



Vil2Bio: Combining village-scale biogas production with pyrolysis in biomass stoves for off-grid sustainable clean cooking and cold production

Pascale Gillon, Stéphane Bostyn, Alan Jean-Marie, Majda Aziza, Marvin Scherzinger, Katrin Kayser, Linus Kosambo, Jane Mutune, Moha Arouch, Mathieu Brule

► To cite this version:

Pascale Gillon, Stéphane Bostyn, Alan Jean-Marie, Majda Aziza, Marvin Scherzinger, et al.. Vil2Bio: Combining village-scale biogas production with pyrolysis in biomass stoves for off-grid sustainable clean cooking and cold production. GEPEA, UMR CNRS 6144, 37 boulevard de l'Université, 44600 Saint-Nazaire. 2024. hal-04659980

HAL Id: hal-04659980

<https://hal.science/hal-04659980v1>

Submitted on 23 Jul 2024

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution - NoDerivatives 4.0 International License



LEAP-RE

Long-Term Joint EU-AU Research
and Innovation Partnership on Renewable Energy

Research & Innovation Action

LEAP-RE Pillar 1 Project Second Call

Mid-term scientific evaluation

*Note: “The mid-term scientific evaluation exercise of funded projects (Pillar1, first call) will be based on the annual project reports and presentations made by the coordinators **at the mid-term Seminar** (Kigali, October 2023) with the participation of the CSC members and invited stakeholders. As a result, the CSC may propose the continuation, the re-organisation or the suspension of the research project activities”. (Text Call)*

Coordinators of the projects are invited to return the duly completed form, the latest in one month (15 May 2023). Such reporting could be enriched by new insights in Kigali meeting. A monitoring, evaluation and learning platform will be delivered end July for electronic reporting.

would you need clarification of additional information, please contact:

- Elena SIMION (elena.simion@uefiscdi.ro)
- Wassim SEBAI (Wassim.SEBAI@agencerecherche.fr)



This project has received funding from the European Union's Horizon 2020 Research and Innovation Program under Grant Agreement 963530.

1. KEY DATA OF THE PROJECT

This data will be already inserted in the reporting template for each project and will require updates in case of any changes during the implementation

SHORT TITLE	Vil2Bio
LONG TITLE	Combining village-scale biogas production with pyrolysis in biomassstoves for off-grid sustainable clean cooking and cold production
PROJECT NUMBER	
PROJECT COORDINATOR	Pascale Gillon GEPEA-CNRS Laboratoire de Génie des Procédés-Environnement-Agroalimentaire
PROJECT PARTNERS	ICARE-CNRS Institut Combustion, Aérothermique, Réactivité et Environnement France ALTRAN-Altran Technologies France CDER-Centre de Développement des Energies Renouvelables Algeria TUHH-Hamburg University of Technology Germany IBBK-Fachgruppe Biogas GmbH Germany KIRDI Kenya Industrial Research and Development Institute UONBI-University of Nairobi Kenya UH1-Université Hassan 1er Settat Morocco USMS-Sultan Moulay Slimane University Morocco
START DATE OF THE PROJECTS	From July 1st 2023
NUMBER OF REPORT	01
REPORT PERIOD	From July 23 to June 24

1.1 Project Key words and Abstract

Project Keywords	Energy, water consumption and assessment, Modelling and designing the optimized energy, water, and material flow within the farm, Designing the prototypes, the battery, and the data interface, data collectors
-------------------------	--

Project abstract	Future sustainable energy systems should be affordable and adapted to the local context, while also preserving natural resources such as forests, water and soil. The Vil2Bio project aims at integrating low-cost biochar, biogas, and solar photovoltaic technologies into a village-scale off-grid hybrid energy system providing energy for cooking, while preserving water, soil and biomass resources. Two demonstration pilots will be installed and operated, near Settat in Morocco , and near Nairobi in Kenya . The Moroccan pilot will include two Indian-type 5m ³ biogas reactors developed in Morocco based on agricultural and food residues as feedstock for its
-------------------------	--



	operation, and allowing the production of biogas that will be purified to be used on-site for food cooking. Downstream of the biogas reactor, a solid-liquid separation system will be installed, including decanter, vibrating sieve and sand filter, whose efficiency can be further increased by biochar addition. The separated liquid fraction will be treated in a low-cost microalgae (cyanobacteria) cultivation system. The final effluent containing cyanobacteria, along with used biochar and sand, will be applied for direct fertigation of crops with biostimulant effect from phytohormones and organic nutrients contained in cyanobacteria (“cyanobacterisation”). The combined processes of biogas production and microalgae culture will be optimized in lab-scale prototypes in France and Germany, and a bench-scale prototype in Algeria. The Kenyan pilot will comprise an automatic briquette production system already operating at KIRDI institute, along with TLUD pyrolysis stoves and charcoal burners manufactured by the institute, which will be tested at the premises of a small on-farm biogas plant in Kenya. For energy production, small biogas stoves from Chinese and Indian manufacturers used for domestic cooking will be evaluated and installed on the pilots. On the Moroccan pilot, biogas will be cleaned in low-cost water scrubbing system, and fed into a small Chinese-type gas engine generator of 1kW_{el}. Biogas washing water containing dissolved CO₂, H₂S, NH₃ gases will then be recycled as a nutrient source to boost microalgae production. The gas engine will provide a microgrid suitable for island operation. Furthermore, a low-cost and water-efficient briquette production system will be tested, composed of a hand sieve and a hand-operated wooden briquette press, applying a share of the liquid fraction of digestate in place of water as a binding agent. The design and operation of components of the energy system will be optimized by means of computer simulations and experimental tests. Socio-economic challenges related to energy security affecting rural communities will be evaluated in environmental, economic and social analyses, focusing on the pilot regions of Settat in Morocco, and Nairobi in Kenya. Regional biomass availability for pyrolysis and biogas production will be evaluated in GIS analyses, and the exploitation potential for village-scale and on-farm deployment of the hybrid energy system will be estimated. A staff exchange plan will promote North-South staff exchange for specific activities. The project involves 10 partners from 5 countries, including 5 partners from the EU, and 5 partners from Africa.
--	---

1.2 Relevance to the LEAP-RE programme

Link with the Multi-Annual-Roadmaps	MAR6 Innovative solutions for priority domestic uses (clean cooking and cold chain) MAR5 Processes and appliances for productive uses (PRODUCE) –
Challenges addressed by the project	Biogas reactor running efficiently with a mix of feedstocks as food, olive oil and crop residues from 2 to 5 m³ size Water, nutrients and CO₂ savings through a coupled technology of methane enrichment of biogas with water scrubbing, digestate treatment and microalgae cultivation. Pyrolysis stoves at the farm scale to produce heat and biochar transformed in briquettes Adaptation of cooking systems to the end users through the analysis of a social survey





LEAP-RE

Expected Findings in relation with the MARS ¹	Design and optimisation of pyrolysis Anila stoves to be used as a standalone system Biogas production based on different feedstocks available on African sites, possibly enhanced by harvested microalgae addition Clean cooking either from pyrolysis stoves, biochar combustion or biomethane Recycling of nutrients, and water by microalgae production for agriculture applications (irrigation, fertilization, crops biostimulation). Identification of suitable, sustainable and affordable clean cooking options for the local population (Living Lab Approach, Kenya)
--	--

¹ https://www.leap-re.eu/wp-content/uploads/2022/12/LEAP-RE-Call-2022_TEXT-V2.0-2022_12_08.pdf



2. PROJECT PROGRESS

2.1 Project Progress in the Reporting Period

Is the project progressing as planned and as stated in the proposal?

☐ YES ☒ NO	Due to many challenges, cost-free extension of the project of 6 months may be useful to deliver more complete results. Priority issue - Complete lockdown of funding of the Moroccan partner USMS due to internal administrative issues: in Morocco, while funding is available at national level, and has been awarded to the Moroccan partner UH1, the funding of the project for the USMS Moroccan co-partner has been blocked due to internal administrative issues. The Technical manager of the project, Mathieu Brulé, invited expert at USMS, participated in the submission of a follow-up project CombiFarm "Combining low-cost biochar, biogas, and cyanobacteria fertigation technologies with low-input crops for sustainable bioproducts in smart circular farming systems" on the European PRIMA Call. CombiFarm project, targeting similar objectives, has been selected, starting in June 2024. This new project will facilitate the links between the European LEAP-RE and PRIMA Calls in the Energy-Agriculture Nexus. The partners GEPEA, USMS, and UH1 are participating in this follow-up project, along with new partners in France, Morocco, Turkey and Tunisia. Furthermore, the USMS team leader, Hafida Hanine vice-Dean of USMS, who has a strong position within the institution has accepted to take over the Leadership of the new project. Therefore, some results may still be produced by USMS, if synergies between LEAP-RE Vil2Bio and PRIMA CombiFarm can be exploited. Secondary issues: Delays in the completion of national funding procedures: One of the Moroccan partners was able to begin the project more than 6 months after the real date of the Vil2Bio starting date while Kenyans did begin only on January 2024. Kick-off was not possible except by visioconference since visas were not obtained in time. - Whithdrawal of the planned Subcontractor Moroccan SME Biodome for the pilot site at UH1 that had been proposed for the construction of the biogas pilot plant in the proposal has moved abroad Morocco. Delays related to the "due diligence" process for the 2 Kenyan partners -, the two Kenyan partners KIRDI and UONBI have successfully completed the "due diligence process" initiated by LGI Sustainable Innovation on behalf of the LEAP-RE Programme, in order to validate the eligibility and internal procedures of the African partners. This comprehensive validation procedure required several months for its completion. - Corrective actions: two African experts have been invited on the project, Billhat Chala from Ethiopia, and Pride Ebile from Cameroon, and tasked to increase contacts and interactions with African partners in addition to monthly online meetings held under the leadership of the Project Coordinator, Pascale Gillon, and discussion groups have been created to develop the pilot sites in Morocco and Kenya.
--	---

2.2 Relevance to the LEAP-RE programme

Anaerobic digestion is studied at lab-scale based on different specific feedstocks at the same time in Algeria, in Morocco and in Kenya. The three sites get advantages of the collaboration of specialists of Germany. Design and optimisation are conducted through the collaboration between TUHH, IBBK, Kirdi and UH1 to propose a digester size and running conditions adapted to a rural environment. CDER is developing their own digester at lab-scale with the help of German partners. Biogas production and storage will be assessed to be associated to cooking systems.

The up-scaling to a larger biogas reactor able to produce sufficient methane to be linked to a small engine generator is expected in the second year of the project if UH1 is able to join the consortium.



A questionnaire to survey the potential users is underway in Kenya and may orient the project on the uses of pyrolysis or digestion and the size and conception of cooking systems that could suit the users demand.

2.3 Interdisciplinarity / Transdisciplinarity

The main interdisciplinary facts in Vil2Bio project arise from the discussion about the questionnaire and the results of the Kenyan survey about the endusers preferences. It constitutes a major event that already orient the design of the RE technologies that will be set-up in the project. It will also define the best sites to exploit a demonstrator.

Collaboration between UH1 and ICARE about the water scrubbing system has led to innovative designs. Discussion about the Anila stove geometries and feedstocks that could be used in Kenya to be modelled by a joint Altran- ICARE collaboration is a source of interdisciplinarity and could lead to innovations. The choice of CDER to build an integrated system that include digester-digestate treatment and microalgae cultivation is a source of improvements for the value chain from waste to energy within the concept of circular economy.

Input from TUHH and IBBK on UH1 and CDER biogas digester design contributes to the interdisciplinarity of Vil2Bio.

2.4 Implementation Formats

No.	(Innovative) Format Description	Type of Working Format	Country of Implementation	Region / City / Area of Implementation	Realised
1	Text (max. 300 characters)	e.g.: workshop, stakeholder involvement		Click or type here to enter text.	Please select
2	Text (max. 300 characters)	e.g.: smart stand-alone system implementation in a public/private lab		Click or type here to enter text.	Please select
3	Text (max. 300 characters)	Please select		Click or type here to enter text.	Please select
4	Text (max. 300 characters)	Please select		Click or type here to enter text.	Please select

2.5 Cooperation with Other Projects and Programmes





Does your project cooperate with other LEAP-RE projects ongoing or planned?	☐ Ongoing ☐ Planned ☒ No If yes, please specify the project(s') name(s):
Is your project involved in other research programmes in your country?	☐ Ongoing ☒ Planned ☐ No For France, ANR-ADEME project.
Does your project build on any other national or international projects?	☐ National ☒ International ☐ No CombiFarm in PRIMA programme WaterGreenTreat in Water4all programme

3. DESCRIPTION OF WORK – (PRELIMINARY) RESULTS AND MILESTONES

WP1 Biogas reactor

- UH1 develops and optimizes biogas production at lab-scale using household, agricultural, and other organic wastes through response surface methodology (RSM).
- A pilot-scale digester design plan, discussed with partners, will select optimal technology options, including geometry, size, mixing, and heating systems.
- CDER is designing a lab-scale digester to provide data from waste characterization to microalgae cultivation.
- TUHH is conducting literature research on small biogas reactors for developing countries, advising African partners, consulting on anaerobic digestion analytics, investigating biogas yields, and planning test series for continuous biogas plants. In collaboration with German partners (IBBK), these activities combine practical and research-oriented expertise.
- KIRDI is procuring a lab-scale flexi biogas reactor for researching various biomass feedstocks to ensure sustainability and prolonged use before farm installation.

Recommendations include adjusting system sizes to be cost-effective with local raw materials and favouring smaller plants for easier testing and comprehensive technological insights.

WP2 Post-treatment and uses of digestate

Digestate post-treatment is performed at GEPEA and includes decantation and separation of solid from liquid phases. At the project mid-term:

- Protocols for decantation have been determined for one type of digestate
- Experimentation was done on a lab-scale set-up and tested on one type of digestate (wastewater treatment plant i.e. sludge) using sand filtration. Partition between solid and liquid is determined.
- Chemical analysis of the liquid digestate from wastewater treatment plant before and after filtration was realized: total nitrogen, COD, Ammonium/ ammoniac, pH, dry matter and ashes content.
- The pilot filtration unit was designed and built. Tests with digestate from sludge are planned.

Investigation of Algae and cyanobacteria cultures on digestate is developed at CDER and GEPEA.

At CEDER, design of a mini pilot combining Biogas production to digestate treatment by micro algae and bacteria is underway.



Meanwhile, lab-tests regarding the different operations are performed:

- Wastes samples recovery: Whey, poultry, slaughterhouse, household wastes and digestate samples recovery from: laboratory cow wastes, whey and slaughterhouse anaerobic digestion, digestate from Water treatment plant biogas digester,
 - Anaerobic digestion at lab scale to recover digestate from wastes already mentioned,
- GEPEA aims to developing microalgae cultivation in biofilm mode on biochar using the digestate liquid fraction as cultivation medium.
- Conception of the raceway pond of 50 L: designed, built, received and tested
 - Cultivation at lab-scale of 2 selected strains on synthetic media then using the liquid digestate at various dilutions
 - Cultivation in the raceway pond first in the synthetic culture medium (BBM) and then in diluted liquid digestate. Harvesting of biomass for biodegradability tests. Preparation of biochar for biofilm.

Challenges and solutions

- Analyzing filtration effects on digestate microbiology is challenging
- Cultivating *A. cylindrica* is difficult due to morphology and cell clusters, necessitating parameter studies.
- Mini pilot biogas and photobioreactor design require adaptations to available resources.

Collaborations

- CDER-GEPEA, regarding all steps dealing with Lab tests of Algae and cyanobacteria cultures on digestate investigation, details also about mini pilot photo bioreactor are discussed. Future actions have been discussed to analyze at GEPEA, samples harvested from different phases, during lab test and experiments depending on obtained results and both parts needs, and GEPEA advice.
- CDER-IBBK, there have been discussions about mini pilot biogas digester design,

WP3 Off-grid energy system and cold-chain

The water scrubber design aims to enrich biogas in methane by reducing CO₂ and H₂S impurities. This counter-current absorption unit uses water as the solvent. Parameters like pH, flowrate, and gas composition will be studied, with gas concentrations monitored by chromatography. The CO₂-rich water will dilute liquid digestate in microalgae cultivation. The pilot has been designed and is in the experimental qualification phase. H₂S has such severe safety constraints that the use of an artificial gas containing this element will not be used in the time available.

Biogas cooking stove. Experimental study on biogas combustion via methanization includes theoretical & bibliographical research on biogas composition from diverse waste sources, setup of combustion systems, and experimentation with varied gas compositions & combustion systems. KIRDI is working on the implementation of the biogas cooking stove in selected test households.

Experiences of combustion on a laboratory burner and commercial gas cookers with different compositions of biogas. Flame stability and pollutant emission will be investigated. For different gas cookers, a range of CO₂ fraction in biogas for possible cooking in single-family houses will be determined.

WP4 Pyrolysis stove for cooking and biochar production

Discussing available measurement tech at TUHH, planning biomass analyses, modeling a biomass-fueled cookstove, conducting pilot tests on biochar briquettes, and KIRDI's fabrication for the distribution of pyrolysis stoves to households at the selected site.

Modelling of this furnace to design its geometry to meet physical constraints and optimization. The constraints needed to define the directions to be taken have been established with the partners. And the equation set of chemical reactions is currently being acquired.

WP5 Citizen involvement in living lab approach

Main Objective: Assess socio-economic factors and preferences for designing clean cooking technologies in Kiambu County, Kenya.

Specific objectives: Analyse current cooking technology use, evaluate socio-cultural and economic preferences, and examine institutional and policy influence on cleaner cooking technologies in Lari Sub-County, Kiambu.

- The University of Nairobi, in collaboration with KIRDI under the Vil2Bio project, conducted a reconnaissance study in February 2024 to assess potential project sites; Lari, near Nairobi.
- MSc student developed and defended her proposal, officially registered on April 3, 2024.



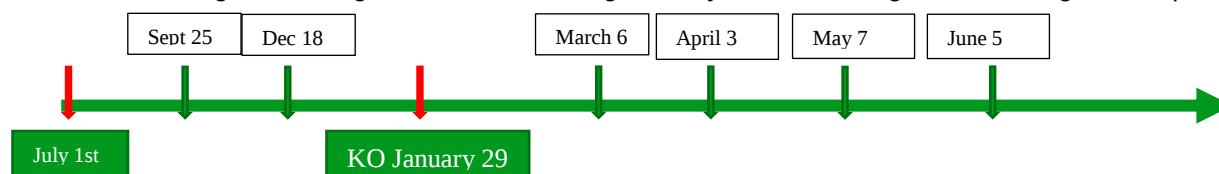
- With the help of the invited experts, a robust questionnaire was pre-tested, six enumerators were trained, and a baseline survey on clean cooking technologies was conducted in Lari in mid-May with local community help.

The UoN team is analyzing baseline study data to compile a report for KIRDI. This report will guide the installation of clean cooking technologies in selected households, advancing project goals.

- Challenges: Respondents were skeptical about participating in the baseline survey due to a previous project's failure.
- Solutions: 1. Engaged a trusted community contact and recruited local enumerators to build trust, 2. Provided clear project information and benefits, and 3. Trained enumerators to address concerns empathetically.
- Exchange between KIRDI and TUHH: Discussed anaerobic fermentation and biochar production in Kenya and evaluated essential knowledge for successful local operation.

WP6 Project management and exploitation

Consortium agreement signed; Kick-off meeting January 29th 2024; Regular e-meetings with reports:



Presentation of research advancements by the young researchers working on the project

Regular WP specific meetings

- To maximize project impact, exchanges between partners and external actors are enhanced through a staff exchange plan.
- African experts, Bilhat Chala and Pride Ebile, join project activities, with plans for a short-term stay in Europe, strengthening North-South links.

Mathieu Brulé facilitates a follow-up project, PRIMA CombiFarm, linking European and African initiatives in sustainable farming systems.

- Under the leadership of Project Coordinator Pascale Gillon, monthly meetings are held, with African expert Pride Ebile assisting in various tasks.
- These include collecting partner information for the midterm report, facilitating monthly meetings, improving communication, and animating working groups focusing on pilot site development in Morocco and Kenya.
- Future plans involve Ebile's involvement in innovation and socio-economic analyses, as well as developing proposals for staff exchanges funded by French and German scholarships.
- Turkish expert Emin Açıkkalp, involved in previous projects, may join as a guest scientist at ICARE-CNRS, enhancing project synergies.

TUHH is exploring German scholarships for African students to visit Germany, with discussions underway to connect scholarships with interested students from partner countries.

4. IMPACT

4.1 Impact of the Project

On a social point of view, the study developed by University of Nairobi (UoN) in strong cooperation with Kirdi to determine the socio-economic factors and institutional preferences in the design of clean cooking technologies for rural households in Kenya is of primary impact.

On the environmental point of view, we have performed an order of magnitude calculation of the CO₂ captation that could be attained using the biogas water scrubbing by absorption of the CO₂ present in the biogas (30%). It has been hypothesized that all the CO₂ is dissolved and is to be captured and transformed by the microalgae during photosynthesis.

The digester considered is described in the following table

Vil2Bio Digester Settlat	5 m ³
--------------------------	------------------



Waste consumption	100 t / year
Biogas production	0,167 Nm ³ /h
CO ₂ percentage	30 %
CO ₂ production	0,05 Nm ³ /h
CO ₂ Density normal condition (1,01325 bar et 0°C)	1,997 kg/Nm ³
CO ₂ Production	99,85 g/h
CO ₂ Production	2 396,4 g/d

Based on dry weight calculation, microalgae biomass contains about 50% C. Using a biomass productivity of 4.3 mg/h/L, the total microalgae suspension volume to consume the CO₂ captured by the water scrubbing of the biogas is 12.7 m³ corresponding to a raceway of 42 m² (culture depth of 30 cm).

4.2 Dissemination

Questionnaire by UONBI

Visit of the microalgae platform at Saint-Nazaire by Moroccans researchers (April 2024)

Oral communication at the CIEC 2024 Montpellier

An extensive list of Invited Experts from various countries and various fields of expertise related to the project has been developed and included in Annex of the Consortium Agreement, which has been signed by the partners. During the upcoming in-person project meeting, which is planned in France in October 2024, some Invited Experts may participate and show a presentation of their own projects and activities, in order to enhance the networking between the project LEAP-RE Vil2Bio and other ongoing or upcoming projects on related research topics.

4.3 List and Reach of Dissemination and Communication Activities

Please specify the number of dissemination and communication activities linked to the project for each of the following categories:

<i>Dissemination or/and Communication Category</i>	<i>Number</i>
Organisation of a Conference	
Organisation of a Workshop	
Press release	
Non-scientific and non-peer-reviewed publication (popularised publication)	
Exhibition	
Flyer	
Training	
Social Media	
Website	1
Communication Campaign (e.g. Radio, TV)	
Participation to a Conference	1



Participation to a Workshop	1
Participation to an Event other than a Conference or a Workshop Presentation of the project Vil2Bio by a poster at the national science day of Algeria, celebrated at CDER	1
Video/Film	
Brokerage Event	
Pitch Event	
Trade Fair	
Participation in activities organised jointly with other AU - EU project(s)	
Other MSc defences 1 Kenya, 4 France,	5

Specify the estimated number of persons reached, in the context of all dissemination and communication activities, in each of the following categories

<i>Category</i>	<i>Number of Persons Reached</i>
Scientific Community (Higher Education, Research)	200
Industry	40
Civil Society	
General Public	
Policy Makers	
Media	
Investors	
Customers	
Other	

5. Overview – PLANNED WORK

WP1: Biogas studies on anaerobic degradability with substrates from African partner organizations (both batch and continuous fermentation)

- Finalization of the reactor concept for a demonstration plant in Morocco
- Support for biogas trials by the Algerian project partners (CDER)
- Consultation with Kenyan partner KIRDI on improvement of local small biogas plants

WP2: Filtration of sludge digestate using the pilot scale unit; filtration and characterizations using digestates from various origins (agricultural, food and industrial wastes). Interest of a secondary filtration by biochar. Culture of two strains in the presence of biochar on small and large scales. Characterization of the biofilm and validation of the process at raceway scale.

Provide input related to digestate management and separation in AD plants in relation to small biogas plants in the partner countries





WP3 Results from low cost biogas cleaning and the level of methane enrichment. Domestic cooking devices based on the biogas produced presenting low emissions.
Bottlenecks are linked to USMS participation to the project. If the development of small size digesters adapted to a cooking utilization at farm sites is planned, the opportunity to scale-up a digester able to fuel an engine for electricity is at risk. That would also threaten the refrigerator design.

WP4 Development by KIRDI of pyrolysis stoves at sites defined by the UoN survey will follow the recommendation of Altran-Icare for the best running conditions.
Laboratory tests on the composition of various solid biomasses (TUHH)
Assessment of the quality of various biochar produced from the biomasses investigated (TUHH)
Biochar briquettes fabrication is still planned in Kenya but will be delayed for Morocco since it was proposed by USMS.

WP5 The next steps are analysis and report writing on the socio-economic and institutional unravelled from the baseline survey. The analysis and report writing will run through June and the results will also be shared with KIRDI to guide them through the technology installation stage. The technologies will be installed in 20 randomly selected households. A monitoring and evaluation study will be done and this will involve participatory cooking test whose purpose will be to assess the actual performance of the installed cleaner cooking technologies. The feedback gathered from the users during the monitoring and evaluation process will be used to improve on the other stoves.

- Creation of teaching materials on the technologies investigated in the project
- Studies on the ecological impact of the technologies examined
- Contribution to developing guidelines for the living-lab approach
- Trainer in Train-the-trainer courses in Kenya or Morocco (the final location needs to be determined within the consortium)

WP6 Organization of an upcoming in-person project meeting, which is planned in France in October 2024.

Exchanges between partners.

Contribution to and continuation of the Communication, dissemination and Exploitation plan

6. PROJECT TEAM AND MANAGEMENT

This data will be already inserted in the reporting template for each project and will require updates in case of any changes during the implementation.

Project Coordinator	Organisation	Contact Person	E-mail	Country
Partner 1				

(no page limit)

Have changes occurred in terms of project organisation and management in the reporting period?

☐ YES	Please explain (max. 1000 characters):
☒ NO	

7. Financial progress

Total requested 656 996 € Total spent in the reporting period 94 287 €

	budget requested	budget spent	fonct	equip	RH	overheads
GEPEA	109 400	61779.2	5800	33950	7829.2	14200





ICARE	90119	26638				10719
CDER	50000	5936	536	5400		
TUHH	199437	25100				
IBBK	50000	5000				
KIRDI	13000	3746				
UONBI	19000	8132				
UH1	50400	25200	9700	15500		
USMS	50600	0				
Total	656996	94287				

8. ANY OTHER COMMENTS

Deliverables and milestones expected to be completed at M12 of the project

ML1	Design plans of pilot biogas reactor	Completed M12	
ML2	Design plans of digestate treatment system	Completed M9	
ML6	Dissemination and exploitation plan	Not completed	Founding delays
D1.1	Design plans, risk analysis and set-up of the pilot biogas reactor	Partially completed	Set-up still to be realized
D2.1	Design plans, risk analysis and set-up of the cyanobacteria reactor	Completed	
D5.1	Living Lab Roadmap	Not completed	
D6.1	Project, quality and risk management plan	Not completed	In progress
D6.4	Project reports	Completed	

Free comments for LEAP-RE Call Secretariat and LEAP-RE Coordination.

Cooperation between African and European players needs to be enhanced in the field of biogas production in order to further expand this sector on the African continent. Before highly specialized concepts are developed, solutions that are easier to handle should be implemented first. Social aspects must not be ignored in all concepts. It must be born in mind that some of the concepts commonly used in Europe are therefore not feasible in Africa.

9. ELECTRONIC SIGNATURE

This report is fully agreed among all partners of the project.

Name of coordinator	Date
Pascale Gillon	





List of Publications

(no page limit, please add columns as needed)

No.	Type	Title	Author(s)	Peer-reviewed	Open Access	Title of the Journal/Proc./ Book	Year published	Place published	DOI	Repository Link
1	Conference Proceedings	Vil2Bio : méthaniseur et four de pyrolyse pour la production d'énergie à partir de déchets à l'échelle d'un village, avec réutilisation des effluents	P. Gillon et al.	yes	Green	ICEC 2024	2024	Hal		
2	please select			please select	please select					
3	please select			please select	please select					
4	please select			please select	please select					
5	please select			please select	please select					
6	please select			please select	please select					
7	please select			please select	please select					

