DEVELOPMENT OF SUSTAINABLE TECHNOLOGIES FOR THE CIRCULAR ECONOMY

The circular economy is a model of production and consumption that involves **sharing, lending, reusing, repairing, reconditioning and recycling** existing materials and products for as long as possible.

This extends the life of products, helping **to reduce waste to a minimum**.

12.2 By 2030, achieve sustainable management and efficient use of natural resources

12.4 By 2020, achieve eco-friendly management of chemicals and all waste throughout their life cycle, according to international rules, and significantly reduce their release into air, water and soil with the goal of minimize their impact on human health and the environment

12.5 By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse

A new action plan for the circular economy. For a cleaner and more competitive Europe - COM(2020) 98 final

- Accelerate the transition to a regenerative growth model
- Consumption of resources within the natural limits
- Reduce the consumption footprint
- Double the % of use of recyclable materials

reduction in the use of resources

extension of the use of resources

use of regenerative raw materials

reuse of resources

Consiglio Nazionale delle Ricerche
STEMS
Istituto di Scienze e Tecnologie per l'Energia e la Mobilità Sostenibili

DEVELOPMENT OF SUSTAINABLE TECHNOLOGIES FOR THE CIRCULAR ECONOMY

- Set up of technologies that encourage the transition to the circular economy, promoting measures to reduce waste, reduce the consumption of resources, and encourage their recovery and reuse.
- Set up of ad hoc sustainable technologies, as well as the development of management tools that allows the networking of surpluses and wastes
- Consider waste not as waste but as a source of recyclable materials
- Research activity transversal to various production sectors

DEVELOPMENT OF SUSTAINABLE TECHNOLOGIES FOR THE CIRCULAR ECONOMY

- Biomasses and agro-industrial and/or contaminated carbon based wastes
  - organic
  - Inorganic
- Solid fuels
- Urban waste
- Metals (PGM - platinum metal group)
- Residues/steel processes waste/ mining industry wastes
- Energy systems
- Agricultural systems

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- ✓ Valorization of carbon-based matrices derived from waste materials (biomasses, solid fuels, end-of-life materials, wastes) and from thermoconversion processes
- ✓ Extraction of oxides with green synthesis / organic molecules replacing petroleum materials: study of the influence of process parameters
- ✓ Biomass valorization by means of enzymatic depolymerization processes
- ✓ Efficiency of resources and raw materials, reduction of wastes production: recovery of material and energy from wastes and residual biomasses

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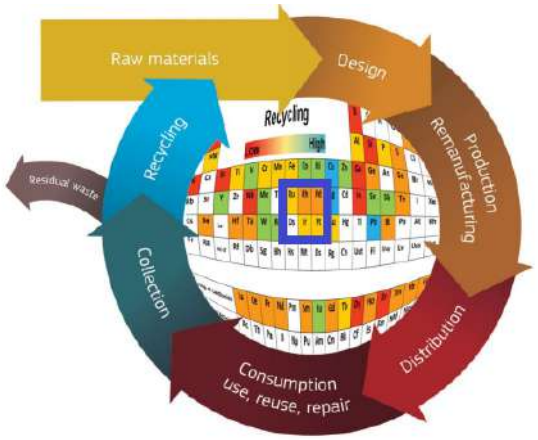

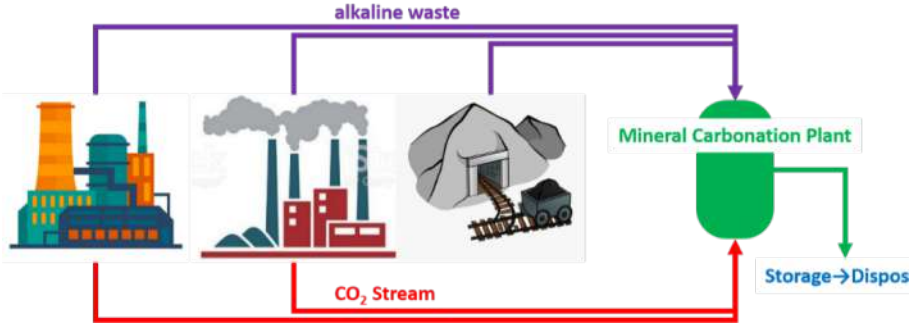

- ✓ Development of metal recovery processes and waste minimization
- ✓ Optimization of operating conditions for CO2 recovery and re-use

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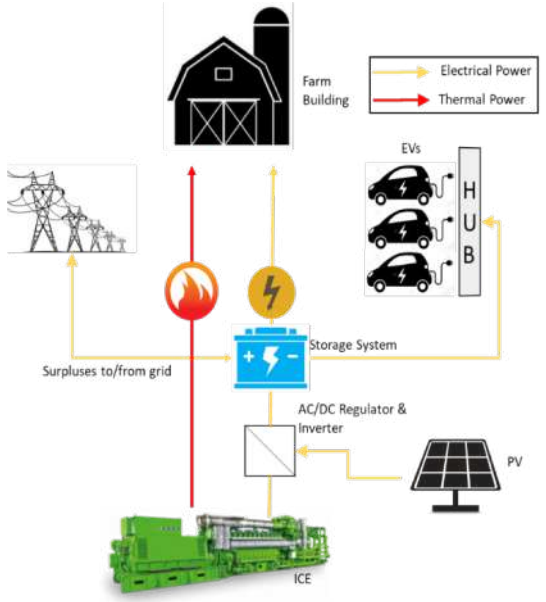

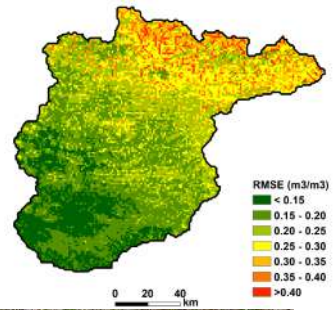

- ✓ Analysis and optimization of hybrid energy generation and storage plants (renewable sources + cogeneration)
- ✓ Increase the efficiency of the use of energy resources deriving from scraps and wastes in small and medium-sized plants distributed throughout the territory.
- ✓ Optimization of agro-industrial waste treatment chains for greater sustainability, recovery and agronomic enhancement of wastes
- ✓ Solutions for soil conservation/recovery, water saving and maintenance of ecosystem services

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Production of liquid and gaseous biofuels	Production of oxides by green synthesis from vegetable waste	Biochar, biomedical products
Fuels, bio-oil, materials for technological applications	Sorbents based on biochar	Products for agronomic use
Energy	Less resource consumption	Greater sustainability

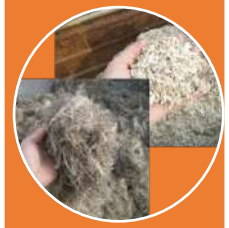
✓ Characterization of the life cycle of a product/process for environmental impact assessment (LCIA-Life Cycle Impact Assessment)

DEVELOPMENT OF SUSTAINABLE TECHNOLOGIES FOR THE CIRCULAR ECONOMY

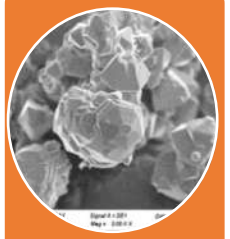
Pretreatment and fractionation of carbonaceous waste materials;

characterization of thermoconversion process products;

methodologies for the purification of complex carbon-based materials

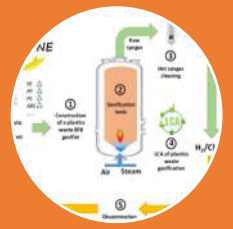


Know-how of oxidic materials (and ceramic in general) in massive and dispersed form and polymeric materials (pure and composite) for different applications



Know-how and tools for chemical-physical, mechanical and tribological characterization (vibrational spectroscopy, diffractometry, electron microscopy)

Thermal and catalytic processes and enzymatic hydrolysis for fractionation, depolymerization and upgrading of residual biomasses



Design and set up of experimental devicess from the laboratory to the pilot scale.

Diagnostics and control of Processes.

Physico-chemical characterizations of materials.

Catalytic processes.

Computational reactive fluid dynamics.

Advanced optical diagnostics.

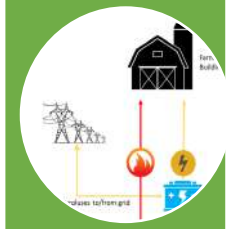
Pyrolyzers, Gasifiers, Burners, Fixed and fluidized bed reactors (fully equipped, up to the pilot scale).

Computational resources.

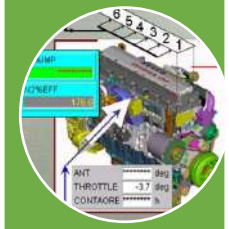
Chemical analysis laboratories.

On-line and off-line diagnostics and control systems

Chemical Reaction Engineering skills (mainly for fluidized bed reactors) - analysis of attrition and particle fragmentation phenomena - Methods and instrumentation: continuous gas analysis; particle size analysis; CHN analysis, calorific value and immediate analyses of solid fuels.

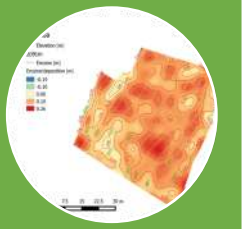


Simulation models validated and characterized by different levels of detail, for the analysis and optimization of hybrid energy generation and storage systems



Exploitation of resources, such as syngas from agricultural forestry or biomass wasts available in the vicinity for energy purposes

Monitoring of ammonia and GHG emissions from agro-industrial wastes, optimization of the densification process of organic residues, physical-mechanical characterization of densified materials. Center for the valorisation of agro-industrial wastes



Physical and hydraulic characterization of soils - Continuous monitoring and models of soil degradation and water balance

Laboratory for the Protection of Soil and Water in Mechanized Agroforestry Systems

Cannona Erosion Plots

Vezzolano Experimental Company

LCIA Life Cycle

Impact Assessment

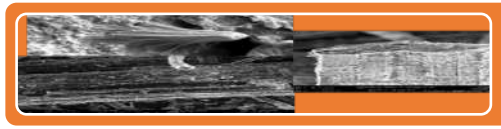
SKILLS / METHODS / INSTRUMENTS

DEVELOPMENT OF SUSTAINABLE TECHNOLOGIES FOR THE CIRCULAR ECONOMY

Use of products from wastes pyrolysis to improve bitumen and asphalts quality and to regenerate exhausted asphalts (RESCA-project@CNR; PRIN 2022 project)

Oxide production through green synthesis starting from vegetable waste.

•Degree thesis in collaboration with UNITO

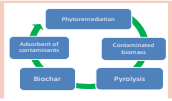


Heat treatment of short fibers and «canapulo» to obtain biochar. Addition of biochar to different polymer matrices. Canapa Campana in Fibra Peoject (CCF), Campania Region, WASTOY, PRIN 2022

Development of a mobile and modular pilot system for the thermal treatment of sewage sludge to reduce the environmental impact and energy enhancement of sewage sludge (POTTERS)

Development of efficient and sustainable innovative solutions for the energy enhancement of sewage sludge produced by the treatment of industrial wastes through gasification processes (FENICS)

Valorisation of mixed plastic residues through gasification processes(PLATONE)



PRIN RIZOBIOREM PROJECT: Role of soil-plant-microbial interactions at rhizosphere level on the biogeochemical cycle and fate of contaminants in agricultural soils under phytoremediation with biomass crops

PROGETTO EU H2020 CERESiS ContaminatEd land Remediation through Energy crops for Soil improvement to liquid biofuel Strategies

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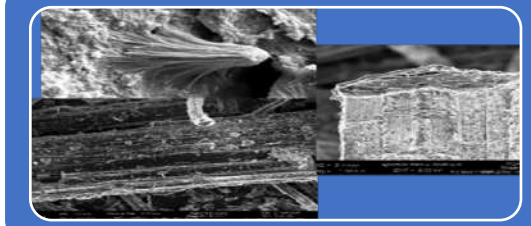
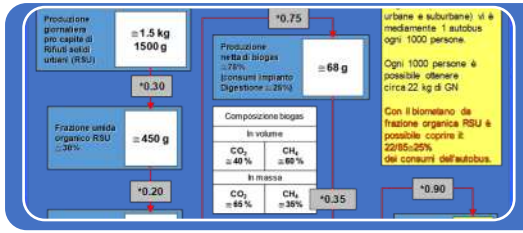


CO2 Capture from exhaust using calcareous sorbents (Calcium Looping) - Soprtion Enhanced Gasification using calcareous sorbents for the production of tailored syngas from residual biomasses - Sorption enhanced methanation for the production of methane



Test of internal combustion engines, with controlled ignition powered by syngas or dual fuel. Analysis of the pressure cycle in the combustion chamber powered by simplified CH4/H2/N2 mixtures.

DIT.AD017.157 Hybrid engines and propulsion systems with low environmental impact and high fuel efficiency with traditional or renewable gaseous fuels

IN-GEST SOIL Project, ATLAS Project, DIT.AD014.031 Energy, Mobility and Sustainable Processes in the Agroforestry System, PRIN 2022

FITRAREF Project, SICOMPOSTA Project, DIT.AD014 Technologies for Sustainable Agriculture and Food Safety Energy

DIT.AD018.059 LCA - Life Cycle Assessment

DEVELOPMENT OF SUSTAINABLE TECHNOLOGIES FOR THE CIRCULAR ECONOMY

UE

POR-FESR

PRIN

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PON

MAIN SOURCES OF FINANCING / COLLABORATIONS