Vil2 bio project

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

July 23-June 26

10 partners from 5 countries
5 partners from the EU + 5 partners from Africa.

GEPEA CNRS - Laboratoire de Génie des Procédés - Environnement - Agroalimentaire	**France**
ICARE-CNRS - CNRS Institut de 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 - IBBK Fachgruppe Biogas GmbH	Germany
KIRDI - Kenya Industrial Research And Development Institute	Kenya
UONBI - University of Nairobi	Kenya
UH1 - Université Hassan Ier Settat	Morocco
USMS - Sultan Moulay Slimane University	Morocco

Vil2Bio objectives

- integrating low-cost biochar, biogas, and solar photovoltaic technologies into a village-scale off-grid hybrid energy system

- providing energy for cooking and cold chain, while preserving nutreints, water, soil and biomass resources.

- Two demonstration pilots :

- Settat in Morocco
- Nairobi in Kenya.

Moroccan pilot

- An Indian-type 10 m3biogas reactor developed in Morocco by the local company “Biodôme”
- A 30L Indian-type batch Top-Lid Up-Draft (TLUD) pyrolysis stove requiring only wood and crop residues for its operation, and allowing the combined production of biochar together with heat, which can be used on-site for food cooking
- A solid-liquid separation system for the digestate including decanter, vibrating sieve and sand filter, coupled with additional biochar
- The liquid fraction will be treated in a low-cost microalgae (cyanobacteria) cultivation system.
- Direct fertigation of crops with biostimulant effects by the final effluents containing cyanobacteria, along with used biochar and sand
- 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.
- A low-cost and water-efficient briquette production system, composed of a hand sieve and a hand-operated wood in briquette press, applying a share of the liquid fraction of digestate in place of water as a binding agent

Kenyan pilot

- TLUD pyrolysis stoves and charcoal burners manufactured by the institute installed on a site that already operated a on-farm biogas plant in Kenya.
- Small biogas stoves from Chinese and Indian manufacturers used for domestic cooking will be evaluated and installed on the
- pilot.
- Transformation of biochar in briquettes through an automatic briquette production system already operating at KIRDI institute.
- Energy supply will be used to power agas-drivenadsorption fridgemodified forbiogas operation, as well aslow-cost online monitoring interfaceforthe hybrid energy system, designed on the basis of digital sensors connected to a Raspberry pieprocessor and phone-SIM internet system. Furthermore, alow-cost and water-efficient briquetteproduction systemwill be tested, composed of a hand sieve and a hand-operated woodenbriquettepress, applying a share of the liquid fraction of digestate in place of water as a binding agent. Thedesign and operation of components of the energy system will be optimized by means of computersimulations and experimental tests.Socio-economic challenges related to energy securityaffectingrural communities will be evaluated in environmental, economic an d social analyses, focusing on thepilot regions of Settat in Morocco, Algiers in Algeria, and Nairobi in Kenya. Regional biomassavailability for pyrolysis and biogas production will be evaluated in GIS analyses, andthe exploitationpotentialforvillage-scale and on-farm deploymentof the hybrid energy system will be estimated. Astaff exchange plan will promote North-South staff exchange for specific activities. The projectinvolves 10 partners from 5 countries, including 5 partners from the EU, and 5 partners from Africa.

Energy production and uses

- Biogas cleaner in low-cost water scrubbing system with reuse of water and nutrients

- Biogas will be fed into a small Chinese-typegas engine generatorof1kWel.
- The gas engine will provide a microgrid suitable for island operation in association with a photovoltaic kit comprisingPV panels connected to an inverter.
- Energy supply will be used to power a gas-driven adsorption fridge modified for biogas operation,
- low-cost online monitoring interface for the hybrid energy system, designed on the basis of digital sensors connected to a Raspberry pie processor and phone-SIM internet system.
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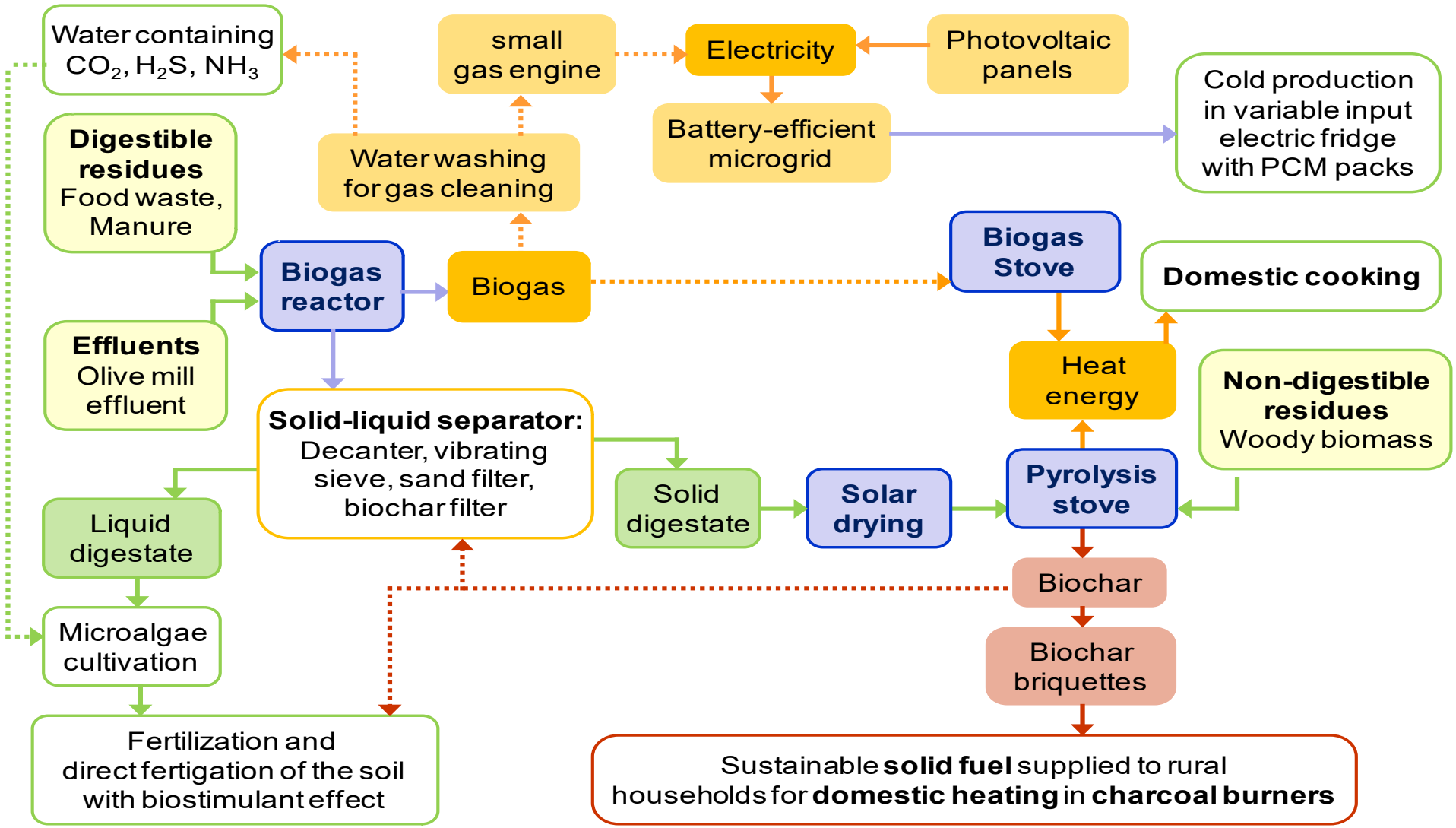
Socio-economic and business model

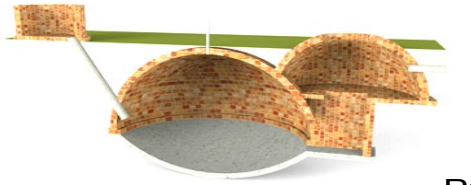
- Socio-economic challenges related to energy security affecting rural communities will be evaluated in environmental, economic and social analyses, focusing on the pilot regions of Settat in Morocco, Algiers in Algeria, and Nairobi in Kenya.
- Regional biomass availability for pyrolysis and biogas production will be evaluated in GIS analyses, and the exploitation potential forvillage-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.

Vil2Bio flow chart

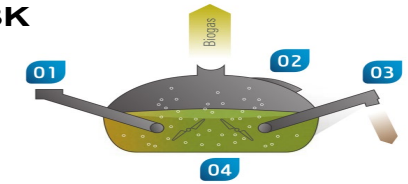


Vil2Bio equipment

Chinese-type biogas reactor designed by the ***Moroccan SME « Biodôme »,*** planned Subcontractor of **UH1**



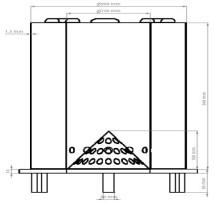
Low-cost bag-type digester developed by the German SME **IBBK**

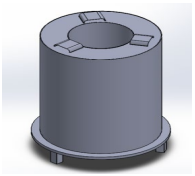


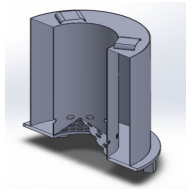
Preliminary design of microalgae cultivation system at **GEPEA**

Pyrolysis reactor « Anila stove » (Indian-type batch TLUD stove, double chamber)

Example of biochar production from straw in Anila stove







CAD Design: Emin Açıkkalp, Eskisehir Technical University (ESTU), Turkey