Bio-Flex CLC

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Newsletters

Flexible chemical looping combustion for combined heat and power production from biogenic residues with negative emission



Project number: 101147904
Project Coordinator: RISE
Project Manager: Amir Soleimani Salim
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www.bioflexclcproject.eu/



WELCOME TO THE THIRD Bio-FlexCLC NEWSLETTER

Welcome!

The Bio-FlexCLC project is now stepping into M30. This edition will show some encouraging results from WP2. We hope you will find them interesting.

We will update ongoing events and research activities on LinkedIn. Also, on our website, you will find more info on our project, public deliverables, videos and latest updates.

Please follow us!

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Project updates

In the second period of the project, all the work packages are progressing as planned. Below are some updates and highlights.

Work package 2 aims to improve the understanding and performance of flexible combined heat and power chemical looping combustion (CHP-CLC) through experimental investigations in laboratory reactors and pilot units. It focuses on evaluating the use of affordable and widely available challenging biomass fuels, such as olive stones, refused-derived fuel (RDF) and forestry residues, assessing cost-effective oxygen-carrier materials, and improving fuel conversion and CO_2 purity through confined fluidization. Additionally, it investigates the performance of the post-oxidation chamber, the behaviour of reactive sulphur and nitrogen species, and interactions between ash and oxygen carriers to support safe and efficient operation with low harmful emissions. Below are some preliminary results.

Feedstock analysis, along with their elemental and proximate analyses

Various regional fuels and biomasses were pre-selected and tested in the 10kW and 20 kW unit in Chalmers and CSIC.



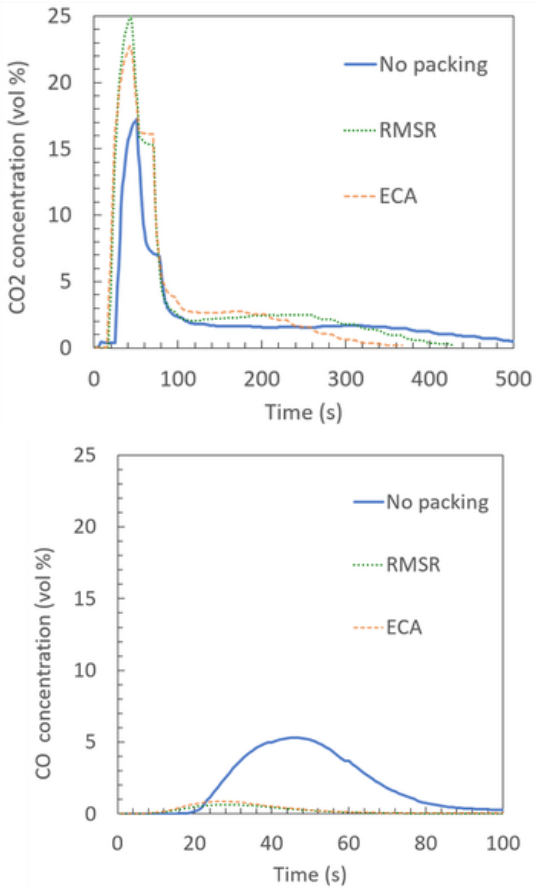
ANALYSIS (wt.%)	Pine wood pellets	Olive stones	Spruce chips	Refused-Derived Fuel
Moisture	7.5	7.3	8.0	2.8
Ash	0.2	0.3	2.5	11.8
Volatiles	77.1	74.9	72.1	76.9
Fixed carbon	15.1	17.4	17.5	8.5
C	47.2	47.8	46.7	55.0
H	5.6	5.3	5.4	6.6
N	0.1	0.2	0.4	0.9
S	<0.1	<0.1	<0.1	0.3
O(by diff.)	39.4	39.1	37.0	22.6
Cl (g/kg)	0	0	0.2	9.0
LHV (kJ/kg)	17042	17352	16808	23211

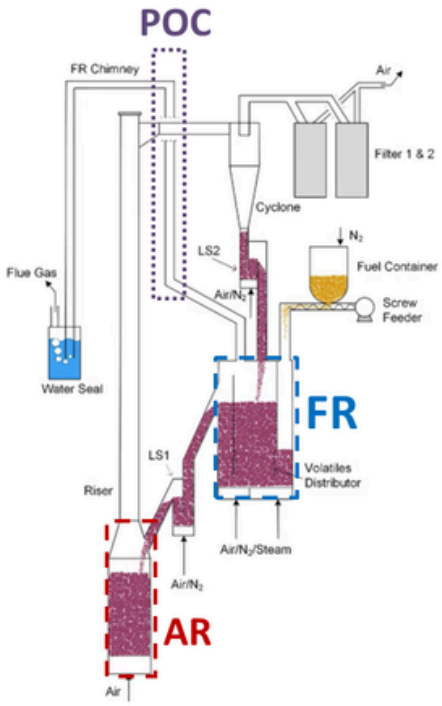


Project updates from WP2

Investigating the effect of operating conditions and packings on fuel conversion (10 kW_{th})

In Chalmers, batch CLC experiments were conducted in a laboratory-scale reactor at 900°C using ilmenite as the oxygen carrier for bed material. Two biomass fuels (wood pellets and torrefied wood pellets), two packing materials (RMSR and ECA), and two superficial gas velocities (0.15 and 0.3 m/s) were investigated.





Layout of the 10 kW CLC unit at Chalmers with post-oxidation chamber and packings

The figures presented the results for wood pellets at a superficial gas velocity of 0.15 m/s. Both packing materials significantly improve the CO_2 production and yield compared to the no-packing configuration. The average CO_2 yield increases from 73.0% without packing to 91.8% with RMSR and 88.3% with ECA.



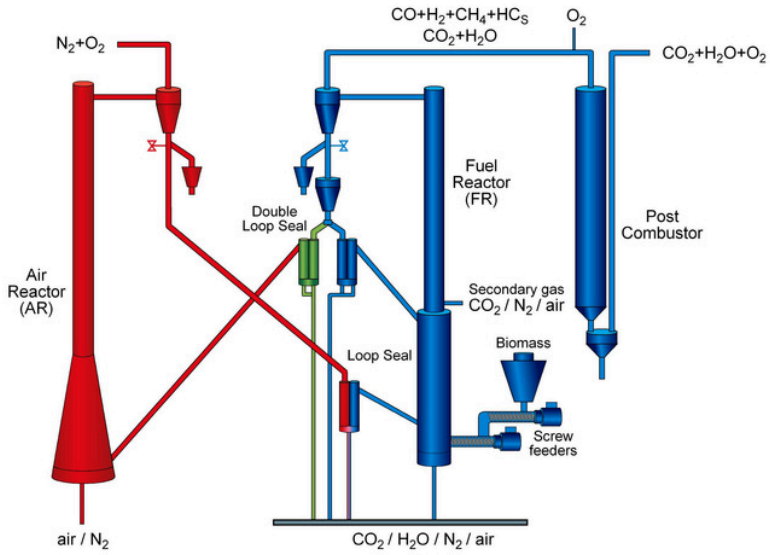
Project updates from WP2

Experimental campaigns in CFB and CLC mode (20 kW_{th})

In CSIC, flexible CFB-CLC operation demonstrated the technical feasibility of converting biogenic residues into heat and power. Built in 2013 with a nominal capacity of 50 kWth for CLOU and 20 kWth for iG-CLC. The CLC unit for solid fuels is now adapted for Bio-FlexCLC project. Below are some important findings from recent campaigns.



Image of the 20 kW unit at CSIC



- Conventional CFB combustion tests:
  - Stable operation achieving combustion efficiencies above 98%.
  - Agglomeration was only observed when using silica sand as bed material and olive stone as fuel.
  - No agglomeration when ilmenite was used as bed material.
- CLC experiments using ilmenite as the oxygen carrier and pine wood pellets as fuel:
  - Stable operation, with carbon conversion exceeding 98%.
  - Post-oxidation chamber ensures the complete oxidation of unburned gaseous compounds and improve overall process performance.



Looking ahead

Looking ahead, we could expect more updates from other WPs.

WP2 More experimental campaigns will be done in the coming weeks in both Chalmers and CSIC with other solid fuels and packing materials.

WP3 Set-ups of downstream treatment and CO_2 liquefaction for flexible Bio-FlexCLC are on the way.

WP4 In September 2026, hot commissioning of the post oxidation chamber (POC) was successfully completed in TUDA. The unit demonstrated good operational stability and the ability to handle high loads, with natural gas up to 450 kW. We are confident that operation in CLC mode can commence in November 2026. The Bio-FlexCLC operation is currently planned to start by the end of January 2027, subject to the installation of the containerized CO_2 liquefaction plant of RISE



Birds view of 1MW pilot plant and gas cleaning in TUDA



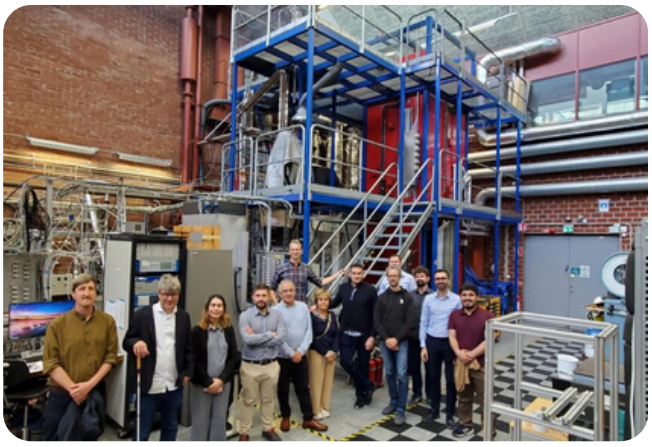
Highlights & Updates

28 – 29 May 2026, Emil Hed from RISE introduced the Bio-FlexCLC project in the joint Symposium "**From Waste to Sustainable Fuels**" in Barcelona



10 - 11 Jun 2026, the **5th GA meeting** was held at Chalmers University of Technology. In two productive days, the project partners updated each other the recent progress on the project, visited the kraft central boiler at Chalmers with a dual fluidized combustion reactor with 12 MW capacity, the 10 kW CLC unit and other relevant labs, planned for upcoming campaigns and dissemination activities.

The meeting reinforced the collaboration within the consortium and our shared commitment to the Bio-FlexCLC project. Sincerely thanks the Chalmers team in hosting us.



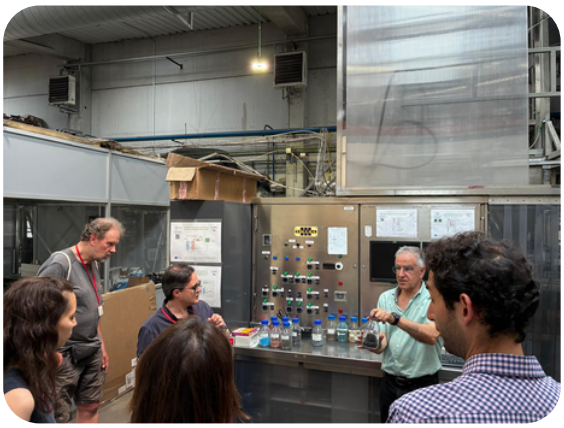




Highlights & Updates

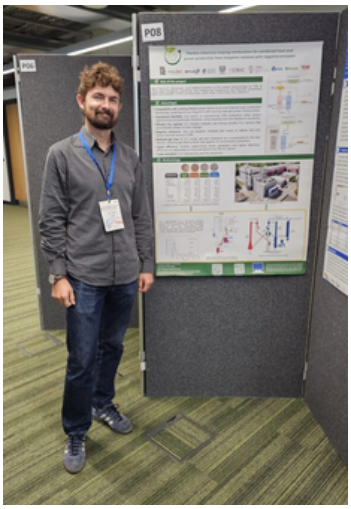
16 Jun 2026, **ICB-CSIC** hosted a Scientific Workshop which brought together around 100 participants from the energy sector in Aragón, Spain. Francisco García-Labiano chaired Session 3: Non-fossil Fuels and Technologies; Teresa Mendiara presented recent development of Bio-FlexCLC project; and Luis de Diego presented the institute's 20 kW Chemical Looping Combustion (CLC) unit to the public.





31 Aug - 4 Sep 2026, Bio-FlexCLC project contributed to the 8th International Conference on Chemical Looping (**ICCL2026**) with 2 poster presentations, 2 oral presentations and 1 joint workshop.





Simona Scoppa (1CUBE) and Emil Hed (RISE) with the Bio-FlexCLC posters.



Amirhosein Filsou from CSIC presented "Flexible CFB-CLC operation strategy for biofuels combustion with negative CO_2 emission" in ICCL2026.



Xiaoyun Li from Chalmers presented "Conversion Enhancement in a 10 kWth Chemical-Looping Combustion Unit: Effect of Random Metal Packings".



On the last day of the conference, Bio-FlexCLC, Bio-MeGaFuel and COUPLED projects hosted a workshop "From Idea to Commercialization with Horizon Europe Projects". Jochen Strole from TUDA and Francisco García-Labiano from CSIC did presentation and co-chaired the discussion of the session.

The workshop provided an opportunity to look beyond individual research results and discuss how innovations developed within Horizon Europe projects can progress through different stages of technological development and ultimately move closer to industrial application. There were approxiamately 50 participants.









Upcoming events

Funded under the same EU call, BioNETzero and Bio-FlexCLC share a common ambition to converting biomass and organic waste into combined heat and power (CHP) with near-zero emission. This joint webinar provides a valuable opportunity to bring the two projects together and strengthen collaboration. It also starts the webinar series of the chemical looping and gasification (CL&G) cluster.

Date: 18 Nov 2026
Time: 11am - 12 pm
Registration link



Tentatively scheduled in June 2027, Bio-FlexCLC & Bio-MeGaFuel projects will cohost a joint workshop "Chemical Looping for Sustainable Fuels and Power: joint Insights from Bio-FlexCLC & Bio-MeGaFuel" in the Technical University of Darmstadt, Germany.
More info will follow.
Stay tune with our website www.bioflexclcproject.eu/!

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