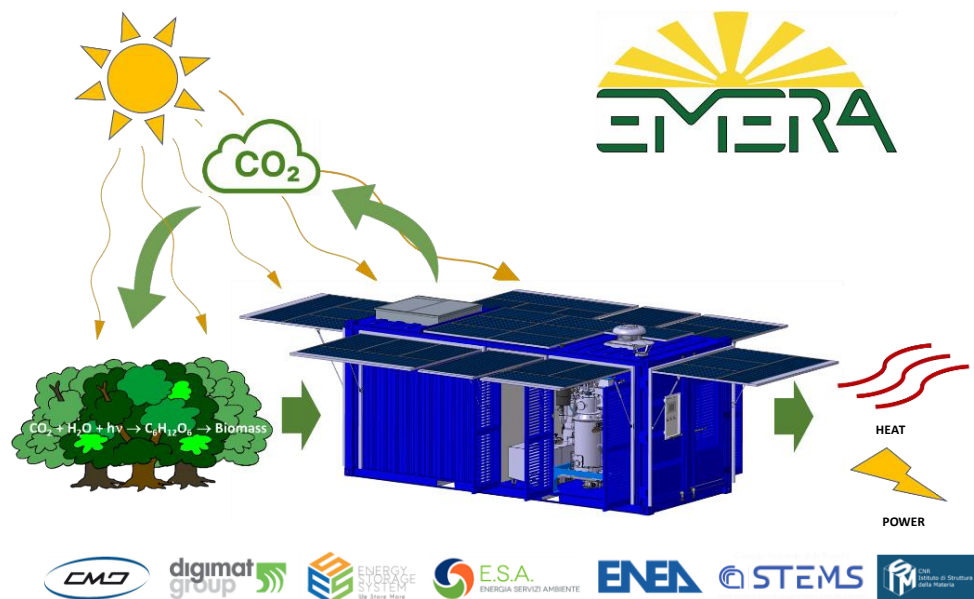


## Progetto EMERA – Efficientamento di Micro reti Energetiche alimentate da sole fonti Rinnovabili per l'Autonomia e l'indipendenza delle zone rurali dal sistema centralizzato



Efficient micro-grids powered by only renewable energy sources for the autonomy and independence of rural areas from the centralised system

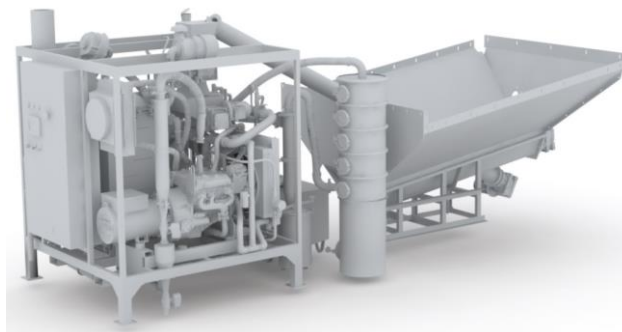


**Figure 1.** The EMERA approach: containerised hybrid prototype for autonomous power generation from biomass and solar energy.

EMERA aims at the development of an integrated hybrid platform for the generation and storage of electricity. Driven by renewable energy sources alone, the unit is conceived to be able to foster the spread of decentralised and customised generation based on local availability.

The proposed innovations are aimed at the development of an autonomous hybrid demonstrator, to be powered by residual biomass and solar energy, equipped with a high-density energy storage system (Figure 1). Flexible and efficient management of the unit is also envisaged, to achieve optimal integration of sources and at the same time ensure continuous availability of electricity at the consumer's installation site.

## Progetto EMERA – Efficiamento di Micro reti Energetiche alimentate da sole fonti Rinnovabili per l’Autonomia e l’indipendenza delle zone rurali dal sistema centralizzato



**Figure 2.** Preexisting micro-cogeneration system to produce electrical and thermal energy from wood and agricultural waste.

Starting from the pre-existing downdraft gasification technology owned by CMD (Figure 2), the main industrial partner and project coordinator, EMERA intends to realize an advanced gasification reactor capable of utilizing different types of carbonaceous feedstocks.

Besides wooden feedstocks, low-quality residual biomass of different origins and biogenic waste fractions, including those with a high ash content and relatively low melting points, are considered (Figure 3).



**Figure 3.** Feedstock specimens to be processed in the downdraft gasification reactor.

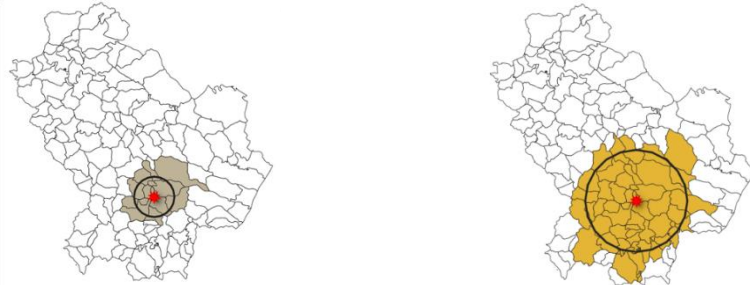
In this view, ENEA takes part in the project with its expertise in the study and development of thermochemical processes, supporting the design of the reactor to achieve the ambitious goal of setting up a gasifier flexible toward the supplied feedstock, characterized by stable and continuous operating performance, requiring no maintenance beyond ordinary and scheduled servicing.

## Progetto EMERA – Efficiamento di Micro reti Energetiche alimentate da sole fonti Rinnovabili per l'Autonomia e l'indipendenza delle zone rurali dal sistema centralizzato



ENEA is also involved in:

- economic and environmental sustainability assessments of the proposed approach with studies on local biomass availability and supply chains (Figure 4):



**Figure 4.** Residual biomass supply areas in the prototype installation site.

- chemical-analytical characterisation of feedstocks, process products such as char, ash and agglomerates (Figure 5):



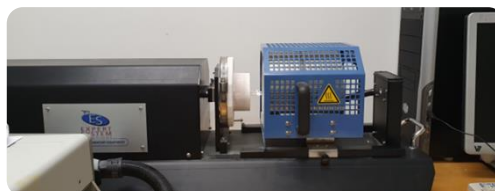
Ash agglomerates



Charpy Impact Testing System



Hardness testers with microscope



Heating Microscope



**Figure 5.** Ash agglomerates and equipment for characterizing their hardness and fusibility.

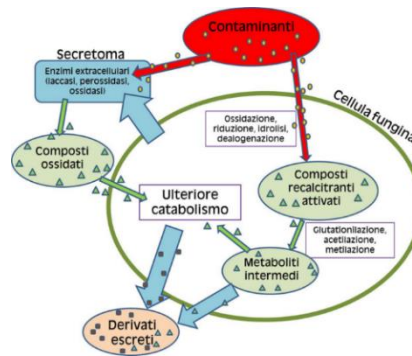
## Progetto EMERA – Efficientamento di Micro reti Energetiche alimentate da sole fonti Rinnovabili per l'Autonomia e l'indipendenza delle zone rurali dal sistema centralizzato



- characterization and treatment of condensation effluents for the removal of contaminating compounds (Tar), including through fungal microorganisms (Figures 6 and 7).



**Figure 6.** Sampling of condensation waste and analysis chromatographic systems (GCMS, HPLC)



**Figure 7.** Schematic of fungal detoxifying metabolism

Once completed, the EMERA integrated module will be delivered to the selected site (agritourism farm in Val d'Agri) for the final phase of performance verification and TRL achievement. During the experimental campaigns, ENEA will contribute to the functioning evaluations of the prototype unit and to the performance validations in a real context.

DURATION: 1 February 2022 - 31 January 2025

CO-ORDINATOR: Costruzioni Motori Diesel S.p.A.

INDUSTRIAL PARTNER: ENERGY STORAGE SYSTEM S.r.l., Energia Servizi Ambiente, DIGIMAT SpA

Other research partners: CONSIGLIO NAZIONALE DELLE RICERCHE (CNR-STEMS, Istituto di Scienze e Tecnologie per L'Energia e La Mobilità Sostenibili; CNR-ISM, Istituto di Struttura della Materia)

Project funding: 5,808,267.01 euro

Funding share to ENEA: 650,000.00 euro

Web site: <https://www.cmdengine.com/gruppo-cmd/progetti-innovativi/progetto-emera/>

ENEA units involved: TERIN-BBC (PTR, BIC, PBE), TERIN-SAEN

ENEA contact persons: Donatella Barisano, Francesco Nanna

**Acknowledgment:** The EMERA project is financed within the framework of the 2014-2020 Basilicata ERDF Operational Programme, CORES call (Progetti Complessi di Ricerca E Sviluppo).