDCs. By aligning with broader community needs and national goals, project developers can strengthen their business model and increase local support for their project concepts.

All clean energy stakeholders should share co-benefit success stories and challenges.

Clean energy stakeholders should highlight success stories and challenges about climate adaptation and resilience co-benefits. Experiences and findings across the sector should be shared more systematically through knowledge products, interactive workshops and learning platforms to broaden global knowledge. Partnerships in knowledge dissemination should be promoted when relevant and possible.

Local youth in Rwanda are employed by OffGridBox to deliver purified water to local shops.

ANNEXES

This report contains the following annexes:

A. Methodology
B. List featured projects
C. Endnotes
D. References

ANNEX A: METHODOLOGY

The existing international literature on clean energy and climate generally focuses on mitigation and rarely addresses the co-benefits for adaptation and resilience. The starting hypothesis of this study was that important co-benefits are being generated but are not being explicitly recognized or tracked.

This analysis draws upon an extensive literature review of over 100 documents and a high-level review of the entire EEP Africa portfolio. The portfolio analysis is illustrative, not exhaustive, as there is inconsistent data available across countries and sectors. The research also included interviews with stakeholders and selected project developers, supported by the deep industry experience of the researcher and EEP Africa team. The report avoids excessive speculation, focusing only on themes and results that are traceable to the project information and literature currently available.

Given this, the report seeks to illustrate examples of what is happening and provide suggestions for a way forward that more proactively promotes and tracks synergies. The main target audience is early-stage funders and impact investors, but it is also relevant for project developers, policymakers, civil society organisations and other stakeholders.

ANNEX B: LIST OF FEATURED PROJECTS

The EEP Africa projects cited in this study were seen as particularly representative examples that provide a cross-section of climate adaptation and resilience co-benefits and have elements that may be replicable elsewhere. Please refer to the EEP Africa website (www.eepafrica.org) for the latest information on these and other projects supported by EEP Africa since 2010.

EEP Africa projects referenced in the report (in order of appearance):

Lead developer	Sector/category	Country
Swimsol	Solar (floating)	Seychelles
East African Power	Hydropower	Rwanda
VAC Solar	Solar (energy hub)	Uganda
Celfre Energy	Solar (irrigation)	Zimbabwe
Agsol	Solar (mills)	East Africa (regional)
Dornova	Biogas	Namibia
SunCulture	Solar (irrigation)	East Africa (regional)
Inspira Farms	Solar (cold chain)	Kenya
Sistema.bio	Biogas	Kenya
Absolute Energy	Solar (mini-grid)	Uganda
The Waste Transformers	Biogas	South Africa
Green Bio Energy	Clean cooking	Uganda
SupaMoto	Clean cooking	Zambia
Pamoja Cleantech	Clean cooking	Mozambique
Tiny Totos	Clean cooking	Kenya
Zembo	Solar (e-mobility)	Uganda
iLive	Biofuel	South Africa
Ensol	Solar (mini-grid)	Tanzania
Acacia Innovations	Clean cooking	Kenya
OffGridBox	Solar (energy hub)	Rwanda

ANNEX C: ENDNOTES

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Cover photo:
iDeal-x is a women-led start-up in Namibia that is conducting applied research in the fields of natural and water resource management, biomass-based renewable energy, energy efficiency and risk management.

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