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ENI CBCMED
Cooperating across borders in the Mediterranean

Project funded by the EUROPEAN UNION

REGIONE AUTÒNOMA DE SARDIGNA
REGIONE AUTONOMA DELLA SARDEGNA

CEOMED

EMPLOYING CIRCULAR ECONOMY APPROACH FOR OFMSW MANAGEMENT WITHIN THE MEDITERRANEAN COUNTRIES

About the project

CEOMED aims to reduce municipal waste generation, promote source-separated collection and the optimal exploitation of the organic component by recovering energy and recycling nutrients. Additionally, the project will train local stakeholders, i.e. consumers, sellers, the informal sector of waste collecting, scholars, farmers, technical and administrative staff, to make sure they have the knowledge and skills to contribute to improving waste management.

Some words from the Coordinator

During these almost 4 years, I was able to learn a lot about how to face Municipal Organic waste is managed in the Mediterranean basin. Also, CEOMED has been a great opportunity to meet new people fully committed to the circular economy on waste management. During these 47 months, we also faced the Covid19 pandemic, which greatly impacted the project implementation. Although this situation made us through critical challenges, sharing our struggles allowed us to grow together in order to achieve better results and more environmentally sustainable practices. So, as in the big families, we became stronger and joined as a consortium able to demonstrate the required resilience to transform the linear economy into a circular economy. The biggest legacy of the CEOMED project is the overarching idea that circularity needs to be implemented across all sectors of the city, in collaboration with the local markets, citizens, and other relevant stakeholders. A special thanks to CEOMED partners and to ENI program for getting together all of these stakeholders and promoting these demonstration actions, which are an optimal way to link people and get to know the best good practices on Biowaste, around the Mediterranean basin.

In this Newsletter

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Previous key activities

Anaerobic digestion optimisation

After a series of batch biochemical methane potential (BMP) tests, the anaerobic digestion of three different fruit and vegetable waste (FVW) mixtures was investigated in continuous-flow systems, i.e. a continuously stirred tank reactor at CSIC, a double-stage dark fermentation and methanogenic moving bed biofilm reactor at UniNA, and a double-stage up-flow anaerobic sludge blanket + leaching bed reactor at DUTH. The results show that these bioreactors are capable to produce a volume of methane (CH4) as high as 200 mL CH4 per L of reactor and obtain a biogas with a CH4 percentage up to 80%. Moreover, a significant decrease of the hydraulic retention time, compared to the conventional AD systems, was obtained.

Pilot at CBS

Two mid-scale pilot plants were installed in the CBS in the frame of the CEOMED project. The first one is an anaerobic CSTR with a total volume 1 m3 (working volume=580 L) equipped with a settler tank and a hydrolysis reactor coupled with an upflow anaerobic fixed bed reactor (UAFBR) (working volume= 630 L). Currently, this pilot is treating 50 kg of FVW per day. The second pilot is an integrated system composed of two identical Leach Bed Reactors (LBRs) and an UAFBR with a total volume of 1.8 m3 and a working volume of 1 m3. The integrated system can treat up to 200 kg of raw FVW every week.

Surveys in Open local markets

The majority of locals who participated in the survey stated that they are not well informed about recycling and organic waste recycling.

Participants from the two markets had different perceptions of the current conditions in the operational aspects of the examined open local markets. Specifically, respondents from Amman were more satisfied with the current waste collection system in the market, the number of bins and the cleanliness of the market than the respondents from Sfax.

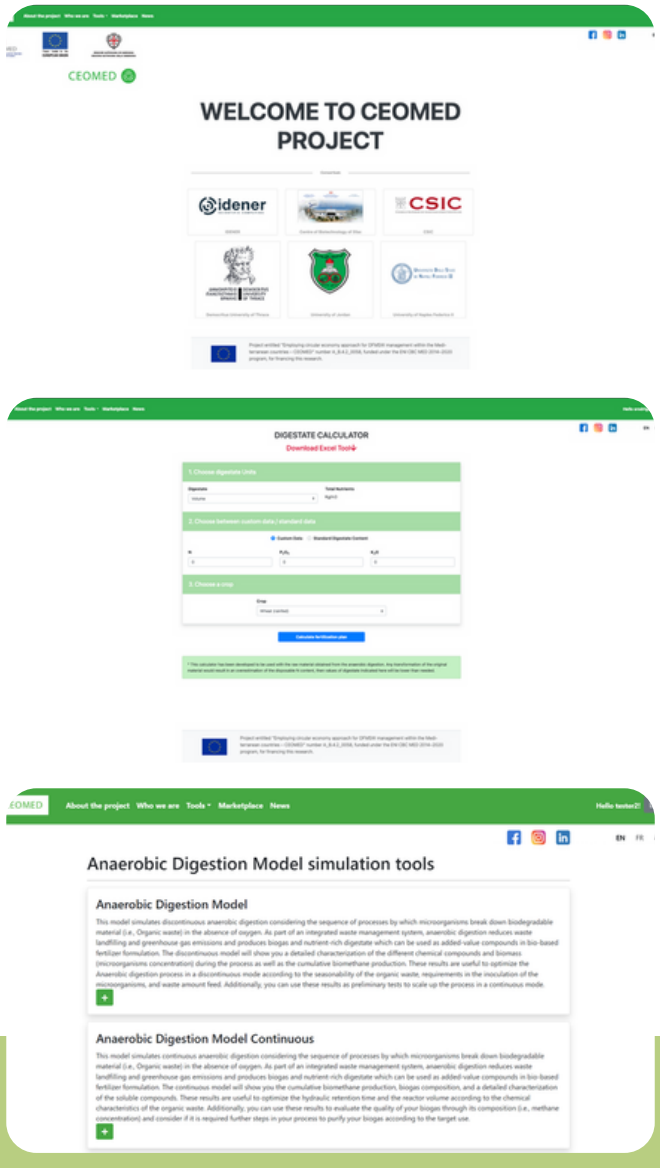
Recycling is not popular practice for locals. The overwhelming majority of the respondents did not recycle their wastes. Locals were positive to participate in organic waste projects

Online market place

The online market place is one of the main results of CEOMED project. This online, high-resolution Anaerobic Digestion (AD) large scale piloting framework will be used as a help for decision-making tool by public and private stakeholders in the valorisation of the organic fraction of waste with the agronomical use of digestate in a circular model

A tour around the platform

This framework will deliver the optimal technology and configuration to produce two products from the organic fraction of waste: (1) biogas produced by the AD; (2) the fertilizer from the digestate produced by the AD process. A Digestate Calculator for determining the amount of digestate as fertilizer to be used for specific crops has been developed. Each user will be able to include the characteristics of their digestate in terms of nutrient and dry matter composition as input parameters. Variables such as type of crop will be integrated automatically, and the calculator will estimate the amount of digestate, and mineral fertilizers required for the crop as a fertilization plan. Also, a mathematical model has been developed and deployed in an IT tool to regulate microbial competition and maximize COD degradation and biomethane yield. Users will be able to simulate their Anaerobic Digestion process through this tool and analyze the results as a help in the making decision process on circular organic waste management. Additionally, the business model on organic waste valorization will be set with a marketplace to connect any potential stakeholder. The online, high-resolution AD piloting framework will be deployed for free in English, Arab, and French in order to maximize the CEOMED approach along the Mediterranean basin.



Final meeting in Sfax, Tunisia

The final meeting of CEOMED project took place during 2 days, April 26 and 27 2023, in the Palais Royal hotel and at the center of Biotechnology of Sfax

The first day was done in the Palais Royal Hotel, where more than 50 academics and steckholders were present. The opening greeting was done by the governor of Sfax, the mayor of sfax, Mr. Youssef WALHA, municipality, the president of Sfax University Pr Abdelwahed MOKNI, the General Director of the CBS Pr Slim TOUNSI, the General Director MEP-Tunisia; NCP ENI CBCMED Mr. Fethi BEN MIMOUN, the Joint Technical Sectretariat Mr. Fadi KARAM & Ms. Laura PINNA and the Branch Officer of the ENI programme Mr. Vincent ERNOUX.

Then, Dr. Santiago Rodriguez and the coordinators of the different work packages of the CEOMED project presented their conferences at the sessions 2, 3 and 4 (Mrs. Andrea Martos, Dr. Katerina STAMATELATOU, Dr. Stefano PAPIRIO, Pr. Maria Pilar BERNAL, Pr. Ghada KASSAB and Pr. Sonia KHOUFI). For, Session 5, presentations in the frame of the project activities were done by researchers and students from LBPE of the CBS, Tunisia.

The second day was for industrials and andacademic from CBS and other institutions. About 100 persons were present. Industrials and steckholders including ANGED, ANPE, agrofood industries, environmental associations, were also present at the conference room in the CBS. The opening was done by Pr Slim TOUNSI, the General Director of CBS. Then Pr Sonia khoufi presented a conference about « Towards a bio-based circular economy in organic solid waste management ». To finish, this session was animated by « Taking into account the Circular Economy in the territorial Carbon Balances » presented by Mr. Khalil KHALIFA (Greenway Systems) and « Environmental approach at CBS as part of its QSE certification » presented by Mr. Fathi ALOUI (CBS).

In the last session, a technical visit was sucessfully done. First, the guests visited the Environmental Bioprocess laboratory (LBPE) and each compartiment was presented by Pr. Mohamed Chamkha, the director of the laboratory. The pilotes station related to CEOMED project was described. All the industrials and the academics were present during the pilot demonstration done by Pr. Sonia KHOUFI. During the meeting, discussions between academics and industrials were fruitfull since they expressed their interest in the CEOMED project, and has positive impacts for possible future collaboration.

Student exchange

"The opportunity of doing an internship in Spain sounds like the challenge, I've been looking for. I appreciate the opportunity to work with a great team in another country, learn new technologies and skills and go faster in developing my work. In fact, during my stay, I learned more about the agronomic value of digestates and I studied the effect of adding digestate to a soil in terms of carbon and nitrogen mineralization. So, I builded a valuable hard and soft skills which are important for my career development.

I have been always very excited for new challenges in my life and if I didn't have this opportunity with CEOMED project, I will try to get it."

Other related projects

Under the same priority in ENI CBC Med: CLIMA

The CLIMA project, and its regional platform of Italian, Tunisian and Lebanese municipalities, public agencies and NGOs, aims to cope with environmental, economic and social problems of organic waste mismanagement in three Mediterranean countries, developing policy tools like integrated Municipal Waste Management Plans, innovative technical solutions such as the compost drum and two improved pilot compost sites. At the same time, the project will support local businesses active in the circular economy sector, as well as information and advocacy campaigns to change citizens' attitude towards zero waste paradigm.

Know more about CLIMA

Under the same priority in ENI CBC Med: MED-InA

The MED-InA project proposes to develop and roll out a methodology for a "Zero Waste" public policy adapted to Mediterranean cities as an exemplary and participatory approach for waste reduction, reuse and recycling. The Zero Waste approach offers an alternative option and aims to reduce the amount of waste sent to landfills or incinerators through waste prevention, reuse, recycling and development of local activities. To adapt this ambitious approach to the Mediterranean context, the MED-InA project will develop a methodology co-designed by the partners, based on a wide consultation with local stakeholders (public, private, associations, citizens) and territorial coordination. It will place the citizens at the heart of the process and will strongly value a "low tech-low cost" approach by promoting in the South and reintegrating in the North traditional practices that generate little quantity of waste.

Know more about MED-InA

Events and Dissemination

Papers published under CEOMED

Carbon and Nitrogen Mineralisation in Soils and Nutrient Efficiency of Digestates from Fruit and Vegetable Wastes.
https://doi.org/10.1007/s42729-022-01049-7

Impact of monoterpenes in the stability of the anaerobic digestion of Mediterranean Wholesale Market Waste. https://doi.org/10-1016/j.jece.2023.109653

Anaerobic Digestion Engineering Opportunities for Fruit and Vegetable Waste Management in the Water-Energy-Waste Nexus
https://doi.org/10.1007/978-3-031-00808-5_96

Anaerobic Digestion of Organic Solid Waste: Challenges Derived from Changes in the Feedstock
ISBN: 978-1-80356-327-5

Does seasonality of feedstock affect anaerobic digestion?
https://doi.org/10.1007/s13399-022-03336-w

PhD thesis

Our colleague Angeles Trujillo from the Superior Council of Scientific Research in Spain (CSIC) started her PhD thesis thanks to this project, culminating in March 2023 with the thesis obtaining excellence. The work titled "Technical-environmental assessment of the anaerobic digestion process applied to fruit and vegetable waste generated in markets from Mediterranean countries" accredits her as the expert in this field of knowledge. **See article.**

BIORESTEC 2023

Our colleague Achilleas Kalogiannis from the Democritus University of Thrace (DUTH), Greek partner of CEOMED, attended the 4th conference on Bioresource Technology for Bioenergy, Bioproducts & Environmental Sustainability (BIORESTEC) 2023 in Italy. **See the event**

INFO DAY IN TUNISIA

8Centre of Biotechnology of Sfax (CBS), Tunisian partner of CEOMED,participated in the event promoted by the INTECMED project "Innovation and Technology Transfer Incubators in the Mediterranean". The participants had the opportunity to attend presentations on the new national direction for the liaison between researchers and the socio-economic world with the core objective of reinforcing their relationships and promoting the transfer of science and technology from the university to the business world. **See the event**

Beyond 4.0

Cour colleague Achilleas Kalogiannis (PhD working on the CEOMED project) participated in the exhibition on behalf of the Democritus University of Thrace. Achilleas presented the advance of the CEOMED project regarding anaerobic digestion tests. **See the event**

Summer school on solid waste management and circular economy

Mouna Jraou (PhD student in the CEOMED framework) attended the 4th PhD summer school and executive training on solid waste management and circular economy which took place in Corfu, Greece on 13th & 14th June 2022. **See the event**

Timeline

More info about events could be found in: enicbcmed.eu/projects/CEOMED

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Stakeholders in CEOMED

The successful experience of Greater Amman municipality boost the replication of CEOMED in Jordan

Municipality of Sfax invite CBS team to duplicate the CEOMED concept

City of Sidi Mansour-Sfax

The implementation of the CEOMED project in Sfax has attracted stakeholders to adopt the methanisation technology for the treatment of organic fraction of municipal solid wastes for biogas and bio-fertilizer production. This was perceived during the CEOMED Event of 26 and 27 April 2023. Recently, the municipality of Sfax invited the CBS to implement a research project aiming to duplicate the CEOMED concept for the management of household wastes. The main objective of this project is to develop a strategy for the management of organic waste collected from a pilot area that applying the source separation (City of Sidi Mansour-Sfax) and then treated by anaerobic digestion for the production of biogas and biofertilizer (digestate).

The research studies about the agronomic potential of digestate from the anaerobic digestion of fruits and vegetable wastes has encouraged some farmers, invited during the open day of CEOMED project (27 April 2023), to apply the digestate for the culture of tomatoes and olive cultivation. The CBS team is working now to sign a cooperation agreement with a farmer to conduct field studies for digestate application for tomato culture

The successful experience of Greater Amman Municipality (GAM) in generating biogas from solid waste at Al Ghabawi Landfill has driven decision-makers at GAM and other municipalities to pursue more practical and feasible biogas generation operations. Accordingly, decision-makers started considering adopting an anaerobic digestion system to manage wastes produced from large generators such as wholesale markets, slaughterhouses, big restaurants and hotels.

Amman City

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