

**FOOD SYSTEM RESILIENCE: TRANSITION TOWARDS A MORE SUSTAINABLE AGRICULTURE**

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**BACKGROUND.** Building food system resilience is necessary to maintain progress towards food and nutrition security and equitable livelihoods for all in a healthy ecosystem. New threats, such as the COVID-19 pandemic and the Ukraine war, are currently challenging the sustainability and resilience of agrifood systems worldwide even more highlighting the strategic role of food production for a safe and secure sustainment of citizens. Recent findings from microbiome research underlined how the microbiome of soils, plants, humans and animals play a key role in addressing new and existing threats to food security, nutrition, health and environmental and energy sustainability of agrifood systems, in the framework of the *One Health* approach. ENEA as Partner or Coordinator in different EU-projects related to food system sustainability and resilience; main examples are summarized hereinafter, covering also aspects related to food quality, food safety, circular economy and integration and interoperability of food-related data.

SOIL



The **SOIL HUB** Project (DBA.AD002.389, 2022-2024) has implemented an the Italian national funded network for healthy soils, to overcome the existing fragmentation of knowledge and stakeholders. The focus is on the sustainability of the production environments and the quality of the agri-food chains through the environmental and soil protection. Special care is paid to the interaction between science and policy in the field of agricultural land management, soil degradation and mitigation and adaptation to climate change.

SOIL HUB intends to support at national level what is being covered at European level by the Horizon 2020 EJP SOIL project, for the creation of a joint European program on soil research. The services that the Soil Hub provide include training, databases, methodologies, a national soil database, cartographic products and soil profile data.



The **European Joint Programme on Soil (EJP Soil, <https://ejpsoil.eu>)** is a Cofund on Agricultural Soil Management from the EU H2020 Research & Innovation Programme (Grant Agreement n° 862695), contributing to key societal challenges including climate change, water and future food security. It targets climate change adaptation and mitigation, sustainable agricultural production, ecosystem services, restoration and prevention of land and soil degradation. ENEA is an active partner in the following four related projects:

- 1) **ΣOMMIT (Sustainable management of soil organic matter to mitigate trade-offs between C sequestration and nitrous oxide, methane and nitrate losses)** focuses on the evaluation of trade-offs and synergies between soil C sequestration, nitrous oxide, methane and nitrate losses as affected by soil management options aimed at increasing soil C storage in the main pedo-climatic conditions and farming systems.
- 2) **MINOTAUR (Modeling and mapping soil biodiversity patterns and functions across Europe)** aims to propose functional indicators of soil biodiversity in relation to soil ecosystem services, and then to identify thresholds and target values for these indicators to support policy.
- 3) **SERENA (Soil ecosystem services and soil threats modelling and mapping)** intends to support land planning and soil policies through the provision of an integrative vision of multifunctional soil quality, putting relevant stakeholders at the core of the projects and providing co-developed indicators and related interpretation values to report both on soil degradation and soil-based ecosystem services.
- 4) **ARTEMIS (Agro-ecological strategies for promoting climate change mitigation and adaptation by enhancing soil ecosystem services and sustainable crop production)**, agroecological farming systems are the key for achieving the resilience to climate changes of the agriculture sector. The project evaluates the impact of good soil management on the ultimate yield stability, carbon storage and nitrate leaching in various – including simulated – climate scenarios.



Food production with minimal environmental impact is one of the aims of the **SIMBA (Sustainable Innovation of Microbiome Applications in the Food System, H2020 GA No. 818431 <https://simbaproject.eu>)** project, which provides a holistic and innovative approach to the development of microbial solutions to increase food and nutrition security. To enhance overall sustainability and the innovation capacity of the European food production system, microbiome-based solutions have been identified and adopted in organic and conventional farming) systems.



ENEA is a Joint Research Unit at **MIRRI-IT (Microbial Resource Research Infrastructure, <http://www.mirri-it.it>)**, the pan-European distributed Research Infrastructure for the preservation, systematic investigation, provision and valorisation of microbial resources and biodiversity. MIRRI brings together 50+ microbial domain Biological Resource Centres (mBRCs), culture collections and research institutes from ten European countries. MIRRI serves the bioscience and the bioindustry communities by facilitating the access, through a single point, to the broadest range of high-quality microorganisms, their derivatives, associated data and services, with a special focus on the domains of Health & Food, Agro-Food, and Environment & Energy. By serving its users, by collaborating with other research infrastructures and by working with public authorities and policy makers, MIRRI contributes to the advancement of research and innovation in life sciences and biotechnology, as well as for a sustainable, competitive and resilient bioeconomy.

FOOD



ENEA coordinates the European **METROFOOD-RI – Infrastructure** for Promoting Metrology in Food and Nutrition ([www.metrofood.eu](http://www.metrofood.eu)), which is focused in providing metrology services in support to the agrifood, in relation to food quality, safety and authenticity, traceability of raw materials and products, food transparency, circular bioeconomy and sustainability. ENEA also coordinates the NRRP project METROFOOD-IT aimed at strengthening the Italian RI for Metrology and Open Access Data in support to the Agrifood.



Furthermore, initiatives focused in integrating RIs knowledge, facilities and services can boost the definition of an integrated and structured landscape, promoting more and more advanced research and highest cooperation with and within the agrifood systems' stakeholders, thus enhancing the social-economic impact. With this reference, two relevant Horizon-funded initiatives are **AgroServ** (HEu GA No. 101058020) aims at providing access to innovative, customized and integrated services for resilient and sustainable European agriculture systems and the agroecological transition; **iNEXT-Discovery** (H2020 GA No. 871037) aims at enabling access to structural biology RIs, and among its activities there is a focus in strengthening the bridge between the "structural biology community" and the "agrifood community" by promoting agrifood-related structural biology applications.



The **FOODSAFETY4EU** project (H2020 GA No.101000613, <https://foodsafety4.eu>) project aims at designing, developing and releasing a multi-stakeholder platform to establish a network of FSS actors at national, European and international level, delivering solutions to support the EC in its endeavor in aligning research, policy and innovation with the societal needs and perspectives and improving food safety across Europe.



The ERANET SUSFOOD2 **PROVIDE** project (<https://www.project-provide.eu/>) aims at fostering a circular food system by promoting the use of food sidestreams to produce high-added value new food products thanks to the application of green extraction technologies to generate ingredients high in valuable proteins and health-promoting compounds.



**DGR4Food** (Empowering a fair and responsible European FoodRegister, fostering citizen sovereignty and creating a data-driven food system - HEu GA No. 101086523) has the goal to achieve trust in a data-driven food system by implementing Digital Responsibility Goals for the food sector to enable reduction of food waste and fair conditions throughout the entire food chain.



Due to the fragmentation of the existing **Food Nutrition Security (FNS)** resources for health and agri-food sciences and their unevenly distribution among the user communities, a first-generation 'food cloud' was launched to overcome fragmentation by federating FNS data on diet, health, and consumer behaviour as well as sustainable agriculture and the bio-economy (**FNS-Cloud**, H2020 GA No. 863059, [www.fns-cloud.eu](http://www.fns-cloud.eu)).

ENERGY



ENEA Energy Efficiency Department largely fosters the implementation of energy efficient solutions for achieving sustainability and resilience in agriculture, including protected agriculture, and in the agro-food processing sector.



ENEA was proposer of the **Energy Efficiency Research Alliance Joint Programme on Energy Efficiency in Industrial Processes (EERA JP-EEIP, current website <https://www.eera-eeip.eu/projects/research-facilities.html>)**, started in 2015, coordinating the Sub-Programme 3 (SP3) dedicated to agro-food industrial processes. Besides energy efficiency improvement, the SP3 adopted the NEXUS approach for a broader vision of the agro-food system, integrating the energy, water and food components; the improvement of feedstock and cultivated species for more efficient industrial processes, the EU integrated labelling; and the closing cycles and symbiosis between local farms and processing plants.



Two European projects, **Transferring Energy Save Laid on Agroindustry (TESLA, Intelligent Energy Europe IEE/758/SI2.644752, 2013-2016, [www.teslaproject.org](http://www.teslaproject.org))** and **Saving Cooperative Energy (SCOPE, H2020-EE-2015-3\_MarketUptake, 2016-2019, <https://scoop.eu>)** strongly addressed the small and medium agro-food cooperatives (SMEs). TESLA pointed to the reduction of energy consumption and the improvement of energy efficiency in cooperatives of key agro-food sectors, namely fruit and vegetable (F&V) processing plants, olive oil mills, wineries and animal feed factories. SCOPE targeted these sectors: crops drying, dairy products, meat and poultry and F&V transformation, analysing the processes in terms of yield and energy, and determining specific Key Performance Indicators (KPIs) for benchmarking production and energy consumption patterns. The several project objectives included the demonstration in operational environment of collaborative energy management systems by realizing six pilot agro-industrial clusters.