USAID
FROM THE AMERICAN PEOPLE

POWER AFRICA
A U.S. GOVERNMENT-LED PARTNERSHIP

ASSESSMENT OF CURRENT AND POTENTIAL OFF-GRID PRODUCTIVE USE OF ENERGY PRODUCTS

CÔTE D'IVOIRE

OCTOBER 2022

ABOUT POWER AFRICA

Power Africa is a U.S. Government-led partnership that brings together the collective resources of more than 170 public and private sector partners to double access to electricity in sub-Saharan Africa.

> *Power Africa's goal is to add at least 30,000 megawatts of cleaner and more reliable electricity generation capacity and 60 million new home and business connections by 2030.*

DISCLAIMER

This report is made possible by the support of the American People through the United States Agency for International Development (USAID). The contents of this report are the sole responsibility of RTI International and do not necessarily reflect the views of USAID or the United States Government. This report was prepared under Contract Number AID-720-674-18-D-00004 / AID-720-674-19-F-00005.

WHAT'S INSIDE

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

ADERIZ	Agency for the Development of the Rice Sector (*Agence pour le Développement de la Filière Riz*)
AFD	French Development Agency (*Agence Française de Développement*)
AfDB	African Development Bank
ANADER	National Rural Development Support Agency (*Agence Nationale d'Appui au Développement Rural*)
ANDE	National Environment Agency (*Agence Nationale de l'Environnement*)
APERCI	Association of Renewable Energy Professionals of Côte d'Ivoire (*Association des Professionnels des Energies Renouvelables de Côte d'Ivoire*)
APROMAC	Associations of Natural Rubber Professionals of Côte d'Ivoire (*Association des Professionnels du Caoutchouc Naturel de Côte d'Ivoire*)
BFA	Bank for Financing of Agriculture
BNETD	National Bureau of Technical Studies and Development (*Bureau National d'Études Techniques et de Développement*)
CGAP	Consultative Group to Assist the Poor
CIDT	Ivorian Company for Textile Development (*Compagnie Ivoirienne pour le Développement des Textiles*)
CSR	corporate social responsibility
COVID-19	Coronavirus Disease 2019
EU	European Union
FAFCI	Support Fund for Women in Côte d'Ivoire (*Fonds d'Appui aux Femmes de Côtes d'Ivoire*)
FAO	Food and Agriculture Organization
FIRCA	Interprofessional Fund for Agricultural Research and Consultancy (*Fonds Interprofessionnel pour la Recherche et le Conseil Agricoles*)
GDP	gross domestic product
GIZ	German Development Agency (*Deutsche Gesellschaft für Internationale Zusammenarbeit*)
GOGLA	Global Off-Grid Lighting Association
GPE	Green People's Energy
INFPA	National Institute for Professional Agricultural Training (*Institut National de Formation Professionelle Agricole*)
kWh	kilowatt-hour
LANADA	National Agricultural Development Support Laboratory (*Laboratoire National d'Appui au Développement Agricole*)
MFI	microfinance institution
NGO	nongovernmental organization

OCPV	Office for the Marketing of Food Products (*Office d'aide à la Commercialisation des Produits Vivriers*)
OGS	off-grid solar
OIPR	Ivorian Parks and Reserves Agency (*Office Ivoirienne des Parcs et Réserves*)
PAEHR	Off-grid Electrification Action Plan (*Plan National d'Électrification hors Réseau*)
PANER	National Action Plan for Renewable Energies (*Plan d'Action National des Energies Renouvelables*)
PAMF-CI	First Microfinance of Côte d'Ivoire (*Première Agence de Microfinance Côte d'Ivoire*)
PAYGO	pay-as-you-go
PEPT	Electricity for All Program (*Programme Électricité Pour Tous*)
PNIA	National Agricultural Investment Program (*Programme National d'Investissement Agricole*)
PNIASE-CI	National Investment Program for Access to Energy Services in Côte d'Ivoire (*Programme National d'Investissement Pour l'Accès aux Services Energétiques en Côte d'Ivoire*)
ProFERE	Vocational Training in the Renewable Energy and Energy Efficiency Sectors Project (*Projet de Formation Professionnelle dans les Domaines des Énergies Renouvelables et de l'efficacité Énergétique*)
PRONER	National Rural Electrification Program (*Programme National d'Electrification Rurale*)
PSDEREE	Sectoral Policy for the Development of Renewable Energies and Energy Efficiency (*Politique Sectorielle de Développement des Energies Renouvelables et de l'Efficacité Energétique*)
PUE	productive use of energy
PV	photovoltaic
RBF	results-based financing
SAPH	African Society of Hevea (rubber tree) Plantations (*Société Africaine de Plantations d'Hévéas*)
SIVAC	Ivorian Slaughter and Charcuterie Society (*Societe Ivoirienne D'abattage et de Charcuterie*)
SODEFOR	Ivorian Forest Development Company (*La Société de Développement des Forêts*)
TRECC	Transforming Education in Cocoa Communities (*Transformer l'Éducation dans les Communautés de Cacao*)
UNACOOPEC-CI	National Union of Savings and Credit Cooperatives of Côte d'Ivoire (*l'Union Nationale des Coopératives d'Epargne et de Crédit de Côte d'Ivoire*)
USAID	United States Agency for International Development

EXECUTIVE SUMMARY

This report shares market intelligence on productive use of energy (PUE) in Côte d'Ivoire to help actors in this market drive increased PUE sales. PUE is any income-generating activity involving electricity or thermal energy as a direct input into producing, processing, and providing goods and services.

The report describes the Ivorian agriculture and energy sectors, focusing on opportunities and challenges. It also explains the country's enabling environment for business, including government and development partners' support programs for agriculture that are likely to increase the demand for solar PUE.

The first section of this report introduces the background and methodology for this research. Thereafter, section two contextualizes the state of agriculture and energy in Côte d'Ivoire. Section three looks at the PUE technologies available in the market and the private sector's role in supplying them. Following this, section four analyzes the energy demand of the major agricultural value chains and their potential to adopt PUE. Chapters five, six, and seven discuss the enabling environment and supporting services for PUE, and identify stakeholders such as public-sector agencies and NGOs. The last section outlines opportunities for PUE and concludes with recommendations for stakeholders looking to support PUE adoption.

Côte d'Ivoire, West Africa's third-largest economy by gross domestic product (GDP),[1] had one of the highest GDP growth rates in the world in early 2020.[2] Its economy is driven largely by primary agriculture (particularly cocoa beans, cashews, coffee, and palm oil), which accounts for almost 60 percent[3] of the country's export earnings. Smallholder farmers, working on fewer than 4 hectares (ha) on average, produce most of Côte d'Ivoire's agricultural output with manual labor, typically earning less than urban residents.[4]

Because of its reliance on primary agriculture, Côte d'Ivoire's economy is very sensitive to changes in commodity prices due to shocks, including variations in climatic conditions. To mitigate such disruptions, the government of Côte d'Ivoire aims to diversify its economy by growing value-adding industries and increasing the country's processing capacity for cocoa and cashew. Farms' limited adoption of PUE technology constrains Côte d'Ivoire's potential for food production and income generation, but also presents an opportunity for the PUE industry.

This assessment found that PUE technology suppliers are present in the Ivorian market, offering off-the-shelf and customized solar energy products and services, but that structural barriers prevent end-users from adopting these technologies.

This report proposes that the economic potential of adopting solar products on family farms is significant and can solve related productivity challenges. It also identifies the bottlenecks that restrict wider adoption of PUE and elaborates on the solutions summarized below.

---

[1] "GDP (Current US$)—Côte d'Ivoire," World Bank, 2020, accessed February 2, 2022, https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=CI.

[2] "GDP Growth (Annual %)—Côte d'Ivoire," World Bank, 2019, accessed February 2, 2022, https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?end=2019&locations=CI&start=1961&type=shaded&view=map&year=2019.

[3] "Ivory Coast Exports by Category," Trading Economics, 2019, accessed February 2, 2022, https://tradingeconomics.com/ivory-coast/exports-by-category.

[4] Government of Côte d'Ivoire, *Programme National d'Investissement Agricole PNIA* (Abidjan: Government of Côte d'Ivoire, July 2010), p. 19. (This document is not currently publicly available and was obtained through stakeholder consultations.)

Widen access to finance

Côte d'Ivoire has among the highest rates of financial inclusion in West Africa, and the use of mobile money and microfinance institutions (MFIs) is widespread.[5] Despite this, Ivorian PUE providers have generally yet to offer PAYGO services. Expanding the financing available to customers would make PUE products more attractive and affordable, particularly for women and rural Ivorians. PUE suppliers should research and pilot community-based financing models, and improve training for MFIs to understand their financial expectations and to develop suitable financial products.

Improve capacity-building for farmers

Technology providers experience difficulties finding qualified staff in rural areas where the need for PUE is greatest, and providing training is costly. However, training local staff fosters better engagement between farmers and the company, and bolsters local incomes. Extending agricultural training and support to women, who play a key role in farming and processing, is also crucial to scale PUE adoption.

Foster an enabling environment

Projects aiming to improve the enabling environment for PUE in Côte d'Ivoire should work with state agencies responsible for implementing and promoting agricultural programs and equipment in farming communities. These agencies are assigned different responsibilities and interventions at national, local, and sectorial levels. One such agency, the Interprofessional Fund for Agricultural Research and Consultancy (*Fonds Interprofessionnel pour la Recherche et le Conseil Agricoles* [FIRCA]), promotes sustainable, innovative, and competitive agriculture by mobilizing funds from donors, private entities, and the state to support agricultural projects. The Agricultural Gender Platform is one notable initiative of FIRCA, which aims to increase women's participation in agriculture by supporting and monitoring gender mainstreaming in this industry.

Those seeking to enhance the country's enabling environment can also work with several international donors and development agencies supporting Côte d'Ivoire's agricultural industry, although the issue of PUE adoption requires more attention and investment. One such initiative is Green People's Energy (GPE), launched by the German development agency *Deutsche Gesellschaft Für Internationale Zusammenarbeit* (GIZ), which aims to enable and expand renewable energy supply in rural Africa. GPE found that it could design more context-specific projects by inviting individuals, cooperatives, municipalities, and small and medium enterprises to help design its projects. GPE focuses on supporting project planning, offering capacity-building, and providing results-based financing (RBF) to increase sales of PUE equipment.

Market and create awareness of PUE technology

Technology providers, NGOs, and development agencies should evolve their marketing strategies to promote PUE, and provide farmers and cooperatives accurate information on financing and correctly using the technology. They need to consider low literacy levels among farmers and encourage communication through word of mouth, smallholder networking, and via product demonstrations, radio, agricultural advice services, trade fairs, and regional exhibitions. Agricultural cooperatives, though they have somewhat low levels of membership among Ivorians, can be powerful avenues for promoting PUE as well. For instance, a technology supplier can partner with women's horticultural groups to demonstrate how solar dryers improve the quality of cocoa beans, or how solar-powered irrigation saves labor.

Designing women-focused marketing is important to reach female audiences. PUE providers should ensure that their marketing materials represent women and show how PUE improves their quality of life. Employing female sales agents will also encourage more women to explore PUE.

The full benefit of PUE, such as solar irrigation, will be achieved only if the technology is used and maintained correctly. Therefore, suppliers of PUE should train their customers at the point of sale and offer after-sales

[5] USAID Power Africa, *Off-Grid Solar Market Assessment: Côte d'Ivoire*, (USAID, October 2019), p. 38, https://www.usaid.gov/sites/default/files/documents/1860/PAOP-CIV-MarketAssessment-Final_508.pdf.

service to ensure that PUE adoption is sustainable. PUE suppliers and NGOs should partner to offer such packages of capacity-building and maintenance to new users of PUE.

Build partnerships through corporate social responsibility

PUE suppliers should partner with their customers to ensure that they serve their market sustainably. Corporate social responsibility (CSR) programs implemented by international cocoa firms typically aim to prevent child labor, but have also had success diversifying farmers' incomes and developing women's agricultural associations. Technology suppliers should seek such corporate partnerships to promote PUE.

Invest in research and development

The Ivorian PUE market remains under-researched, but market information does show that solar-powered post-harvest processing machinery could not compete with diesel-powered ones. Solar-powered machinery available typically has lower processing capacity, longer processing times, higher cost, fewer operational hours and days a year, and cannot match or improve the quality of cereals processed by small-scale diesel or grid-powered processors. Accordingly, PUE organizations should research and develop more technically viable solar-powered machinery adapted to local needs. Until such optimized products appear, PUE suppliers should optimize business models and seek grant funding to increase the uptake of solar processing.

Improve gender inclusion

Broader PUE adoption depends on including more women across this industry. To reach women working in post-harvest processing, NGOs and development agencies need to provide subsidies, not just technical assistance and training, so that women's groups can afford solar-powered machinery. PUE providers should seek the expertise they need to understand the energy requirements and challenges faced by female farmers, so that these suppliers can develop specialized marketing materials that speak to women. Suppliers should adapt their business models so that they can partner with women's groups interested PUE. Additionally, women's savings and loans groups can lower barriers to acquiring PUE equipment by sharing the technology for group income-generating activities. Training institutes should invest in agricultural education for women, and encourage them to become solar technicians to help close gender gaps in the worker profile of the solar industry.

1 BACKGROUND AND METHODOLOGY

1.1 About the Power Africa Off-grid Project

The Power Africa Off-grid Project (the Project) provides technical assistance and targeted grant funding to develop Africa's off-grid solar home system (SHS), mini-grid, and PUE sectors. Through a team of resident technical advisors across East and West Africa, the Project works with companies, investors, and governments to advance the role of the private sector in extending energy access. By offering broad-based market intelligence to investors and financiers to inform financial product design, advising governments on establishing supportive policy frameworks, and providing hands-on support to companies, the Project is helping to build the off-grid market and accelerate private sector–led energy access.

Productive use of solar energy is beginning to emerge in Côte d'Ivoire. This technology allows off-grid smallholder farmers and agri-businesses to increase their yields or process their crops after harvest. Solar companies in Côte d'Ivoire have started to offer a range of products such as solar water pumps and machinery for grinding cassava. However, the stakeholders interested in expanding energy access in Côte d'Ivoire require more information on off-grid PUE to seize the opportunities this technology unlocks and to promote PUE effectively. These stakeholders include government ministries and agencies, financial institutions, companies, development partners, and farmers' organizations.

1.2 Scope of the report and methodology

This report shares commercially valuable market intelligence on PUE in Côte d'Ivoire to help actors in this market drive increased PUE sales. This report aims to:

- Assess off-grid PUE technologies available and used in Côte d'Ivoire. This assessment also outlines the stakeholders installing and operating PUE, their marketing strategies to reach off-grid areas, and the barriers they have encountered.
- Assess the energy demand of smallholders.
- Assess the opportunities for new PUE technologies in Côte d'Ivoire and the organizations that can help scale their adoption, such as off-grid solar (OGS) companies, agricultural support programs, agro-processing companies, and agricultural organizations.
- Uncover the market potential of PUE and determine what support off-grid companies need to meet the energy demand of smallholder farmers.

The methodology of this report comprises desk research and a review of reports, statistics, and surveys by international and state organizations which are cited in the footnotes. The stakeholders interviewed for this report are OGS companies, international organizations implementing off-grid energy programs, financial institutions, government ministries, and others involved in Côte d'Ivoire's agricultural and energy industries. These interviews gathered data on PUE technology and service providers, energy demand, and the agricultural value chains that stand to benefit most from PUE. This report also assesses supporting services and international donors looking to invest in PUE. The findings of this report and its recommendations are available to all stakeholders interested in developing off-grid energy and agriculture in Côte d'Ivoire, including USAID Power Africa, the government of Côte d'Ivoire, and OGS companies.

2 COUNTRY OVERVIEW

This section is an overview of agriculture in Côte d'Ivoire; it focuses on the role of women in agriculture, the national programs supporting this sector, and how renewable energy and energy efficiency benefit agriculture.

2.1 Overview of agriculture in Côte d'Ivoire

Côte d'Ivoire is the third-largest economy in West Africa, with a GDP of $61.35 billion in 2020.[6] Côte d'Ivoire's economy has seen one of the highest rates of expansion in the world with an annual GDP growth of 7.36 percent in 2017, and 6.23 percent in 2019.[7]

The economy heavily depends on agriculture. In 2019, agriculture contributed almost a fifth of Côte d'Ivoire's GDP,[8] employed 40 percent of the country's working-age population,[9] provided a livelihood for nearly 70 percent of the Ivorian population,[10] and contributed 66 percent of export earnings. Agriculture contributes significantly to the state's budget through the Single Exit Duty on cocoa.[11] Côte d'Ivoire is the world's largest producer and exporter of cocoa beans and cashews, and is a major producer and exporter of coffee and palm oil. Agricultural goods such as cocoa, nuts, fruit, rubber, palm oil, and cotton account for almost 60 percent of the country's export earnings, with cocoa and cocoa products alone accounting for 39 percent of this income.[12] In comparison, mineral fuel, oil, and distilled products account for 17 percent, and pearls, precious stones, and metals for 8.5 percent of export earnings.

Because of its reliance on exports, Côte d'Ivoire's economy is highly sensitive to fluctuations in commodity prices and to climatic conditions that harm agriculture. Its GDP growth rate slowed to 1.8 percent[13] in 2020 because of the COVID-19 pandemic, which has weakened global demand mainly for petroleum products and forestry, but also depressed agricultural exports.[14]

According to the African Development Bank (AfDB), the weakened global economy and lower demand for exports have harmed Côte d'Ivoire's primary industries, including export agriculture (reduced by 2.2 percent), agro-food industries (-1.3 percent), forestry (-16.5 percent), mining (-4.8 percent), petroleum

---

[6] "GDP (Current US$)—Côte d'Ivoire," World Bank, 2020, accessed February 2, 2022, https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=CI.

[7] "GDP growth (annual %)—Cote, World Bank, 2019, accessed June 3, 2022, d'Ivoire, https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?end=2019&locations=CI&start=1961&type=shaded&view=map&year=2019.

[8] "Côte d'Ivoire," CIA World Factbook, January 18, 2022, accessed February 2, 2022, https://www.cia.gov/the-world-factbook/countries/cote-divoire/.

[9] "Employment in agriculture (% of total employment) (modeled ILO estimate)—Côte d'Ivoire," World Bank, January 29, 2021, accessed February 9, 2022, https://data.worldbank.org/indicator/SL.AGR.EMPL.ZS?locations=CI.

[10] CGAP, *Understanding the Demand for Financial, Agricultural, and Digital Solutions from Smallholder Households: Insights from the Household Survey in Côte d'Ivoire* (CGAP, 2018), page 7, accessed February 2, 2022, https://www.cgap.org/sites/default/files/publications/slidedeck/Insights_from_Smallholder_Household_Survey_CotedIvoire_English_1.pdf.

[11] Brahima Coulibaly, personal communication, February 2021.

[12] "Ivory Coast Exports by Category," Trading Economics, 2019, accessed February 2, 2022, https://tradingeconomics.com/ivory-coast/exports-by-category.

[13] "GDP Growth (Annual %)—Côte d'Ivoire," World Bank, 2019, accessed February 2, 2022, https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=CI.

[14] "Côte d'Ivoire Economic Outlook," AfDB, March 2021, accessed 2 February, 2022, https://www.afdb.org/en/countries/west-africa/cote-d%E2%80%99ivoire/cote-divoire-economic-outlook.

products (-26.9 percent), and transport (-1.8 percent). Inflation, due to higher food and transport prices, rose from 0.8 percent in 2019 to 1.8 percent in 2020, compounding economic difficulties. The government's budget deficit also doubled from 2.3 percent to 5.5 percent of GDP in 2020 because of expenditure on economic support and extra financing for healthcare to deal with one of the highest COVID-19 infection rates in West Africa. This spending was funded by loans, programs, and borrowing from the region's financial market, which compensated for increased imports and falling exports in 2020.[15]

Since 1994, Côte d'Ivoire has carried out a large program of structural reforms to increase private-sector growth. This program includes privatization and state withdrawal from agricultural production and processing companies in the cocoa-coffee, rubber, palm oil, sugar, and cotton industries. To lessen its dependence on commodity exports, the government of Côte d'Ivoire is prioritizing agricultural processing of the goods it produces as an area for development.[16, 17]

Figure 1: World map indicating countries' GDP growth in 2019. Côte d'Ivoire (marked red) has experienced one of the highest GDP growth rates (between 6.23 and 7.36) percent from 2017 to 2019, and 1.8 percent in 2020.

Ivorian agriculture comprises two sub-sectors:

- Cash crop agriculture: Consists of export crops (e.g., cocoa, nuts, fruit, rubber, palm oil, and cotton) cultivated by 72 percent[18] of farmers, with low national consumption (except for palm oil).
- Subsistence agriculture: Focuses on plantains, yams, cassava, rice, maize, vegetables, livestock farming, and fishing. Subsistence agriculture relies on traditional farming methods and is practiced by 82 percent[19] of farmers, who are inadequately supported by the state and receive little public funding.

[15] "Côte d'Ivoire Economic Outlook," AfDB, March 2021, accessed 2 February, 2022, https://www.afdb.org/en/countries/west-africa/cote-d%E2%80%99ivoire/cote-divoire-economic-outlook.

[16] Government of Côte d'Ivoire, *Programme National d'Investissement Agricole PNIA* (Abidjan: Government of Côte d'Ivoire, July 2010), pp. 28–29; 34. (This document is not currently publicly available and was obtained through stakeholder consultations.)

[17] Ministry of Agriculture and Rural Development, *PNIA 2: Programme National d'Investissement Agricole 2 (2018–2025)* (Abidjan: Ministry of Agriculture and Rural Development, 2018), pp. 5; 29; 42; 44–45, https://www.gafspfund.org/sites/default/files/inline-files/7b.%20Ivory%20Coast_Investment%20Plan.pdf.

[18] Calculated based on data from: FAO, *Synthèse des résultats du Recensement des Exploitants et Exploitations Agricoles (REEA) 2015–2016, Volume 2* (Abidjan: FAO, 2019), p. 24, https://www.fao.org/3/CA3110FR/ca3110fr.pdf.

[19] Ibid.

Family farms drive Ivorian agriculture. These farms rely on manual labor for sowing, soil preparation, irrigation, and post-harvest processing, rarely using modern farming equipment. A farmers' census carried out from 2015 to 2016 by FAO identified 1,407,451 family farms.[20] Eighty-nine percent farm on plots smaller than 10 ha, with the average household farming on 3.89 ha.[21]

Livestock farming, including chicken, goats and cattle, is practiced throughout the country, with sheep also reared primarily in the northern Savannah region.[22] Fishing comprises industrial sea fishing, where sardine is the most important catch, as well as small-scale inland, lagoon and sea fishing, and aquaculture, which yields low volumes.

Figure 2 shows the number of family farms according to their focus, illustrating the prevalence of agriculture and livestock.

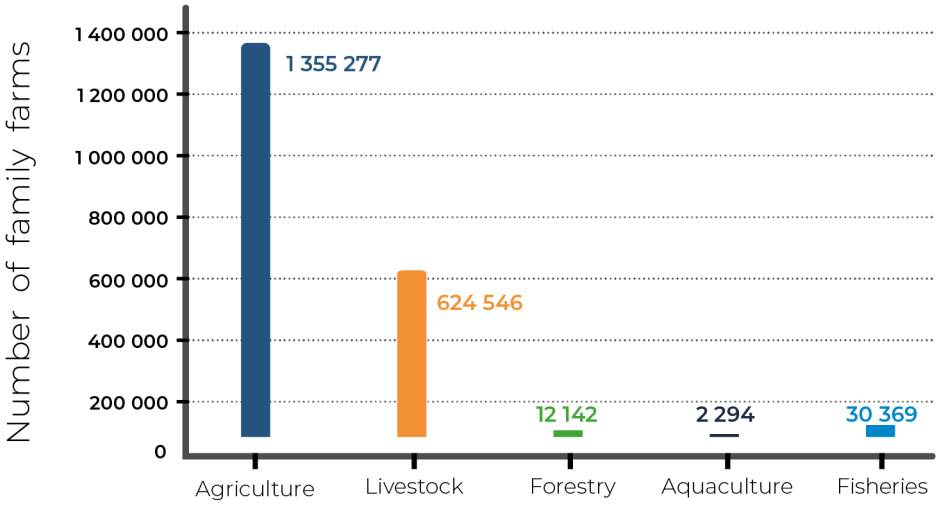

Figure 2: Distribution of family farms by activity.[23]

According to a census conducted by FAO from 2015 to 2016,[24] family farms are concentrated in the western and south-western areas of Côte d'Ivoire. In the west, the Tonkpi region has the highest number of farming households (106,469), and the northern regions have the lowest number. More than a quarter of family farms are located in urban areas throughout the country.

Most of Côte d'Ivoire's farmers have neither formal agricultural training nor a diploma or qualification. Sixty-seven percent of farmers are illiterate, with literate farmers concentrated in the southern regions of Côte d'Ivoire.[25] Dominant crops in these areas—apart from coffee and cocoa—are oil palm, rubber, dessert banana, and pineapple. These crops are typically grown by more educated farmers, including civil servants, and an increasing number of learners who left school prematurely and have turned to farming as part of the

[20] Ibid.

[21] Government of Côte d'Ivoire, *Programme National d'Investissement Agricole PNIA* (Abidjan: Government of Côte d'Ivoire, July 2010), p. 19. (This document is not publicly available and but was obtained through the stakeholder consultations.)

[22] Corinne Riquet, David Musiime, and Collins Marita, National Survey and Segmentation of Smallholder Households in Côte d'Ivoire: Understanding Their Demand for Financial, Agricultural, and Digital Solutions, working paper, (Washington, D.C.: CGAP, March 2017), https://www.cgap.org/sites/default/files/Working-Paper-Survey-and-Segmentation-Smallholders-Coted%27Ivoire-Jul-2017.pdf.

[23] FAO, *Synthèse des résultats du Recensement des Exploitants et Exploitations Agricoles (REEA) 2015–2016, Volume 2* (Abidjan: FAO, 2019), p. 26, https://www.fao.org/3/CA3110FR/ca3110fr.pdf.

[24] Ibid.

[25] The national the literacy rate is 45 percent (53.3 percent for men and 36.3 percent for women). See FAO, Synthèse des résultats du Recensement des Exploitants et Exploitations Agricoles (REEA) 2015–2016, Volume 2 (Abidjan: FAO, 2019), p. 7, https://www.fao.org/3/CA3110FR/ca3110fr.pdf.

social-professional integration policies for young people initiated by the government of Côte d'Ivoire.[26]

The FAO census also shows[27] that, although cooperatives are present in more than 25 percent of rural villages nationwide, few farmers (5.6 percent) are members of professional agricultural or livestock organizations. Some initiatives, such as the National Association of Professional Organizations of Côte d'Ivoire (*Association Nationale des Organisations Professionnelles Agricoles de Côte d'Ivoire* [ANOPACI]), attempt to organize farmers into groups, but are still insufficient to reach most farmers.

The cocoa and coffee sectors also face several difficulties, including ageing orchards, limited maintenance of plantations, and diseases and pests such as brown pod rot, stem borers, and outbreaks of cacao swollen-shoot virus. Financial difficulties created by the poor functioning of the sector's management structures, set up after the sector was liberalized, also compound these issues. Coffee and cocoa yield volumes lower than their potential. Low levels of input use (e.g., fertilizers and pesticides) and the effect of climate change further harm output.[28]

Growing and harvesting coffee and cotton is labor-intensive, leading many farmers to prefer production of valuable rubber, cashew, and palm oil trees. These earning opportunities also attract "part-time" farmers, who start farming as a secondary activity alongside other income-generating activities, such employment in urban areas.

Box 1. The potential of rubber in Côte d'Ivoire

Côte d'Ivoire is the leading African producer of natural rubber, having produced 600,000 tons in 2020, representing 70 percent of African production. The government of Côte d'Ivoire aims to reach two million tons in 2023. The Association of Natural Rubber Professionals of Côte d'Ivoire (*Association des Professionnels du Caoutchouc Naturel de Côte d'Ivoire* [APROMAC]) reported that its turnover increased from $207 million (120 billion West African Franc) in 2008 to $854 million (495 billion West African Franc) in 2017. In the same period, the income distributed to farmers increased from $69 million to $173 million (40 billion to 100 billion West African Franc). **The rubber industry offers 300,000 direct jobs, providing a living for more than 900,000 people.**

Ivorian agriculture is characterized by a low level of irrigation. Côte d'Ivoire's arable land is estimated to be 17 million ha, or 53 percent of the country's total area. The irrigable potential from surface water sources, with and without dams, is estimated to be approximately 430,685 ha, of which 32,484 ha is used (see Figure 3).[29]

[26] FAO, *Synthèse des résultats du Recensement des Exploitants et Exploitations Agricoles (REEA) 2015–2016, Volume 2* (Abidjan: FAO, 2019), p. 26, https://www.fao.org/3/CA3110FR/ca3110fr.pdf.[27] Ibid.

[28] "Production de Caoutchouc Naturel: La Côte d'Ivoire ambitionné d'atteindre 2 millions de tonnes dans les cinq prochaines années," Portail Officiel du Gouvernement de Côte d'Ivoire, October 23, 2018, accessed February 2, 2022, http://www.gouv.ci/_actualite-article.php?d=1&recordID=9333.

[29] FAO, *Synthèse des résultats du Recensement des Exploitants et Exploitations Agricoles* (REEA) 2015–2016, Volume 2 (Abidjan: FAO, 2019), p. 6, https://www.fao.org/3/CA3110FR/ca3110fr.pdf.

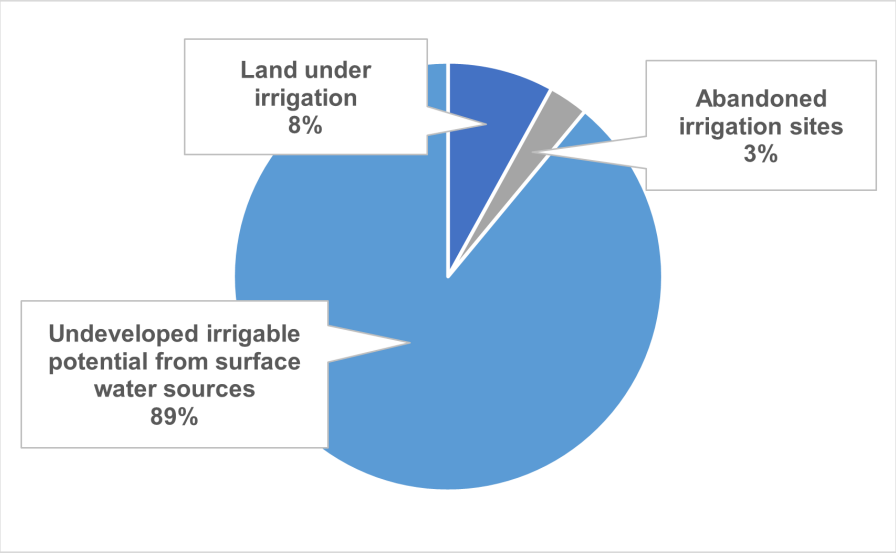

Figure 3: Potential irrigable land and its use.

In summary, the agricultural sector in Côte d'Ivoire is characterized by:

- Low productivity and low yields
- Low purchase prices from farmers
- High input costs
- Significant post-harvest losses between 30 and 50 percent[30]
- The inadequate use of modern farming practices (e.g., low levels of irrigation)
- A very low level of product processing
- Aging plantations (e.g., in cocoa and coffee value chains)

Women in agriculture

Subsistence farming employs 85 percent of the agricultural labor force, 90 percent of whom are women. But of the 1.74 million farmers or heads of farms in Côte d'Ivoire, only 21.8 percent are women.[31]

Despite the involvement of women in producing and selling produce, several obstacles limit their involvement in economic activities, particularly unequal access to land, resources, and division of labor.[32]

Unequal access to land and resources

Ivorian laws allow women to purchase land, but in practice, women typically exercise this right only in urban areas. In some rural areas, local customs prevent women from inheriting land, and the lack of collateral further limits their access to credit. Inclusive microcredit initiatives, therefore, are an effective means for women to pursue financial empowerment. One exemplary initiative is the Ivorian African Finance Company (*Compagnie Financière Africaine* [COFINA]) Group's subsidiary, the Financial Institution Dedicated to Women Entrepreneurs in Africa (*l'Institution Financière dédiée aux Femmes Entrepreneures d'Afrique* [Fin'ELLE]), which supports loans to female micro-entrepreneurs. However, only a limited number of these initiatives offer favorable conditions for women.

[30] Ibid, pp. 24–26.

[31] Ibid.

[32] AFD, "Profil Genre Côte d'Ivoire," AFD, December 2016), page 2, accessed February 2, 2022, https://plateforme-elsa.org/wp-content/uploads/2016/10/Profil-Genre-Cote-Ivoire.pdf.

The division of labor

Women work primarily in subsistence farming, whereas men work primarily on plantations in commercial agriculture (e.g., cocoa, palm, and rubber), which is largely for export.[33] Although subsistence farming contributes to food self-sufficiency and food security, investors are reluctant to invest in this type of farming. With low investment, female farmers can realize only marginal improvements to their livelihoods. Subsistence farmers receive less social recognition in economic policies.

In aquaculture and fishing, men are involved primarily in fishing, whereas women are involved in fish processing, often working in factories. Women sometimes use the money that they earn through this employment for financing fishing-based microenterprises. Although illiteracy rates are high among women in northern and southeastern Côte d'Ivoire, the country's eastern regions have the highest rates.[34]

Ongoing national programs supporting agriculture

The government of Côte d'Ivoire has established several programs to alleviate problems constraining the agricultural industry. Its two major interventions are outlined below.

The National Agricultural Investment Program (Programme National d'Investissement Agricole [PNIA 1])

PNIA 1 was a support program with a budget of $2.8 billion (1.6 trillion West African Franc) implemented from 2012 to 2016. The program supported mainly irrigated crops, including lowland rice, rain-fed rice, plantain banana, cassava, cotton, cashew nuts, and cocoa. Its aim was to increase production, reduce poverty, and reduce social, economic, and cultural inequalities among vulnerable groups and between women and men. The program also aimed to involve more private-sector actors and to process at least 50 percent of agricultural products locally. The PNIA also intervened in issues of gender inequality in agriculture, reviewing land tenure laws to improve women's access to land ownership and establishing a fund to finance female farmers.

National Agricultural Investment Program (PNIA 2)

PNIA 2 runs from 2018 to 2025, with a budget of approximately $21 billion (12 trillion West African Franc). PNIA 2 aims to make Ivorian agriculture more competitive and share incomes from farming more equitably. The program promotes sustainable fishing and agro-silvo-pastoral practices (i.e., those combining agriculture, livestock, and pastures); prioritizes inclusive growth that guarantees rural development and the wellbeing of populations; and seeks to regionalize agricultural production and processing.

2.2 Energy access in Côte d'Ivoire

Côte d'Ivoire has one of the best energy infrastructures in West Africa, and the government of Côte d'Ivoire aspires to make the country a regional leader in electrification. Off-grid PUE for agriculture, including equipment for processing cocoa beans, the country's leading export, will increase economic activity in Côte d'Ivoire and aid rural development. The government of Côte d'Ivoire has committed to meeting the population's energy demand by increasing installed generation capacity by approximately 150 MW each year, largely through independent power producers. The government and its partners increased national grid coverage from 33.1 percent in 2011 to 73.6 percent in June 2020 (see Figure 4).[35] It also plans to diversify the generation matrix to include a larger share of hydropower, biomass, solar, and imported liquefied natural gas.

[33] JICA, Country Gender Profile: Côte d'Ivoire, (JICA, March 2013), p. 29, https://www.jica.go.jp/english/our_work/thematic_issues/gender/background/c8h0vm0000anjqj6-att/cotedivoire_2013.pdf.

[34] FAO, *Synthèse des résultats du Recensement des Exploitants et Exploitations Agricoles* (REEA) 2015–2016, Volume 2 (Abidjan: FAO, 2019), pp. 24–26, https://www.fao.org/3/CA3110FR/ca3110fr.pdf.

[35] "Côte d'Ivoire," Tracking SDG 7: The Energy Progress Report, 2021, accessed February 2, 2021, https://trackingsdg7.esmap.org/country/Cote-divoire.

Although the country's electricity grid is relatively expansive and access rates are high (80 percent), only 42 percent of rural areas are grid connected, compared with 94 percent of urban areas.[36] The actual share of household connections is also low because of the up-front cost of connecting to the grid.[37]

In its medium and long-term rural electrification planning, the government of Côte d'Ivoire has prioritized grid extension rather than developing mini-grids, and seeks to extend the power grid to reach 100 percent of the population by 2025. The government will subsidize household connections to the grid through the National Rural Electrification Program (*Programme National d'Electrification Rurale* [PRONER]). By the end of 2020, approximately 80 percent of the locations prioritized for the first phase of this program were electrified.[38] As part of the government's Social Program,[39] PRONER also aims to improve the living conditions of the population through access to electricity, empower women, and generate youth employment.

PRONER's grid extension strategy requires increased financial resources to electrify many remote rural locations, especially those more than 20 km from the national grid. This high cost of connecting to the grid, and the fact that PRONER prioritizes only villages with a population larger than 500 inhabitants, will likely continue the rural-urban discrepancy in energy access.

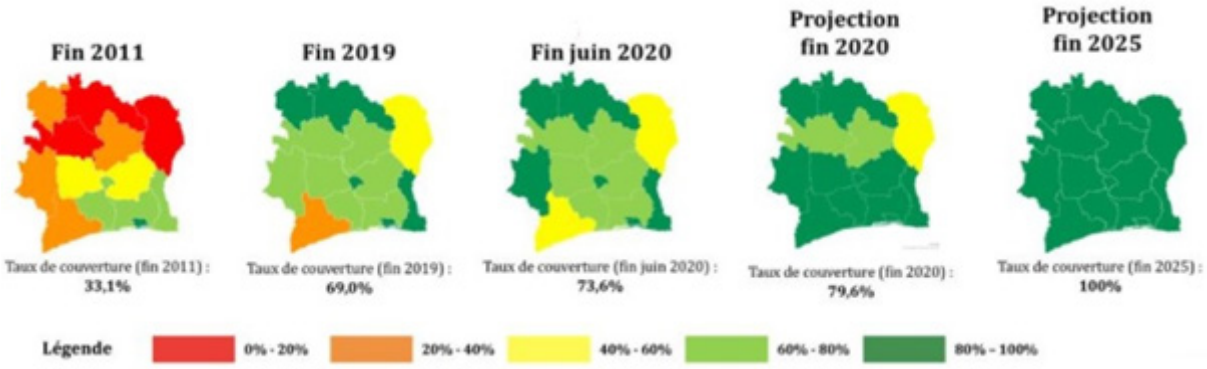

Figure 4: Expansion of the electricity grid from 2011 to 2020, with a projection for 2025.

The country does struggle with limited generation capacity. Technical delays and low water levels at hydropower dams in May 2021 caused a 200 MW power generation deficit and power outages,[40] disabling cocoa grinding machines and interrupting the cold chain for foodstuffs like fish. Climate change will likely worsen low water levels at hydropower dams, increasing the number of power cuts.

[36] "Côte d'Ivoire," Tracking SDG 7: The Energy Progress Report, 2021, accessed February 2, 2021, https://trackingsdg7.esmap.org/country/Cote-divoire.

[37] Power Africa, "Energy Sector Overview: Côte d'Ivoire," USAID, n.d., accessed February 2, 2022, https://www.usaid.gov/sites/default/files/documents/1860/CDIPACFSDEC2017.508.pdf.

[38] Namizata Binaté Fofana, Benoît Ledjou, and Wadjamsse B. Djezou, "Promouvoir la centrale à biomasse: Une solution à l'autonomisation de la femme rurale en Côte d'Ivoire," policy brief no. 232 (Partnership for Economic Policy, March 2021), p. 1, https://portal.pep-net.org/document/download/36083.

[39] "Accélération de l'accès à l'électricité par le renforcement du Programme National d'Electrification Rurale (PRONER)," Programme Social du Gouvernement 2019–2020, 2019, accessed February 2, 2022, https://psgouv.ci/welcome/details_sous_menu3/acclration-de-l-accs-l-lectricit-par-le-renforcement-du-programme-national-d-electrification-rurale-proner363.

[40] Loucoumane Coulibaly, "Power Generation Woes in Ivory Coast and Ghana Hit Industry and Neighbours," Reuters, May 11, 2021, accessed February 2, 2022, https://www.reuters.com/business/energy/power-generation-woes-ivory-coast-ghana-hit-industry-neighbours-2021-05-11/.

Gender and energy access

The Côte d'Ivoire Energy Sector Gender Profile,[41] published by the AfDB in 2016, suggests several interventions to improve women's energy access, such as:

- Identifying the different income-generating activities men and women would undertake if they had access to electricity
- Investing in both women's and men's businesses that use energy
- Investing in labor-saving technology and energy services that alleviate the drudgery of domestic tasks (such as mills)
- Increasing employment for women and men in the energy sector
- Taking into account gender differences in customers' ability and willingness to pay for energy services and solve gender-based constraints
- Prioritizing milling, refrigeration, and ice-making for food preservation, which are key income-generating opportunities for women

A study of PRONER's effects on women's empowerment found that the program **benefited women in the categories "time allocation" and "job quality."**[42] Electrification through PRONER allowed women to spend 13 percent less time on household tasks and reallocate their time to diversified income-generating activities, spending 14 percent more time on agriculture and 23 percent more time on non-agricultural income-generating activities. Women were also 57 percent more likely to have a full-time job and four percent more likely to have a paid job. These results demonstrate electrification's benefits for household well-being and gender equality.

Ongoing programs supporting the energy sector

Because PRONER lacks the resources to reach all Ivorians, particularly the poorest and most remote people, several technical and financial partners have put in place complementary projects to fill these gaps. PRONER also does not include agriculture and PUE in its electrification strategy. However, recently established programs—such as the Off-grid Electrification Action Plan (*Plan National d'Électrification hors Réseau* [PAEHR]) and the Sectoral Policy for the Development of Renewable Energies and Energy Efficiency (*Politique Sectorielle de Développement des Energies Renouvelables et de l'Efficacité Energétique* [PSDEREE])—prioritize PUE in agriculture, as summarized below and in section 2.2.3.

Project to Improve Access to Electricity in Rural Areas (Projet d'Amélioration de l'Accès à l'Électricité en Milieu Rural [PAEMIR])

PAEMIR, funded by the AfDB, aims to extend the country's medium-voltage electricity networks and connect rural areas, prioritizing remote areas far from the electricity grid. The project covers three northern districts (Savanes, Woroba, and Zanzan), focuses on 426 localities, and reaches an estimated population of 259,486 inhabitants. PAEMIR also aims to connect dozens of schools, training centers, and health facilities to the grid.[43]

[41] African Development Bank (AfDB), "Côte d'Ivoire Energy Sector Gender Profile," AfDB, 2016, accessed February 2, 2022, https://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/RCI_Energy_Sector_Gender_Profile-2016.pdf.

[42] Namizata Binaté Fofana, Benoît Ledjou, and Wadjamsse B. Djezou, "Promouvoir la centrale à biomasse: Une solution à l'autonomisation de la femme rurale en Côte d'Ivoire," policy brief no. 232 (Partnership for Economic Policy, March 2021), p. 1, https://portal.pep-net.org/document/download/36083.

[43] Ibid.

Electricity for All Program (Programme Électricité Pour Tous [PEPT])

PEPT, in cooperation with the Ivorian Electricity Company, aims to connect one million households to the gird in the period of 2015 to 2020, averaging 200,000 households annually.[44] PEPT prioritizes low-income households which rely on income from seasonal farming and informal trade. These households usually find it difficult to save and pay for a grid connection. Between 2014 and June 2020, PEPT benefited 884,036 households (or 5.3 million citizens) with a connection subscription to the electricity grid. The most vulnerable populations have benefited from a **20 percent reduction in the cost of electricity per kWh.** At the end of June 2020, approximately 1,200,000 households benefited from this reduction.[45]

Off-grid Electrification Action Plan (Plan National d'Électrification hors Réseau [PAEHR])

PAEHR aims to improve access to electricity by promoting and implementing decentralized energy solutions, and to provide a better quality of life for all rural and peri-urban households.[46] PAEHR will foster the development of the OGS market in Côte d'Ivoire by removing barriers and providing incentives for OGS companies to enter the formal market. The action plan will help rural end-users improve their quality of life through access to modern energy services such as lighting, radio, television, mobile communication, the digital economy, and the internet. Beneficiaries can use their off-grid equipment to enhance their income-generating capacity by extending service hours, boosting agricultural productivity, processing harvests, and conserving produce. PAEHR will help to develop an enabling environment for growing the off-grid energy sector sustainably by promoting an inclusive supply chain and helping to develop local entrepreneurial skills. PAEHR aims to improve women's living conditions and reduce the exodus of youth from rural areas by expanding the opportunities offered by access to energy.

Other programs

The government of Côte d'Ivoire has announced other energy-access programs and funds that have never become operational, often because of a lack of resources. For example, the National Investment Program for Access to Energy Services in Côte d'Ivoire (*Programme d'Investissement pour l'Accès aux Services Énergétiques en Côte d'Ivoire* [PNIASE-CI]) was supposed to be implemented from 2012 to 2015. The program aimed to improve access to electricity, modern cooking energy, and PUE, increasing the use of solar power for irrigation pumping and other agricultural uses.

Renewable energy and energy efficiency

The use of solar energy in Côte d'Ivoire is still far below its potential; renewables comprised only 21 percent of the country's energy mix in 2018.[47] Most solar installations are **isolated mini-grids, standalone off-grid systems in remote villages,** or rooftop systems (on- or off-grid) in urban areas. Only a few isolated pilot projects have been developed by the private sector or NGOs for schools, health centers, or some remote residences.[48] Three photovoltaic (PV) power plants are under development (25 MW in Benguébougou, 66 MW in Korhogo, and 37.5 MW in Boundiali).[49]

---

[44] "Programme Electricité Pour Tous (PEPT)," Compagnie Ivoireienne d'Electricite (CIE), 2015, accessed February 2, 2022, https://www.cie.ci/pept/.

[45] "Electrification en Côte d'Ivoire : Voici les chiffres à fin juin 2020," Ministry of Mines, Petroleum, and Energy, September 8, 2020, accessed February 2. 2022, http://www.energie.gouv.ci/actualites/details_actualite/electrification-en-cte-d-ivoire-voici-les-chiffres-fin-juin-2020760.

[46] "Plan d'Actions de l'Electrification Hors-Réseau de la Côte d'Ivoire (PAEHR)," November 2019. (This document is not public and was obtained through the stakeholder consultations.)

[47] Ministry of Mines, Petroleum, and Energy, *Politique Sectorielle de Développement des Énergies Renouvelables et de l'Efficacité Energétique en Côte d'Ivoire 2020–2030 (PSDEREE)*, (Abidjan: Government of Côte d'Ivoire). (This document is not publicly available and was obtained through consultation with stakeholders.)

[48] "Côte d'Ivoire," GET.Invest, 2022, accessed February 2, 2022, https://www.get-invest.eu/market-information/cote-divoire/.

[49] Emiliano Bellini, "Ivory Coast Announces Another 66 MW Solar Plant," PV Magazine, November 1, 2018, accessed February 2, 2022, https://www.pv-magazine.com/2018/11/01/ivory-coast-announces-another-66-mw-solar-plant/.

Côte d'Ivoire's National Action Plan for Renewable Energies (*Plan d'Action National des Energies Renouvelables* [PANER]) aims to **increase the share of renewable power in the energy mix to 42 percent by 2030,** 16 percent of which will be solar. The only PUE mentioned in this plan are solar water heaters for food processing. PANER is based on the principles of the ECOWAS (Economic Community of West African States) gender policy, which encourages energy policies and programs that enhance women's wellbeing and reduce their working hours.

The PSDEREE program aims to stimulate private investment in renewable energy and energy efficiency, mostly through large-scale infrastructure projects like hydro-electric power plants. PSDEREE also prioritizes renewable energy to electrify remote locations and promotes PUE for domestic, industrial, and agricultural uses.

In 2016 the government of Côte d'Ivoire established the National Fund for Energy Efficiency (*Fond National pour la Maitrise de l'Energie* [FONAME]). The fund aims to stimulate investment in energy through credit and subsidies, and guarantees to:

- Promote technical innovation and to help disseminate efficient technologies for energy management
- Demonstrate the feasibility of these technical innovations through pilot projects
- Finance programs promoting efficiency and renewable energy

Although the fund is not yet operational, the Ministry of Mines, Petroleum, and Energy has set up the fund's council and is negotiating with donors how best to sponsor the fund.

3 SUPPLIERS OF PRODUCTIVE USE OF ENERGY TECHNOLOGY

This section provides an overview of the PUE technologies available on the Ivorian market and the companies supplying them. Typically, PUE equipment suppliers are companies offering mainly solar energy products like pumps, fridges, and freezers. Some technology providers are local manufacturers of solar dryers or mills.

3.1 Sectorial overview

The role of technology providers is to offer PUE appliances with a good cost-benefit ratio that are adapted to the local context, and to provide after-sales service. Ideally, they form partnerships with microfinance institutions (MFIs) to offer credit and payment plans adapted to their rural customers.

This assessment identifies 17 companies that distribute PUE technology in Côte d'Ivoire (see Table 1 below). More companies, such as Baobab+ and Aphelion, are developing and introducing PUE appliances, although these are not yet offered in their product ranges. Other PUE suppliers have withdrawn from the market, such as Phaesun and Station Energy.

TABLE 1: SOLAR COMPANIES DISTRIBUTING PUE APPLIANCES IN CÔTE D'IVOIRE

COMPANIES	PUE TECHNOLOGIES	PRODUCT BRANDS/SUPPLIERS
AD Solar	• Solar pumps	• Lorentz and Futurepump
Africool	• Solar fridges • Solar freezers	• Keco
Beeshop	• Solar freezers	• Leap Solar
Caprari West and Central Africa	• Solar pumps	• Caprari
Eco Solar	• Solar freezers	• Leap Solar
ED Service	• Solar pumps • Solar fridges and freezers • Cassava grinders	• Grundfos and Lorentz • Nasco 1250M
EHUABO SAS	• Solar fridges • Solar cold rooms	• Coldinnov
GMACI (*Groupe Marketing des Affaires et Courtage International*)	• Solar fridges • Solar cold rooms	• Coldinnov
La Belle Caille de Songon	• Corn grinding machines • Egg incubators	• Fiem • Novital
Mady Koanda	• Solar fridges • Solar freezers	• Supergreensolar/ Solargreen
NOA Trading	• Solar pumps	• Grundfos and Lorentz
PEG Côte d'Ivoire	• Solar pumps • Solar fridges	• Davis & Shirtliff • Nilo
Schneider Electric Côte d'Ivoire	• Solar pumps	• Schneider Electric

COMPANIES	PUE TECHNOLOGIES	PRODUCT BRANDS/SUPPLIERS
SI2E ENR (*Société Ivoirienne d'Efficacité Energétique et des Energies Renouvelables*)	• Solar fridges • Solar cold rooms	• Coldinnov
SIV Energy	• Solar fridges • Solar cold rooms	• Coldinnov
Yandalux	• Solar pumps • Solar fridges	• Britefil • Steca
ZECI SAS	• Solar pumps	• SunCulture (not yet commercialized)

Note: This table does not include companies that distribute SHS or solar lanterns.

3.2 Findings on productive use of energy technology suppliers

Irrigation suppliers

Lorentz and Grundfos, which offer larger-capacity pumps, are well represented in Côte d'Ivoire. Futurepump, Schneider Electric, and SunCulture offer several smaller pumps designed to irrigate small farms, supply water to households, and pump water for fish farms or livestock. These pumps integrate PAYGO software, allowing smallholders to pay in installments. The pumps are portable, allowing users to change the pump's application or to share it with neighboring farms.

Figure 5: A small portable pump by Futurepump available in Côte d'Ivoire.

Cooling suppliers

A variety of solar cooling solutions has become available on the Ivorian market. These products include fridges and freezers, solar-powered street vending carts, milk tanks, icemakers, and cold rooms, offering a range of opportunities for off-grid micro-enterprises. Currently, one modular cold room, FREECOLD by Coldinnov, is available in Côte d'Ivoire and is distributed by four companies: Ehuabo SAS, Business Marketing and International Brokerage Group (*Groupe Marketing des Affaires et Courtage International* [GMACI]), SIV Energy, and SI2E ENR. Three of the solar fridges (by Nilo, LEAP Solar, and Steca) are VeraSol-certified.[50]

Figure 6: Some of the solar cooling solutions available in Côte d'Ivoire.

[50] "VeraSol Product Database," VeraSol, 2021, accessed February 2, 2022, https://data.verasol.org/.

PUE suppliers interviewed for this assessment reported selling solar fridges and street vending carts for cash to vendors who sell fish, chicken, and other perishable consumer goods. The suppliers marketed these products through social media, tele-sales, and demonstrations at markets and exhibitions. One distributor, Ehuabo SAS, is negotiating with a fish store in Sakassou in central Côte d'Ivoire to supply a customized solar cold room.

Dryer suppliers

Solar dryers and solar mills are not yet commercially available, but the Félix Houphouët-Boigny University is developing solar dryer models; they require further testing before companies introduce them into the market in Côte d'Ivoire.

Agro-processing suppliers

Few solar-powered agro-processing products are available in Côte d'Ivoire, with ED Service being the only manufacturer and distributor of a solar cassava grinder. Phaesun, the only distributor of solar-powered mills and oil presses, has withdrawn from the Ivorian market.

Figure 7: Solar cassava grinder by ED Solar.

Lighting Global states in its report, Market Opportunity for Productive Use Leveraging Solar Energy (PULSE) in Sub-Saharan Africa, that solar-powered hullers, mills, and grinders are uncompetitive against established and wide-spread diesel-powered machines (see Section 5: Energy Demand in Key Agricultural Value Chains).

Sprayer suppliers

Solar sprayers are not yet commercially distributed, but are entering the Ivorian market via the cotton industry. The company Solar Village developed solar batteries for sprayers and has worked with the Ivorian Company for Textile Development (*Compagnie Ivoirienne pour le Développement des Textiles* [CIDT]) to test samples by cotton farmers.

4 ENERGY DEMAND IN KEY AGRICULTURAL VALUE CHAINS AND POTENTIAL FOR PUE TECHNOLOGY

4.1 Sectorial overview

Table 2 displays the **most important crops and value chains in Côte d'Ivoire's agricultural and livestock sector.** It summarizes energy needs throughout the segments of production, conservation, and processing across each respective value chain.

TABLE 2: ENERGY NEEDS IN IMPORTANT VALUE CHAINS IN CÔTE D'IVOIRE

	PRODUCTION			CONSERVATION			AGRO-PROCESSING			
Value chain	pumping/ irrigation	spraying	egg incubation	cooling	freezing	drying	hulling	milling	oil pressing	grinding
Coffee-cocoa	x	x				x	x			
Cashew	x	x		x			x			
Cotton	x	x							x	
Rubber	x	x								
Palm oil	x	x						x	x	
Rice	x	x				x	x			
Horticulture	x	x		x		x				
Cassava								x		x
Mango	x			x		x				
Kola nut	x									
Sugar cane	x							x		
Onion	x									
Shea	x					x	x		x	
Maize	x	x				x		x		
Coconut	x					x			x	x
Fruits	x	x		x		x				
Poultry	x		x	x	x					
Meat	x			x	x					
Fish	x			x	x					

Energy needs across the value chains vary. Crops such as cocoa, coffee, and oil palm require more energy in the nursery and during post-harvest processing, whereas market-bound garden crops constantly require large amounts of energy from the nursery and production phase—for irrigation and phytosanitary (plant health) treatment—to processing (e.g., for conservation through cooling or drying).

Irrigation demand

Almost all value chains require water supply; therefore, pump-irrigation solutions can increase agricultural yield and income significantly. Rather than depending on unreliable rainfall to water their crops, farmers can use irrigation to increase their productivity, diversify their crops, and increase their resilience to climate change.

The market for solar water pumping includes the 341,641 ha of non-irrigated agricultural land.[51] Assuming Côte d'Ivoire follows the trend throughout West Africa that only one percent of small farms use irrigation,[52] then the 56.3 percent of farms that are smaller than 2 ha may also be part of the market potential for solar irrigation (see Table 3).[53] Farmers with smaller farms may prefer smaller pumping solutions which are more affordable, such as those of SunCulture, Futurepump, and Schneider Electric.

TABLE 3: NUMBER AND SIZES OF FARMS IN CÔTE D'IVOIRE

	< 1 ha	1–2 ha	2–5 ha	5–10 ha	10–20 ha	20–50 ha
Number of farms (Total:1,117,667)	470,433	158,933	215,974	148,516	91,416	32,395
Share of farms	42.1%	14.2%	19.3%	13.3%	8.2%	2.9%

Cooling and drying demand

Crops such as fruits and vegetables benefit from conservation through cooling or drying. In mass quantities, these crops often require cold rooms rather than fridges. The meat, poultry, and fish value chains would benefit from businesses offering a wide range of fridges, freezers, ice-makers, and dryers for reducing loss due to spoilage.[54]

Spraying demand

Solar spraying solutions allow farmers to apply pesticides, disinfectants, and phytosanitary treatments to protect crops, thereby increasing production. Sprayers are easy to use and reduce labor across various value chains (see Table 2). Farmers can reduce operating costs by replacing diesel or battery-powered sprayers with solar-powered technologies.[55]

[51] FAO, *Synthèse des résultats du Recensement des Exploitants et Exploitations Agricoles (REEA) 2015–2016, Volume 2* (Abidjan: FAO, 2019), pp. 24–26, https://www.fao.org/3/CA3110FR/ca3110fr.pdf.

[52] Lighting Global, *Off-grid Solar Market Trends Report 2020* (Washington, D.C.: International Finance Corporation, March 2020), https://www.lightingglobal.org/wp-content/uploads/2020/03/VIVID%20OCA_2020_Off_Grid_Solar_Market_Trends_Report_Full_High.pdf.

[53] FAO, *Farms, Family Farms, Farmland Distribution and Farm Labour: What Do We Know Today?* (Rome: FAO, November 2019), p. 53, http://www.fao.org/3/ca7036en/ca7036en.pdf.

[54] Lighting Global, "The Market Opportunity for Productive Use Leveraging Solar Energy (PULSE) in Sub-Saharan Africa" (Washington, D.C.: IFC, 2019), pp. 26; 28; 34, https://www.lightingglobal.org/wp-content/uploads/2019/09/PULSE-Report.pdf.

[55] "Solar Village's Solution Benefits," Solar Village, n.d., accessed June 2, 2022, https://www.solarvillage.no/benefits.html.

Agro-processing demand

Agro-processing equipment is used to grind products like cassava, press oils, or hull and mill grain. Many farmers would benefit from increased access to this equipment; for example, 95 percent of farmers travel between two and seven kilometers to a mill to process rice.[56] Solar agro-processing benefits women in particular, who are often in charge of processing crops manually and are more likely to carry heavy loads of grain over long distances to and from diesel-powered agro-processing services. Increasing the availability and sale of local agro-processing solutions would shorten travel distances and reduce the daily burden of Ivorian women. Unfortunately, demand for solar agro-processing products is limited by their lack of competitiveness against widespread diesel-powered equipment.[57]

4.2 Findings on energy demand in agriculture

There is demand for PUE technologies among smallholder farmers, agricultural cooperatives, agribusinesses, and agricultural processing companies. Development organizations, governments, NGOs, and associations with external funding drive the PUE sector by purchasing and implementing PUE technologies for projects.

Consider capital-sharing models

Some smallholders find it more economically viable to rent, rather than purchase, solar PUE equipment, given the small scale of their farms. The CEO of Volaille d'Or, a poultry farm, would rather rent an egg incubator than own one. By doing this, he can share it with other farms, outsource energy consumption, and pursue other periodic activities, like disinfecting chicken houses with a solar sprayer.[58] Some solar PUE equipment is adaptable for sharing, including the portable Futurepump that provides irrigation for small farms, and Solar Village's solar sprayer. However, in Côte d'Ivoire, **renting or leasing solar equipment is uncommon.** A successful sharing model requires good relationships and effective communication among farmers.

Expand farmers' awareness of PUE

Consultations with a sample of agricultural cooperatives reveal that members have limited knowledge of PUE. Among the cooperatives consulted, members reported familiarity with solar PV equipment for domestic use, but not specifically about agricultural PUE technology. Among cooperatives, **informational and awareness-raising campaigns are necessary to promote PUE technologies and their potential.** According to FAO, although cooperatives represent only 5.6 percent of farmers, they can act as aggregators to acquire solar PUE appliances for their members.

Understand the role of gender in PUE demand

In consultations, leaders of agricultural cooperatives reported that men are more likely to purchase PUE appliances, whereas women more often use them—particularly cooling solutions for consumer products and agro-processing. These claims are consistent with data from the GOGLA Powering Opportunity data dashboard, which finds that men in West Africa purchase 88 percent of solar products for domestic use.[59] **Further research is necessary to understand the barriers preventing women from investing in PUE technology.**

Women and men who farm and who invest in agricultural equipment for commercial agriculture can generate more income, reduce their physical labor, and reduce their working hours. In consultations with agricultural cooperatives, participants noted that according to traditional, culturally imposed gender roles for the division

[56] Ibid., p. 34.

[57] Lighting Global, "The Market Opportunity for Productive Use Leveraging Solar Energy (PULSE) in Sub-Saharan Africa" (Washington, D.C.: IFC, 2019), https://www.lightingglobal.org/wp-content/uploads/2019/09/PULSE-Report.pdf.

[58] Interview with the CEO of Volaille d'Or.

[59] "Powering Opportunity," GOGLA, n.d., accessed February 2, 2022, https://www.gogla.org/powering-opportunity#datavis.

of labor, women usually engage in unpaid subsistence farming, whereas men usually earn money through commercial agriculture.[60] **As women and men often take on these separate roles, more analysis is necessary to understand how PUE assists them in different ways.** For example, although many projects focusing on women seek to help them generate an income, not all women can earn money through PUE.

Expand to agro-industrial companies

Agro-industrial companies can be customers of PUE technologies in three different ways:

1. **End-users:** Companies like African Sugar (*Sucrerie Africaine* [SUCAF]) and Sucrivoire could be end-users of PUE technologies to produce and process sugarcane. However, these are companies use large-scale irrigation systems, which are not viable for solar PUE.
2. **Intermediaries:** Other agri-businesses carry out contract farming, buying inputs at the beginning of an agricultural campaign and distributing them to the contracted farmers. Agricultural cooperatives are the primary implementers that could benefit from PUE technologies. After the harvest at the end of the campaign, the companies recover their initial costs. This method helps to guarantee the delivery of the crops at harvest and retain farmers. Several companies and associations have adopted such a model: Ivory Cotton (*Ivoire Coton*) and the Ivorian Company for the Development of Textiles (*Compagnie Ivoirienne pour le Développement des Textiles* [CIDT]) in the cotton value chain; Palmafrique, PALMCI, and SIPEF-CI in palm oil; and SAPH in rubber. The company Solar Village is gaining experience with this approach by disseminating its solar sprayers as part of input packages in the cotton value chain, specifically with CIDT. It could test the same approach in rubber and oil palm nurseries.
3. **Corporate social responsibility (CSR):** The third way in which agro-industrial companies can become customers of PUE technologies is to use this equipment as part of their CSR programs. These companies include mostly foreign buyers and manufacturers of cocoa rather than producers (see Table 4 below).

TABLE 4: OVERVIEW OF CSR PROGRAMS IN THE COCOA VALUE CHAIN

CSR PROGRAM	GOAL	ORGANIZATION INVOLVED	RELEVANCE FOR PUE
Cocoa Horizons	To improve the livelihoods of cocoa farmers and their communities by promoting sustainable, entrepreneurial farming, improved productivity, and community development. After a two to three-year training course, farmers are supported to develop a business plan to improve productivity, diversify income, and adopt clean energy. For farmers that have developed their business plans, Cocoa Horizons offers: • Support to gain access to finance. • Farm services for more productivity. • Support for income diversification and women's empowerment.	Barry Callebaut	The program facilitates: • Access to productivity packages. • Empowering women in the cocoa industry. • Reducing pollution by disseminating improved stoves. • Helping establish village savings and credit associations. • Access to SHS that reduce kerosene burning for lighting. • Access to household water treatment systems.

[60] JICA, *Country Gender Profile: Côte d'Ivoire,* (JICA, March 2013), p. 29, https://www.jica.go.jp/english/our_work/thematic_issues/gender/background/c8h0vm0000anjqj6-att/cotedivoire_2013.

CSR PROGRAM	GOAL	ORGANIZATION INVOLVED	RELEVANCE FOR PUE
Cocoa Plan	• Providing training and resources to help farmers improve yields and quality, increasing income. and improving livelihoods. • Preventing child labor, empowering women, and improving education to help communities thrive. • Enhancing supply chain traceability and avoiding deforestation.	Nestlé	The Cocoa Plan works with cooperatives, e.g., Koado-Dué, by assisting women to produce food crops such as cassava, plantain, eggplant, and chili, and to raise livestock. The Cocoa Plan also helps increase women's incomes through processing primary products, including cassava grinding. To a large extent, women use the additional income to send their children to school and to help build schools.
Cocoa Promise	• Promoting professional cocoa farming practices to strengthen the social and economic resilience of cocoa farmers, especially women, and their communities. • Enhancing the safety and wellbeing of children and families in cocoa farming areas. • Promoting environmental best practices across the supply chain. • Strengthening more cooperatives with management tools (Coop Academy).	Cargill	The program supports: • Income diversification for financial, social, and environmental benefits (on- and off-farm). • A maize and tomato program with 130 farmers. • Empowerment and entrepreneurship opportunities for women and young farmers. • A gender awareness-raising training program for more than 70,000 Ivorian cocoa farmers through its network of 1,800 Farmer Field Schools with the support of ANADER. • Improved access to digital information sources to improve farms. Farmers receive voice messages on managing their farms. • A three-year leasing deal, allowing cooperatives to lease cocoa collection trucks (Doni Doni initiative). • Planned: A credit facility that provides cooperatives with approved, high-quality crop protection products.
TRECC Project	The TRECC ecosystem brings together the Ivorian government, companies in the cocoa and chocolate industry, philanthropic foundations, research partners, and civil society organizations. The project aims to develop evidence-based solutions that support early childhood development and improve the quality of education.	Jacobs Foundation	Although the project does not have a specific PUE component, it is involved in electrifying healthcare centers and schools to power digital tablets.

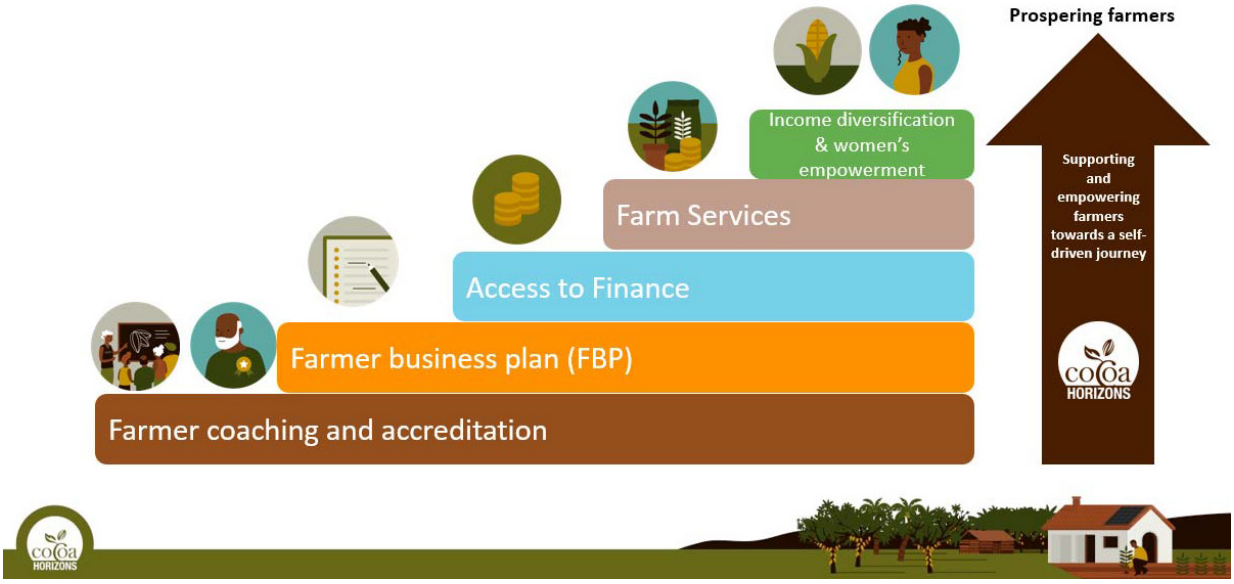

Figure 8: The support that Barry Callebaut's Cocoa Horizons Foundation offers to farmers.

Challenges to PUE product disctribution

Stakeholders who want to distribute PUE in Côte d'Ivoire must overcome technological, financial, and demand challenges.

One **technical challenge** are the prevalent diesel-powered hullers, mills, and grinders that outperform solar-powered versions. For example, solar hullers have a potential revenue lower than that of diesel hullers because of their lower processing capacity. Based on current systems, solar hullers are operational only six hours per day for 188 days of the year, whereas diesel hullers can operate eight hours per day for 243 days of the year. Solar mills for rice have 70 percent less capacity and cost six times more than diesel ones.[61]

Access to finance also limits companies' ability to innovate and diversify their products. For example, when the company Ehuabo sought to equip the processing machines of women's groups with solar generators to produce powdered spices, it found no way to finance the project. Additional financing would also improve the sector's ability to overcome technical challenges by innovating products to be competitive against diesel-powered machines.[62] End-use customers would also benefit from financial support; so far, **no programs exist to support farmers or retailers to purchase solar cooling devices.**

Uptake of solar agro-processing equipment may be low because of these products' inherently slow processing times, which result in longer customer waiting times. To be competitive, solar agro-processing equipment should match or improve the quality of processed rice achieved by small-scale diesel or grid-based processors. Additionally, **suppliers are not well connected to agricultural stakeholders and have little knowledge of the energy needs in the sector.** These suppliers require support to identify the relevant customer and market segments and develop business models for solar cold rooms.

[61] Lighting Global, "The Market Opportunity for Productive Use Leveraging Solar Energy (PULSE) in Sub-Saharan Africa" (Washington, D.C.: IFC, 2019), https://www.lightingglobal.org/wp-content/uploads/2019/09/PULSE-Report.pdf.
[62] Power for All, "Power for All Fact Sheet: Harnessing the Power of Solar for Agro-processing," Power for All, November 2020, accessed February 2, 2022, https://www.powerforall.org/application/files/8716/1355/4931/2020_FS_Solar_agro-processing.pdf.

5 SUPPORTING SERVICES

Supporting services create an enabling environment in which the PUE industry can grow. Examples of supporting services are:

- Those provided by **financial institutions and mobile money providers** that financially include smallholders and rural households, enabling them to invest in solar systems and PUE equipment.
- **Government and development programs** that extend technical assistance to PUE providers, network stakeholders, finance pilots, and support PUE adoption through subsidies or bank guarantees.
- **Training institutions** which ensure the long-term transfer of knowledge to farmers and solar technicians.

5.1 Sectorial overview

Several organizations and companies provide a range of supporting services to the energy and agriculture sectors in Côte d'Ivoire, including assistance with telecommunication, finance, and fintech, as outlined in Table 5 below.

TABLE 5. OVERVIEW OF SUPPORTING SERVICES

<table>
<tr><th>SUPPORTING SERVICE</th><th colspan="2">ORGANIZATION</th></tr>
<tr><td rowspan="6">Mobile network services</td><td colspan="2">All three mobile network operators in Côte d'Ivoire—Orange Côte d'Ivoire, MTN, and Moov—offer mobile money platforms. Users of mobile money have grown from 16,000 in 2014 to 93,000 in 2018.

Thirty-six percent of Côte d'Ivoire's smallholder farmers have used mobile money and 27 percent smallholders own a mobile money account (although male users outweigh female users).

Only MTN and Orange work with PAYGO platforms, and only five solar companies currently offer PAYGO systems. These companies distribute domestic solar systems, such as solar lanterns and SHS. PUE products are not yet widely sold through PAYGO.</td></tr>
<tr><td>Mobile money platforms offering PAYGO</td><td>Solar companies using PAYGO</td></tr>
<tr><td rowspan="2">MTN Mobile Money</td><td>Lumos</td></tr>
<tr><td>Fenix international</td></tr>
<tr><td rowspan="2">Orange Money</td><td>Orange Energy</td></tr>
<tr><td>PEG Africa</td></tr>
<tr><td colspan="2">The solar company ZECI, a joint venture by EDF and the American start-up OGE, also offers PAYGO options for SunCulture's solar pumps.</td></tr>
</table>

Financial services	Several financial institutions support solar energy. Commercial banks, such as Orabank and Société Générale, have financed renewable energy and energy efficiency projects or provided financial guarantees. However, as commercial banks focus mainly on larger businesses, many Ivorians rely on microfinance. Cooperatives or mutual institutions operating mainly in urban areas in the south and east of the country are the primary providers of microfinance. In recent years, MFIs have started to explore opportunities in rural areas. Leading MFIs are ADVANS, PAMF-CI, UNACOOPEC-CI, Baobab, and Cofina.
Training support	Under the supervision of the Ministry of Agriculture, the National Institute for Professional Agricultural Training (*Institut National de Formation Professionelle Agricole* [INFPA]) provides vocational training in agriculture, livestock raising, and literacy courses for farmers. ProFERE, an initiative by GIZ, aims to strengthen the supply of specialized technical and managerial knowledge in the field of renewable energy and energy efficiency in Côte d'Ivoire. ANADER's e-extension program also offers information on agriculture and online resources (see Section 6.2).

5.2 Findings on supporting services

Mobile network services

In 2017, 41 percent of Côte d'Ivoire's adult population had an account with a financial institution or with a mobile money service provider, up from 34 percent in 2014. This gave the country one of the **highest rates of financial inclusion in West Africa** and the Sahel: Eight percent above the regional average, but slightly below the average for sub-Saharan Africa.[63]

The Ivorian **mobile money** market is the largest in the West African Economic and Monetary Union (WAEMU) zone. At the end of 2016, the value of transactions reached was approximately $9 billion (4.9 trillion West African Franc), increasing by 120 percent since the end of 2014 and accounting for nearly 40 percent of the total transactions in the region. The Ivorian market also has the highest number of subscriptions (12.8 million), 35 percent of subscriptions in WAEMU.[64]

Despite Ivorians' widespread use of mobile money and financial services, PUE providers in the country have largely yet to offer PAYGO. Only ZECI, one distributor in the country, offers PAYGO financing for SunCulture's solar pumps.

Commercial banks

The Sustainable Use of Natural Resources and Energy Finance (SUNREF) program, Orabank, and Société Générale have ventured into financing renewable energy and energy efficiency projects. SUNREF aims to facilitate access to green energy, promote managing natural resources sustainably, and help to develop a low-carbon economy by adapting the business practices of financial actors in the region.

[63] USAID Power Africa, *Off-Grid Solar Market Assessment: Côte d'Ivoire*, (USAID, October 2019), p. 38, https://www.usaid.gov/sites/default/files/documents/1860/PAOP-CIV-MarketAssessment-Final_508.pdf.

[64] Jean Mermoz Konandi, "Mobile money : La BCEAO fait le point dans la zone UEMOA," SIKA Finance, April 5, 2019, accessed February 2, 2022, https://www.sikafinance.com/marches/mobile-money-la-bceao-fait-le-point-dans-la-zone-uemoa_16860.

Within SUNREF's framework,[65] and with support of the French Development Agency and the European Union, Orabank and Société Générale have financed 12 renewable energy and energy efficiency projects in West Africa between 2014 and 2018 worth $7.26 million. These projects seek to save 2,567 megawatt-hours (MWh), produce 5,283 MWh of renewable energy, and cut 1,686 tons of CO2 emitted per year. Four of these projects are investments in energy management and efficiency (which finance more efficient motors, ovens, cooling systems, air conditioning, and lighting), five focus on solar energy, and three projects are mixed, combining energy efficiency and renewable energy.[66]

The government of Côte d'Ivoire intends to create a new agricultural bank after its previous Bank for Financing Agriculture (*Banque pour le Financement de l'Agriculture* [BFA]) failed in 2014.[67] Agricultural banks in sub-Saharan Africa are fragile. They serve low-income and rural customers who often struggle to provide collateral, and who are exposed to high levels of risk and crop failure. As a result, agricultural banks often focus on cash crops and export production, neglecting cereals, fruit, and staple food crops grown by low-income smallholders.[68] Unlike the state-owned BFA, the new agricultural bank will allow private companies and farmers to purchase shares, and will rely on digital technology to deploy its products and services.[69]

Microfinance institutions (MFIs)

MFIs hold only two percent of the financial assets in Côte d'Ivoire, yet **MFIs' customers account for about one-third of the bank accounts with Ivorian financial institutions.**[70] The main beneficiaries of MFI loans are households, retailers, and informal artisans.[71] Ivorians are familiar with using MFIs to finance agricultural investments, and MFIs are a promising avenue for expanding PUE access.

ADVANS Côte d'Ivoire

ADVANS Côte d'Ivoire is a major MFI investing in agribusiness, particularly cocoa and cashew exporters; it is piloting programs to acquire solar water pumps and fridges, and has signaled interest in financing cold chain equipment and other PUE. **UNACOOPEC-CI**,[72] an MFI operating since 1976 with broad national coverage, provides insurance for agriculture. For enterprises deemed too small, informal, or risky for other institutions, COFINA funding is available, and can fund larger PUE equipment such as solar cold rooms.

MFIs are particularly important for financial inclusion in rural areas, where fewer residents, particularly women, have accounts or borrowing history from formal institutions.[73] Several MFIs can support PUE specifically for women and rural Ivorians.

---

[65] "SUNREF: Appui aux Investissements d'Efficacité énergétique et d'Energie Renouvelable en Afrique de l'Ouest,"AFD, 2014, accessed Februrary 2, 2022, https://www.afd.fr/fr/carte-des-projets/sunref-appui-aux-investissements-defficacite-energetique-et-denergie-renouvelable-en-afrique-de-louest.

[66] "Oragroup agit en faveur de la croissance verte en Afrique de l'Ouest avec SUNREF," Orabank, November 19, 2018, accessed, February 2, 2022, https://www.orabank.net/sites/default/files/20181116_sunref_ao_communique_de_presse_oragroup_afd_vf.pdf.

[67] Baudelaire Mieu, "Le gouvernement ivoirien va liquider la Banque pour le financement de l'agriculture (BFA)," Jeune Afrique, October 1, 2014, accessed February 2, 2022, https://www.jeuneafrique.com/6316/economie/le-gouvernement-ivoirien-va-liquider-la-banque-pour-le-financement-de-l-agriculture-bfa/.

[68] Estelle Maussion, "Le renouveau attendu des banques agricoles en Afrique," Jeune Afrique, September 23, 2020, accessed February 2, 2022, https://www.jeuneafrique.com/mag/1046376/economie/le-renouveau-attendu-des-banques-agricoles-en-afrique/.

[69] "Projet de création d'une banque agricole," Portail de l'Economie et des Finances, Ministère de l'Economie et des Finances, 2019, accessed Februrary 2, 2022, https://finances.gouv.ci/actualites/65-contenu-dynamique/actualite/637-projet-de-creation-d-une-banque-agricole.

[70] APSFD-CI, "Reporting des Informations Financières des SFD pour le 1er Trimestre 2021," APSFD-CI, June 18, 2021, p. 12, accessed February 2, 2022, https://docs.google.com/viewer?a=v&pid=sites&srcid=YXBzZmRjaS5jb218Y2xvdWQtYXBzZmQtY2ktdjEtMnxneDpkMWMzYTgyMDQzY2M1NW.

[71] "Microfinance : 1,3 million d'épargnants grâce aux reformes,2 Portrail Officiel du Gouvernement de Côte d'Ivoire, August 20, 2018, accessed February 2, 2022, http://www.gouv.ci/_actualite-article.php?d=4&recordID=9152.

[72] National Union of Savings and Credit Cooperatives of Côte d'Ivoire (Union Nationale des Coopératives d'Epargne et de Credit de Côte d'Ivoire

[73] "The Global Findex Database 2017," World Bank, 2018, accessed February 2, 2022, https://globalfindex.worldbank.org.

First Microfinance of Côte d'Ivoire (Première Agence de Microfinance Côte d'Ivoire [PAMF-CI])

PAMF-CI[74] is an MFI prioritizing financing rural residents' agricultural productivity, livestock purchases, and small business investments. It has signaled interest in PUE and solar energy, discussed developing an energy-finance program with Aphelion Energy, Schneider, and PEG, and is a founding member of APERCI.[75] It is also one of the few MFIs operating in the politically unstable northern rural areas, making it a key actor for piloting and scaling PUE there. **FAFCI**[76] is a fund for women's income-generating activities, having loaned $86 million to more than 261,000 women, 70 percent of whom use this funding for agriculture. A COFINA subsidiary, Fin'ELLE, is another MFI exclusively for Ivorian women.

Additional information on MFIs operating in Côte d'Ivoire

A government campaign launched in 2012 to restructure, professionalize, and improve the quality of MFIs' assets reduced the number of MFIs operating in Côte d'Ivoire from 75 in 2014 to 51 in 2017, but increased the number of MFI customers from 850,000 to 3.5 million[77] from 2014 to 2020. Savings and credit increased four-fold in the same period to approximately $539 million (306.6 billion West African Franc) and about $476 million (270.4 billion West African Franc), respectively.

The information below explains the operations of specific MFIs operating in Côte d'Ivoire.

National Union of Savings and Credit Cooperatives of Côte d'Ivoire (Union Nationale des Coopératives d'Epargne et de Credit de Côte d'Ivoire [UNACOOPEC-CI])

The largest MFI in 2014, the market share of UNACOOPEC-CI has since shrunk and the organization has closed several branches.

Founded in 1976 under the supervision of the Ministry of Agriculture and Animal Resources, UNACOOPEC-CI is a cooperative finance institution that specializes in microfinance, banking, and insurance for agriculture. UNACOOPEC-CI focuses on rural development and has broad national coverage. Members contribute equitably to the capital of their cooperative by each paying a share and having control over it, without discrimination on the basis of identity. Local cooperatives affiliated with UNACOOPEC-CI are organized into two levels:

Level 1: The cooperatives are local entities, which are legally autonomous and independent, and comprise a General Assembly made up of all the members; a Board of Directors, a management body composed of members elected by the General Assembly; a credit committee composed of three members which is in charge of the validation of credit files; and a Supervisory Board, the governing body. The members of these bodies are volunteers elected by the members. The cooperative also employs managers, cashiers, and credit and collection agents. All cooperatives are grouped into four Regional Directorates.

Level 2: The cooperatives' umbrella fund, also known as the Union (UNACOOPEC), supports the cooperative movement as a whole.[78]

[74] First Microfinance of Côte d'Ivoire (Première Agence de Microfinance Côte d'Ivoire [PAMF-CI]).

[75] Association of Renewable Energy Professionals of Côte d'Ivoire (*Association des Professionnels des Energies Renouvelables de Côte d'Ivoire* [APERCI]).

[76] Support Fund for Women in Côte d'Ivoire (*Fonds d'Appui aux Femmes de Côtes d'Ivoire* [FAFCI]).[76] Support Fund for Women in Côte d'Ivoire (*Fonds d'Appui aux Femmes de Côtes d'Ivoire* [FAFCI]).

[77] APSFD-CI, "Reporting des Informations Financières des SFD pour le 1er Trimestre 2021," APSFD-CI, June 18, 2021, p. 12, accessed February 2, 2022, https://docs.google.com/viewera=v&pid=sites&srcid=YXBzZmRjaS5jb218Y2xvdWQtYXBzZmQtY2ktdjEtMnxneDpkMWMzYTgyMDQzY2M1NW.

[78] "UNACOOPEC," UNACOOPEC, n.d., accessed February 2, 2022, https://www.unacoopec.com/.

UNACOOPEC-CI hosts 700,000 active accounts and 135 functional service points in urban, peri-urban, and rural areas throughout Côte d'Ivoire. The institution offers public financing programs for low-income populations or those seeking employment through:

- The Support Fund for Women in Côte d'Ivoire (*Fonds d'Appui aux Femmes de Côtes d'Ivoire* [FAFCI]) in partnership with the office of the first lady of Côte d'Ivoire.
- The Youth Employment Project (*Projet Emploi Jeunes* [AEJ]) managed the Ministry for the Promotion of Youth, Youth Employment, and Civic Service.

UNACOOPEC-CI's support programs[79] for rural residents and the youth comprise:

- A project to support agricultural production and commercialization—in partnership with the Ministry of Agriculture and Rural Development and the International Fund for Agricultural Development (IFAD)—that aims to support 270,000 beneficiaries.
- The project Acting for Youth (*Agir pour les jeunes*), which will support 12,337 beneficiaries.

Support Fund for Women in Côte d'Ivoire (Fonds d'Appui aux Femmes de Côtes d'Ivoire [FAFCI])

Created in 2012 by UNACOOPEC-CI, in partnership with the First Lady's office, FAFCI aims to provide women with access to financial resources needed to create or strengthen income-generating activities. Since July 2021, FAFCI's balance sheet shows that it loaned $86 million (49.77 billion West African Franc) to 261,450 women, with 70 percent using these funds for agricultural projects. The reimbursement rate of 98 percent is high compared to similar programs. The fund's capital was recently increased by 5 billion West African Franc, bringing it to about $45 million (25 billion West African Franc). FAFCI plans to expand its microfinance options and mobilize resources from the Ivorian state and other partners, and to increase its branches throughout the country.[80]

COFINA Côte d'Ivoire

Also known as Compagnie Africaine de Crédit (African Credit Company), COFINA serves small, medium, and micro-enterprises whose needs are too large for smaller MFIs and whose structure is too informal or risky for commercial banks, thereby financing "missing-middle" enterprises.[81] OIKOCREDIT, NSIA Banque, the International Finance Corporation (IFC), and PROPARCO have funded COFINA to support SMEs and women (the latter through its subsidiary Fin'ELLE, an MFI dedicated exclusively to women[82]). COFINA has received €5 million from the Dutch development bank FMO to finance women-owned micro-enterprises, young entrepreneurs, and SMEs in Côte d'Ivoire. COFINA can fund larger PUE equipment such as solar cold rooms.

ADVANS Côte d'Ivoire

ADVANS is a major MFI in Côte d'Ivoire. The company plans to invest approximately $1.84 billion (one trillion West African Franc) into the Ivorian economy by 2023. Much of this capital is earmarked for projects in agribusiness and agriculture, particularly cocoa and cashew nuts, where ADVANS issues loans for agricultural inputs, vehicles, and working capital.[83] ADVANS has worked closely with cocoa exporters, input suppliers, and licensed cocoa cooperatives in a program called Cocoa Credit.

---

[79] "L'UNACOOPEC-Ci peaufine un projet d'agri-business pour les populations rurales," Abijan.net, July 20, 2021, accessed February 2, 2022, https://news.abidjan.net/articles/641667/lunacoopec-ci-peaufine-un-projet-dagri-business-pour-les-populations-rurales.

[80] "Dominique Ouattara annonce une augmentation du FAFCI," Abijan.net, July 14, 2021, accessed February 2, 2022, https://news.abidjan.net/articles/694942/dominique-ouattara-annonce-une-augmentation-du-fafci.

[81] "Groupe Cofina," Groupe Cofina, 2018, accessed February 2, 2022, https://www.groupecofina.com/.

[82] "Fin'ELLE," Fin'ELLE, 2018, accessed February 2, 2022, http://www.fin-elle.com/.

[83] Maïmouna Dia, "La Microfinance peut et doit prendre une meilleure place dans le secteur financier africain," La Tribune Afrique, April 4, 2018, accessed February 2, 2022, https://afrique.latribune.fr/think-tank/entretiens/2018-04-04/la-microfinance-peut-et-doit-prendre-une-meilleure-place-dans-le-secteur-financier-africain-773925.html.

This credit program is designed for borrowers carrying out seasonal activities and works as follows:

- ADVANS or cocoa exporters identify cooperatives eligible for financing.
- Cooperatives select eligible farmers and collect deposits for guarantee.
- ADVANS collects and evaluates loan applications and defines the level of financing for each cooperative.
- Input suppliers deliver products to the cooperatives; cooperatives distribute to farmers and coordinate repayments.
- Cooperatives collect cocoa from farmers and deliver it to exporters.
- Exporters deduct a fixed amount per kilogram of cocoa to reimburse the cooperatives' loans with ADVANS.[84]

ADVANS plans to expand its financial products to other value chains and varieties of PUE and has indicated that it is willing to finance cold chain equipment. Moreover, **in partnership with CARE and GIZ, is piloting acquiring solar water pumps and solar fridges.**

PAMF-CI

PAMF-CI prioritizes providing loans to rural residents. Customers use these loans to improve agricultural productivity, purchase livestock, and to finance small businesses in rural and urban areas. PAMF-CI is one of the few MFIs operational in the northern rural areas, despite political instability. This position makes this MFI **a key actor in agricultural finance in the north of the country**, where it can help to pilot and scale PUE. PAMF-CI has long been interested in PUE and is one of the founding members of the Association of Renewable Energy Professionals of Côte d'Ivoire (*Association des Professionnels des Energies Renouvelables de Côte d'Ivoire* [APERCI]). The MFI has discussed developing an energy-finance program with the companies Aphelion Energy, Schneider, and PEG. PAMF-CI has balanced its loan portfolio, with 50 percent rural loans and 50 percent urban loans and is improving the gender-balance of its portfolio: Women now represent more than a third of PAMF-CI's borrowers. PAMF-CI's group lending program remains one of its most popular forms of obtaining credit and has provided a loyal customer base. PAMF-CI also works with the company Ivoire Coton and may be willing to finance PUE for the cotton industry.

Financial inclusion case highlights

Box 2: Financial inclusion of rural populations

In 2015, the MFI ADVANS formed a partnership with the humanitarian agency Care to promote a banking system among village associations. The village association members, 85 percent of whom were women, were largely excluded from banking services because of their geographical distance from bank branches, lack of information, and inadequate access to digital services. The main objective of the ADVANS/Care partnership was to strengthen the capacity of rural communities to save, mobilize and manage their own resources, and gain access to formal financial services.

Through this partnership, Care assists populations excluded from the banking system to create village savings and loans associations (VSLAs). VSLAs are highly organized groups of 15 to 30 people (mainly women) who pool their savings and meet regularly to manage their combined savings. The savings are kept in a physical cash box and redistributed in the form of credits to finance income-generating activities or to deal with emergencies.

Once VSLAs are mature enough to be linked to a financial institution, ADVANS offers a group bank account and individual interest-bearing accounts, allowing groups to make free mobile money deposits or withdrawals from their savings. For groups with sufficient savings histories, ADVANS offers group credit to finance the purchase of technologies like agricultural PUE equipment.

[84] "ADVANS Annual Report," ADVANS, 2016, accessed February 10, 2022, https://www.advansgroup.com/fileadmin/user_upload/Advans_Rapport_SA_2016-BAT3web.pdf.

Group purchase models

Through farming collectives and village-enterprise organizations, smallholders can jointly invest in PUE technologies that would be too costly and uneconomical to purchase by individuals. Group purchase models are particularly well-suited to technologies that are more cost-effective at greater scales, like irrigation products or agro-processing machinery. Although more research is needed to assess how effective this model would be in Côte d'Ivoire, group purchase models have seen success among smallholders elsewhere in Africa.[85, 86]

Other financing mechanisms

Village savings and loans associations (VSLA) account for five percent of agricultural funding. They have considerable reach in remote areas at relatively low cost, compared to more formal financial institutions, benefiting from close relationships and high repayment rates. As VSLAs enjoy close proximity to their members, are independently managed, and can operate with little technical assistance and a relatively small number of members, they can serve remote, sparsely populated areas. VSLAs can improve local capital efficiency and reduce dependence on external funding and grants by reinvesting local money. CARE International is a major agency working with VSLAs in Côte d'Ivoire.

Informal financing—which includes unlicensed loan agents, tontines (see Box 3), itinerant bankers, and loans from family and neighbors—is the most established form of rural financing. Informal sources of lending are highly localized and are exposed to the same risks faced by local farmers. Rural residents often prefer to use funds from informal sources for emergencies rather than agricultural investments, making these sources less promising for PUE.

Box 3: Doni Doni initiative

Cargill's Doni Doni (meaning step-by-step) initiative, in partnership with the IFC and *Société Ivoirienne de Banque* (SIB), provides a credit facility that allows cooperatives in Côte d'Ivoire to lease cocoa collection trucks.

Farmers' organizations that have completed the Cargill Coop Academy (a 28-day training session on governance, management, and financial skills) can acquire new trucks through a three-year leasing agreement, which also includes insurance. Participating cooperatives each pay ten percent upfront and then put 10 FCFA (~2 US cents) for every kilogram of cocoa delivered to Cargill into a savings fund, which covers their monthly lease fees.

Based on the experiences of Doni Doni, Cargill plans to launch a second credit facility that provides cooperatives with approved, high-quality crop-protection products. This finance scheme could be an entry point for solar sprayers.

Training in renewable energies

Technology providers experience difficulties finding qualified staff with the required education and experience in rural areas where PUE is needed. Training local staff can be more cost-effective than sending qualified staff from cities, resulting in higher community engagement and lower turnover rates and operational costs. GIZ's ProFERE program aims to strengthen specialized technical and managerial knowledge in the field of renewable energy and energy efficiency in Côte d'Ivoire. ProFERE analyzed the training needs of the solar energy industry, describing different tasks suitable for staff at different educational levels; a middle school-level education prepares staff for installation work, high school–level education prepares staff for electrical work, and advanced tasks require workers with university-level skills (see Table 6).

[85] "Private finance investment opportunities in climate-smart agriculture technologies," CASA, October 2021. https://www.casaprogramme.com/wp-content/uploads/2021/10/Private-finance-investment-opportunities-in-climate-smart-agriculture-technologies.pdf.

[86] "Feed the Future Egypt Food Security and Agribusiness Support Project, Quarterly Report FY2020 Q1," CNFA, January 2020. https://pdf.usaid.gov/pdf_docs/PA00X2R2.pdf.

TABLE 6. OVERVIEW OF TRAINING NEEDS IN SOLAR ENERGY

MIDDLE SCHOOL LEVEL	HIGH SCHOOL LEVEL	DEGREE LEVEL
• Physical structures • Ballasting • Installation of PV modules • Mechanical cable protection • Battery wiring	• Execution of electrical diagrams and plans • Installation of controllers • Installation of inverters • Wiring installation of enclosures and protection devices • After-sales service • Preparation of quotations • Reporting	• Commercial offers • Sizing of PV systems • Selection of components • Drawing electrical diagrams • Drawing plans • Team management • Follow-up and verification of work • Report writing

Including women in staffing is also critical for marketing and scaling PUE, and training programs must consider women's professional development needs. Cargill's CSR program for the cocoa value chain provides on training to women only.

Training in agriculture

Agribusinesses, government institutes like the Ministry of Agriculture's INFPA, and private-public partnerships offer vocational training in agricultural practices to smallholder farmers, who are often untrained and lacking formal qualifications. Although not all of these programs incorporate PUE, suppliers or donors involved in PUE can engage these training initiatives to discuss including PUE in their curricula. For instance, Cargill is funding women-only training for up to 1,000 female farmers to help them improve their agricultural and business skills. This training focuses on teaching better agricultural practices, promoting cocoa tree growing as a source of income, developing business skills, and improving literacy.[87] Another training program is offered by **HortIvoire**,[88] a project inaugurated in June 2021 in the district of Yamoussoukro. The project is a partnership between Agrifer, INFPA, and three private-sector companies from the Netherlands, aiming to train 240 market garden farmers (including youth and women) in new soilless cultivation techniques over six months.

[87] "Overcoming the Barriers for Women in Cocoa Farming," Cargill, January 1, 2016, accessed February 2, 2022, https://www.cargill.com/story/overcoming-the-barriers-for-women-in-cocoa-farming.

[88] "HortIvoire: Une formation complète pour le maraîcher de demain," Agrifer, 2020, accessed February 2, 2022, https://www.agrifer.nl/hortivoire/.

6 PUBLIC-SECTOR STAKEHOLDERS SUPPORTING PUE

6.1 Sectorial overview

The following public-sector organizations support and implement agricultural and energy programs in Côte d'Ivoire. See Table 7 for a full list of stakeholders.

The **ministries** prioritize and direct interventions in energy and agriculture. The two ministries involved in this study are the Ministry of Petroleum, Energy, and Renewable Energies, and the Ministry of Agriculture and Rural Development. Additionally, the Ministry of Animal Productions and Fishery Resources and the Ministry of Rice Promotion guide the livestock, fishing, and rice industries. Agricultural policies developed by the ministries are implemented in regions, departments, and communities by **decentralized regional councils**. Several **public agencies**, such as ANADER, ADERIZ, the Ivorian Office of Parks and Reserves (*Office Ivoirienne des Parcs et Réserves* [OIPR]), and the Tropical Technology Society support specific value chains and sectorial policies. **Research institutes** and laboratories provide new insights on best practices and innovate new cultivation methods by, for example, trialing improved seeds, and **training institutes** provide capacity-building in a range of agricultural activities.

TABLE 7. PUBLIC-SECTOR STAKEHOLDERS

GOVERNMENT ENTITIES	INVOLVEMENT
Ministry of Agriculture and Rural Development	Crop production and hydro-agricultural developments.
Ministry of Animal and Fishery Resources	Animal rearing and aquaculture.
Ministry of Higher Education and Scientific Research	Training and technology development
Ministry of Hydraulics	Implementation and monitoring of the government's hydraulics policy.
Ministry of the Environment and Sustainable Development	Formulation and implementation of environmental policy to ensure the sustainable development.
Ministry of Water and Forests	Reforestation programs, Flora and fauna preservation, Water protection.
SUPPORT STRUCTURES	
ADERIZ	Agency for the Development of the Rice Sector (*Agence pour le Développement de la Filière Riz*)
ANADER	National Rural Development Support Agency (*Agence Nationale d'Appui au Développement Rural*)
ANDE	National Environment Agency (*Agence Nationale de l'Environnement*)
OCPV	Office for the Marketing of Food Products (*Office d'aide à la Commercialisation des Produits Vivriers*)
OIPR	Ivorian Parks and Reserves Agency (*Office Ivoirienne des Parcs et Réserves*)
Tropical Technology Society (I2T)	Assistance to companies to promote agro-industrial development in the fields of preservation and fresh storage, processing, and packaging of agricultural products.

STATE COMPANIES	
SIVAC	Ivorian Slaughter and Charcuterie Society (*Societe Ivoirienne D'abattage et de Charcuterie*)
SODEFOR	Ivorian Forest Development Company (*La Société de Développement des Forêts*)
LABORATORIES AND RESEARCH INSTITUTIONS	
BNETD	National Bureau of Technical Studies and Development (*Bureau National d'Études Techniques et de Développement*)
CNRA	National Center for Agricultural Research (*Centre National de Recherche Agronomique*)
FIRCA	Inter-professional Fund for Agricultural Research and Consultancy (*Fonds Interprofessionnel pour la Recherche et le Conseil Agricoles*)
LANADA	National Agricultural Development Support Laboratory (*Laboratoire National d'Appui au Développement Agricole*)
AGRICULTURAL EDUCATION AND TRAINING	
INFPA	National Institute for Professional Agricultural Training (*Institut National de Formation Professionelle Agricole*)
School of Agriculture (INPHB/ESA)	Elite Agriculture School in Yamoussoukro

6.2 Findings on the public sector

This section focuses on public-sector bodies involved in promoting PUE technologies Côte d'Ivoire. These organizations are **FIRCA**, **ANADER**, and **CNRA.**

FIRCA is a legal entity that is recognized as a public utility[89] and aims to be the engine for sustainable, innovative, and competitive agriculture. FIRCA mobilizes resources from the agricultural sector, the state, and technical and financial partners to implement flagship projects for agricultural development in the areas of agricultural and forestry research, experimental agriculture, technological research to improve agricultural and processed products, knowledge dissemination, and vocational training for farmers and professional agricultural organizations, working across more than 26 agricultural value chains. FIRCA benefits from a cooperation agreement with USAID/Power Africa, Ivorian state subsidies, and significant contributions from private partners and donors. FIRCA can also obtain loans from commercial banks and has the confidence of most of the agricultural industry.

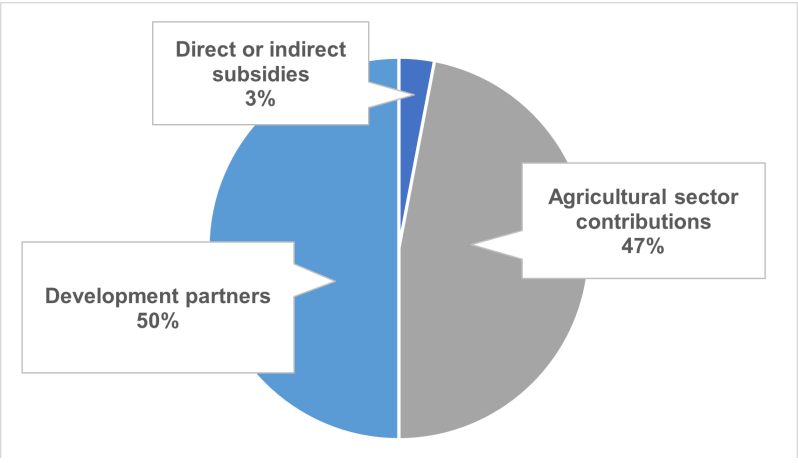

Figure 9: Breakdown of FIRCA funding sources, 2018 (totaling $62 million).

[89] Governed by law no. 2001-635 of 9 October 2001 and decree n°2002-520 of 11 December 2002.

In 2018 FIRCA mobilized actors in the agricultural sector to create an **Agricultural Gender Platform.** This platform of 25 members aims to improve gender equality in Ivorian agriculture, strengthen gender-analysis, improve the design of programs and projects, and ensure gender-monitoring for all stakeholders.

ANADER is a state-owned limited company with a minority stake in the capital stock (35 percent), the rest being divided between professional farming families (33 percent) and the private sector (32 percent). ANADER provides agricultural advice and helps to professionalize farmers to improve the living conditions of rural inhabitants. In their agricultural mechanization and processing program, ANADER offers capacity-building on using and maintaining diesel pumps. The agency also promotes drip irrigation for the off-season production of vegetables and for cocoa nurseries,[90] and trains rice farmers to use, manage, and maintain threshing and the hulling machines.[91] It also utilizes an e-extension program,[92, 93] with a 24/7 hotline for farmers to call with questions on pest problems, current pricing, and financing options for agricultural activities. These services can also help to disseminate information on PUE.

The **CNRA** is a public limited company, and Côte d'Ivoire's principal agricultural research agency, bringing together several agricultural research sites across the Ivorian territory. Each site consists of a set of research stations administratively attached to a regional directorate. CNRA's research aims to improve agricultural production systems, conservation, and transformation, researching crops, livestock, forestry, and post-harvest processing, as well as technology transfer and human resources development. The research center is also a resource on best practices for each value chain, including techniques for irrigation, plant protection, and processing or storage.

[90] "Programmes genie rural," ANADER, n.d., accessed September 2021, http://www.anader.ci/fichiers/programmes%20de%20genie%20rural.pdf.

[91] "Programmes de Mécanisation Agricole et de Transformation," ANADER, n.d., accessed September 2021, http://www.anader.ci/fichiers/programmes%20de%20mecanisation%20agricoles%20et%20de%20transformation.pdf.

[92] "Vulgarisation Agricole Electronique E-Extension," ANADER, n.d., accessed September 2021, http://www.anader.ci/fichiers/programme%20e-extension.pdf.

[93] "E-ANADER," ANADER, n.d., accessed November 2, 2022, http://www.e-anader.com/.

7 DEVELOPMENT PARTNERS SUPPORTING PUE

7.1 Sectorial overview

Several international donors and multi- and bilateral development agencies work in the agriculture and energy sectors in Côte d'Ivoire. See Table 8 below for a list of these development partners and their scope of work.

TABLE 8. OVERVIEW OF DEVELOPMENT PARTNERS INVOLVED IN ENERGY AND AGRICULTURE

INSTITUTION	PROJECT	PERIOD	DESCRIPTION
AFD	Debt relief and development contract (C2D)	2016–2020	Initiate and support changes in agricultural practices and resource management (€77 million).
AfDB	Enable Youth Côte d'Ivoire	2016–2020	**Train the next generation of agriculture entrepreneurs.**
	Agro-industrial cluster project in the Belier region (2PAI Belier)	2020–2021	Boost agriculture to achieve food self-sufficiency in a region in economic decline. **Create an agro-industrial hub for processing agricultural products.**
EU	National Indicative Program (NIP)	2014–2020	Agriculture (€60 million): Contribute to land-tenure reform and **support food-crop value chains.** **Energy** (€139 million): Two major projects include expanding electricity networks in Abidjan, San Pedro, and Bouake; and constructing a new national dispatching center.
FAO	Country Programming Framework (CPF)	2018–2021	Improve the productivity, sustainability, and resilience of fisheries, farms, and forests. Improve the competitiveness of value chains and promote healthy, efficient, and inclusive diets.
GIZ	Green People's Energy	2018–2022	Help to develop decentralized renewable energy systems in rural regions of Africa by involving local stakeholders and private investors. **Promote local value creation, PUE**, and employment opportunities.
	Water and Energy for Food (WE4F)	2020–2023	Disseminate climate-friendly, energy-efficient, and water-efficient innovations for more productive and environmentally sustainable food production.
	Green Innovation Centers for the Agriculture and Food Sector (GIC) in Côte d'Ivoire	2018–2023	Diversify cocoa production systems. Develop local processing and marketing of cocoa products. Promote sustainable cocoa production without deforestation.

INSTITUTION	PROJECT	PERIOD	DESCRIPTION
GIZ	Energy solutions—made in Germany—with the Project Development Program (PDP)	2018–2023	Develop financially viable energy projects and raise capital from commercial banks and private investors. Organize training events.
IFAD	Agricultural Production and Marketing Support Project/ West Extension (PROPACOM West)	2014–2020	Help to improve food security of the population in the project areas; enable small producers to gain access to **efficient production services, appropriate technologies, formal financial services, and markets.**
IFAD	Strategic Options Program	2020–2025	Establish a framework to develop agriculture. Promote agriculture that is resilient to climate change, and **increase productivity and production** sustainably. Strengthen value-creation and access to markets.
UNDP	Support program to develop inclusive value chains and promote local initiatives (PACIPIL)	2017–2020	Help to develop inclusive value chains for the **rice, maize, cassava and cashew nuts, and to market and process products.** Out of a budget of $8 million, **$1.1 million was devoted to making processing equipment available to producers.**
World Bank	e-agriculture project	2018–2023	The project, with a budget of $70 million, will help increase access to digital services in rural communities and use digital platforms to improve farms' productivity and access to markets.
USAID	Power Africa Off-grid Projects	2018–2022	Help to grow energy-agriculture projects and products in Côte d'Ivoire, focusing on helping off-grid companies develop PUE applications and collaborating with relevant USAID projects and partners.
	Feed the future Project- West African Trade & Investment Hub (WATIH)	2019–2020	A $60 million project to fund business initiatives in agriculture, energy and textile.

7.2 Findings on development partners

The information below elaborates on two projects prioritizing PUE.

Green People's Energy (GPE)

The Green People's Energy (GPE) initiative aims to enable, expand, and secure the supply of sustainable energy in rural Africa. It is part of Germany's Marshall Plan with Africa and is being implemented by GIZ in nine sub-Saharan African countries. GPE focuses not only on large power plants and companies, but also how citizens, municipalities, and cooperatives shape energy systems through decentralized renewable energy. GPE seeks to take advantage of the capital, labor, contextual knowledge, and ideas of local populations when introducing renewable energy to rural sub-Saharan Africa. At the same time, local citizens, as co-owners and co-operators of these energy systems, assume responsibility for maintaining these systems. GPE prioritizes supplying energy for businesses and social institutions such as schools and health centers, and promotes an enabling environment for clean energy investment.

The GPE program in Côte d'Ivoire focuses on two main activities:

- **Support for project planning or capacity-building:** GPE supports agricultural companies, cooperatives, women's groups, and farmers' organizations that plan PUE projects, and helps them to prepare the documents to apply for funding.

- **Results-based financing (RBF) for selling PUE:** Participating companies receive financial incentives for each PUE unit sold and installed commercially. GPE pays the incentive once it has verified that the company has offered after-sales service for each product sold. Some PUE suppliers will need up-front funding from grants or patient capital to complement RBF.[94]

2PAI Belier

The African Development Bank finances the **agro-industrial cluster project in the Belier region (2PAI Belier),** which the Ministry of Agriculture and Rural Development oversees. This project is providing $93 million to boost agriculture and achieve food self-sufficiency in the Belier region. The objective is to create an agro-industrial center to revitalize agricultural production and processing by involving the private sector, youth, and women.

From 2018 to 2020, 2PAI Belier has:

- Developed 1,186 ha of irrigated to cultivate rice and vegetables.
- Rehabilitated 542 km of rural roads to transport agricultural products.
- Rehabilitated four training centers for young people to include them in agriculture.
- Built 50 new boreholes equipped with manual pumps and repaired 100 manual pumps to improve access to drinking water.
- Rehabilitated social infrastructure.

[94] Adams Etrin, Edi Boraud, and Jean Eric Ketekou, personal communication, September 2021.

8 OPPORTUNITIES AND RECOMMENDATIONS FOR STAKEHOLDERS PROMOTING PUE

Market and raise awareness of PUE

Farmers and cooperatives need to have better access to information about PUE technologies, applications, and financing options if they are to make informed decisions or organize their members for group purchases. Stakeholders should design and put in place marketing campaigns for PUE through channels accessible to smallholders. Communication through word of mouth, product demonstrations at agricultural trade fairs, and regional exhibitions should be a key channel to reach these communities, in addition to radio and mobile phone communications.

Development partners should encourage networking among farmers by supporting agricultural trade fairs where PUE can be showcased. They can also perform outreach and develop partnership with farming cooperatives. Even if only 5.6 percent of farmers belong to cooperatives, they will serve as pioneers to demonstrate the feasibility of PUE, encouraging uptake among other farmers. **Public-sector stakeholders** can incorporate messaging about PUE into their established communication channels. For example, ANADER's agricultural advice service, through its e-extension program, can help to inform farmers and cooperatives about PUE and possible funding opportunities. **Suppliers and distributors** can tailor their promotional materials to reach smallholders in remote places, using radio and phone calls to reach people with low literacy. Platforms like Viamo[95] use mobile-based interactive voice response technology to make information accessible to more people. Using a toll-free hotline, callers can access content in their local language, interact with the system, and provide feedback. By navigating a menu, where callers listen to and choose the option needed, clients can gain access to information. Developing women-centered marketing strategies is also crucial to reach female audiences. PUE providers should ensure that their marketing materials represent women and show how PUE improves their quality of life. Employing female sales agents will also encourage more women to explore PUE.

Develop end-user finance

Côte d'Ivoire's high levels of financial inclusion and Ivorian smallholders' familiarity with mobile money present an excellent opportunity to PUE providers to offer PAYGO to their customers. Providers can work with mobile network operators to offer PAYGO financing, making PUE more affordable and attractive to smallholders. In some cases, sharing PUE appliances such as small solar pumps or solar sprayer could be an option for smallholders to split purchase and maintenance costs. Suppliers and distributors should offer PAYGO options, and provide financing for collective purchases. Further research of community-based models is needed to analyze in which settings this can be adapted to ensure it is relevant, which **donors and development partners** can support. MFIs should be trained to better understand farmers' financial needs for PUE applications and develop adapted financing products by, for example, setting up flexible re-payment schemes based on agriculture seasons.

Establish partnerships to promote PUE adoption

Partnerships with corporate social responsibility (CSR) programs

Several international organizations in the cocoa industry—such as Barry Callebaut, Cargill, and Nestlé—have implemented CSR programs, mainly to prevent child labor. These programs also work to improve the farmers' incomes by developing women's agricultural associations.

[95] Viamo, 2022, accessed 2 February, 2022, https://viamo.io/.

CSR programs should be approached to advocate for PUE. Below are some examples of CSR programs involving PUE:

- In Ecuador, Nestlé's Cocoa Plan has supplied solar dryers to farmers to improve the quality of cocoa beans and to help them fetch better prices. The CSR program could be approached to explore implementing the same project in Côte d'Ivoire and forming partnerships with providers of solar dryers.
- Cargill's Doni Doni initiative could be approached to confirm if solar sprayers will be eligible under its second credit facility. This credit facility can serve as an entry point for solar sprayers in the Ivorian market and help reduce the amount of phytosanitary products used on crops.

Partnerships between PUE suppliers and training services

PUE suppliers should partner with training institutions and training programs, such as the Hortivoire project, to integrate PUE equipment like solar pumps and solar sprayers into their curriculum.

Support cooperatives and agricultural organizations to advocate for farmers' interests

Cooperatives and other agricultural organizations can help to bring together farmers and promote their concerns and interests, negotiate lower prices for equipment, or share capital among members. **PUE suppliers** should partner with agricultural organizations and offer special benefits that encourage farmers to join. Building on the experience of Solar Village and CIDT in supplying solar sprayers, PUE providers can offer input packages for farmers working on contracts. PUE providers should investigate partnerships with the companies PALMCI, SIPEF-CI, Palmafrique (which produces palm oil), and with SAPH (rubber). Solar sprayers will benefit coffee plantations in particular, where maintenance is often neglected.

Promote PUE technology as a way to boost productivity

Solar-powered technologies can increase yields and stabilize farmers' incomes across multiple value chains. Irrigation can diversify crops and boost yields; solar sprayers can increase production and reduce labor; solar cold rooms can prevent spoilage. **PUE providers working with NGOs and development projects** should inform farmers about the technical and financial benefits of PUE.

The full benefits of PUE will be achieved only if the technology is used and maintained correctly. Therefore, **suppliers of PUE** should train their customers at the point of sale and offer after-sales service to ensure that PUE adoption is sustainable, offering such packages of capacity-building and maintenance to new users.

The technology is available and suppliers are motivated to enter the market, but they do not have enough information to reach the correct customers. PUE providers also encounter barriers in funding projects, as not all MFIs recognize the potential of PUE. Pilot projects implemented by **PUE providers and NGOs**—with grant funding **from development partners**—as well as testing appropriate business models, are necessary to demonstrate feasibility and develop training for MFIs.

Research and develop PUE technology

Solar-powered post-harvest processing machinery struggle to compete with diesel-powered ones.[96] As described in Section 6, solar-powered machines have a lower processing capacity, longer processing times, higher cost, and fewer operational hours and days a year. Solar-powered agro-processing equipment also needs to match or improve the quality of cereals processed by small-scale diesel or grid-powered processors. Accordingly, PUE organizations should research and develop more technically viable solar-powered machinery adapted to local needs. **Donors** should fund, and **development partners and public sector entities** should support, this R&D. Until such optimized products appear, **PUE suppliers** should optimize business models and seek grant funding to increase the uptake of solar processing.

[96] Power for All, "Power for All Fact Sheet: Harnessing the Power of Solar for Agro-processing," Power for All, November 2020, accessed February 2, 2022, https://www.powerforall.org/application/files/8716/1355/4931/2020_FS_Solar_agro-processing.pdf.

Include women in PUE projects

Solar-powered PUE benefits women, who are often responsible for processing crops manually. Broader PUE adoption thus depends on including more women across this industry. To reach women working in post-harvest processing, **NGOs and development agencies** need to provide subsidies, not just technical assistance and training, so that women's groups can afford solar-powered machinery. PUE providers should seek the expertise they need to understand the energy requirements and challenges faced by female farmers, so that these suppliers can develop specialized marketing materials that speak to women. **Suppliers'** business models should be adapted so that these companies can partner with women's groups interested PUE. Additionally, women's savings and loans groups can lower barriers to acquiring PUE equipment by sharing the technology for group income-generating activities. **Training institutes** should encourage women to become solar technicians to help close gender gaps in the worker profile of the solar industry, and invest in agricultural education for women.

USAID.GOV/POWERAFRICA

/POWERAFRICA

/POWERAFRICA

/@POWERAFRICAUS

Power Africa's goal is to add at least 30,000 megawatts of cleaner and more reliable electricity generation capacity and 60 million new home and business connections by 2030.