

BioCatPolymers PROJECT

BioCatPolymers is a European project funded by the European Union's Horizon 2020 research and innovation programme under grant agreement No 760802.

The main objective of BioCatPolymers is to demonstrate a cost-effective, sustainable and efficient cascade technological route for the conversion of low-value, low-quality residual biomass to bio-polymers with equal or better performance than their fossil-based counterparts.

The BioCatPolymers consortium comprises 7 legal entities within four EU Member States (Greece, Germany, Sweden, Netherlands) and one Associated Member State (Switzerland). The project is coordinated by the Centre for Research & Technology Hellas (Greece).

The total duration of the project was extended from originally 36 to 42 months.

BioCatPolymers 2nd REVIEW MEETING

The 2nd review meeting took place on 10 February, 2021 with the participation of representatives from all 7 partners. The EC project officer, Dr Angel Fuentes-Mateos and the scientific expert and monitor, Dr Daniela Monti, also participated in the meeting.

During the 2nd review meeting the current status of the project was presented, regarding the technical progress, the financial status and the dissemination activities of the project. After the detailed presentation of the progress and results that have been accomplished in each work package, the reviewer commented positively on the outcome of this meeting and the presented progress.



The final review of the project has been scheduled at the end of the project, where the total accomplishments of the BioCatPolymers project will be presented and evaluated.

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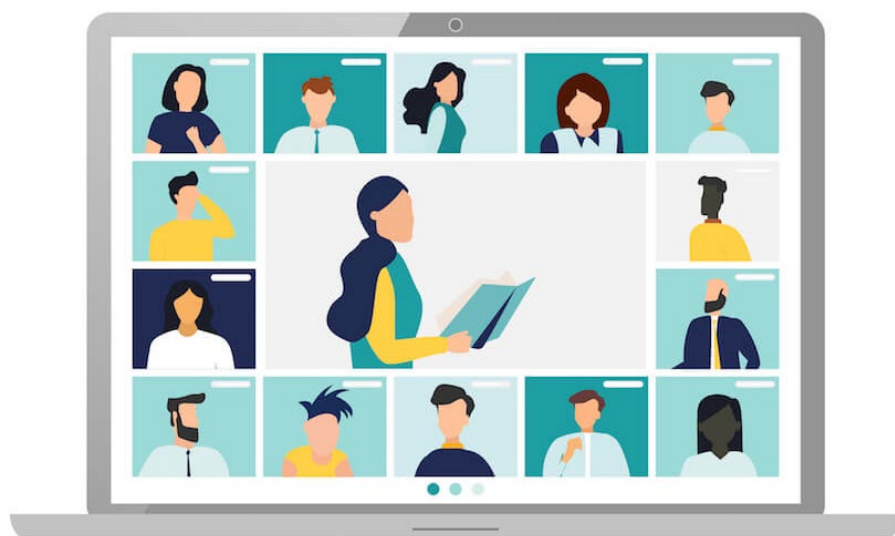
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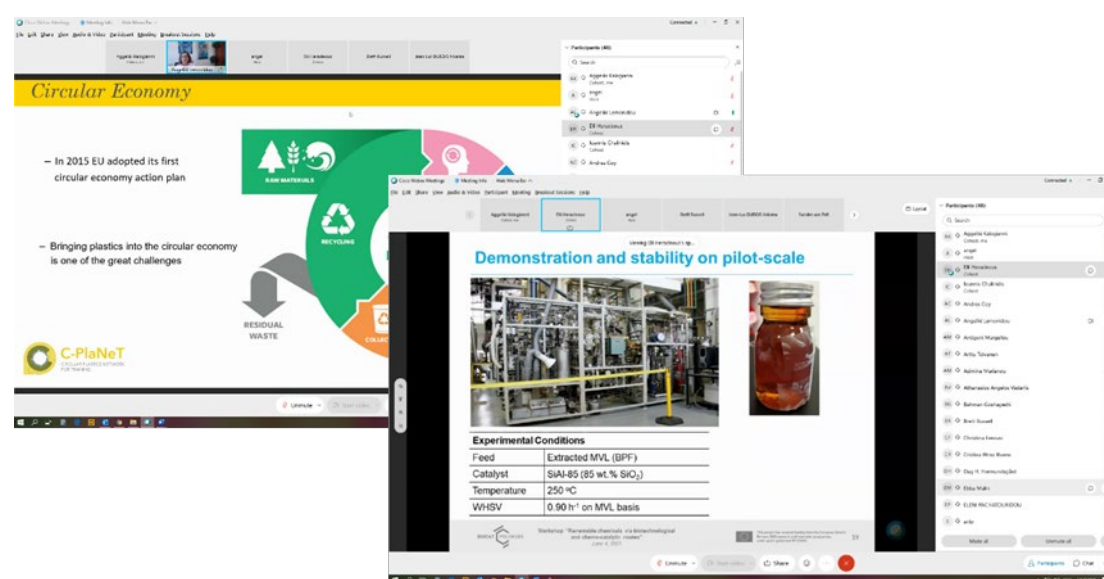
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BioCatPolymers 2nd technical workshop & stakeholder's event



Two important dissemination events of the project were successfully combined on June 4, 2021: The 2nd technical workshop of the project and the BioCatPolymers stakeholders' event. The event was entitled ***“Renewable chemicals via biotechnological and chemo-catalytic routes”*** and was held as web-event.

In terms of the workshop, major issues of the biopolymers and biochemicals production process were presented, including strain engineering strategies, synthesis of biobased platform molecules, thermochemical conversion to biomonomers and plastics recycling. Furthermore, representatives of industries active in biochemicals and related European-funded projects working on innovative bio-catalytic and chemo-catalytic process concepts presented as plenary speakers in the workshop.



During the stakeholders' event, the BioCatPolymers partners presented an update of the biomass pretreatment technology, the fermentation and down-stream processing scale-up, the techno-economic & environmental analysis and results of the production of biopolymers, as well as the commercialization plan of a new bio-based building block for production of elastomers and green solvents, followed by comments and discussion between the participants of the event.

The BioCatPolymers 2nd workshop and stakeholders' event brought together representatives of academic/research organizations and industry from all over the world, to discuss the current and future trends of biochemicals technologies and markets.

In terms of impact, both events were very successful, with 99 participants coming from 14 different countries, 58% from academia and 42% from industry in total.

BioCatPolymers ACHIEVEMENTS of the 3rd & 4th year

LARGE SCALE BIOMASS PRETREATMENT



- ✓ 8.5 tons of birch chips were delivered and processed in the Biorefinery Demo Plant in Örnsköldsvik, Sweden.
- ✓ 12.5 tons of pre-treated material were produced.

LARGE SCALE HYDROLYSIS



- ✓ Large scale hydrolysis of pretreated material to cellulosic sugars.
- ✓ A total amount of ~ 9100 L of hydrolysate was produced.
- ✓ The hydrolysate contained in total > 600 kg of cellulosic sugars.

LARGE SCALE FERMENTATION TO MVL



- ✓ Large scale fermentation of cellulosic hydrolysate to mevalonolactone (MVL).
- ✓ Pilot-scale runs at 300 L and 4 m³.
- ✓ Final achieved MVL yield: 0.38 g MVL/g sugar.

SEPERATION OF MVL FROM BROTH



- ✓ Methods tested for large scale separation of MVL from fermentation broth: Centrifugation, Ultrafiltration, Diafiltration, Cation and anion exchange, Carbon treatment, Concentration, "HALT" process, Solvent extraction, Heterogeneous catalysis.
- ✓ Final achieved MVL purity: 98%.

THERMOCHEMICAL CONVERSION OF MVL TO ISOPRENE



- ✓ Large scale thermochemical conversion of MVL to isoprene for several hours time-on-stream.
- ✓ Tests with fermentation-derived MVL feed under industrially-relevant conditions.
- ✓ Evaluation of the effect of feedstock impurities on isoprene yield.

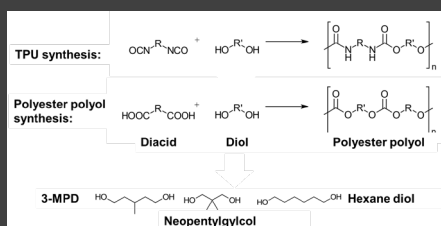
BioCatPolymers ACHIEVEMENTS of the 3rd & 4th year

HYDROGENOLYSIS REACTION OF MVL TO 3MPD



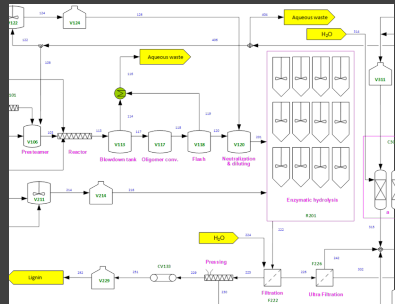
- ✓ Large scale thermochemical conversion of MVL to 3-methyl-pentanediol (3MPD).
- ✓ Process demonstration and stability for several hours time-on-stream.
- ✓ Achieved 3MPD yield: > 90 wt.%.

POLYMERIZATION OF 3-MPD



- ✓ Purification of bio-based 3-MPD.
- ✓ Analysis of the structural properties and the potential of 3-MPD as a thermoplastic polyurethane (TPU) building block.
- ✓ Synthesis of TPU with bio-based 3-MPD for comparison with fossil TPU.

CONCEPTUAL DESIGN, TECHNO-



- ✓ Conceptual process design for the production of monomers from biomass
- ✓ Economic and social evaluation of the production of monomers from biomass
- ✓ Environmental Life Cycle Assessment of the production of polymers from biomass.

RISK ANALYSIS, BUSINESS & COMMERCIALIZATION PLAN

- ✓ Final commercialization plan.
- ✓ Training module and plan.

PROMOTIONAL ACTIVITIES/ DISSEMINATION



- ✓ Development of web-based footprinter.
- ✓ Two joint publication in scientific journals.
- ✓ Article in the European Energy Innovation Magazine – Spring edition 2020.
- ✓ Presentations at 2 national/international conferences.
- ✓ Organization of BioCatPolymers 2nd technical workshop & stakeholder's event.
- ✓ 3rd Annual Newsletter.

MANAGEMENT & COORDINATION

- ✓ Submission of 3rd, 4th & 5th Amendment to the Grant Agreement
- ✓ Submission of all 43 deliverables and 12 milestones.

BioCatPolymers PUBLICATIONS

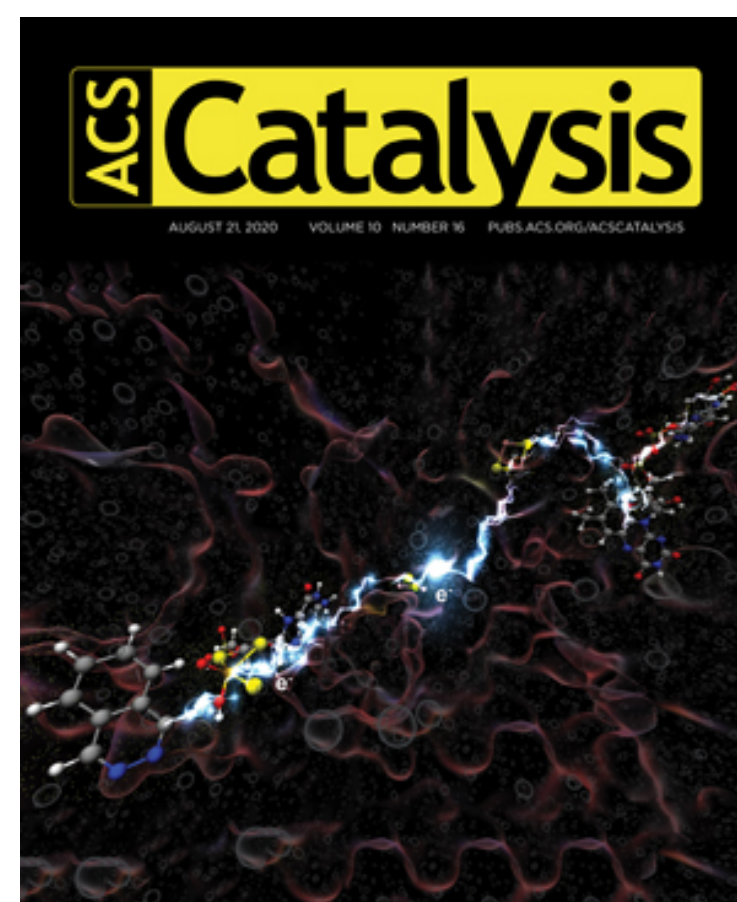
Two scientific **open access** publications were prepared in the frame of the BioCatPolymers project. Both publications are the result of joint efforts of the project partners and follow an inter-disciplinary approach.

★ First joint scientific publication

Eleni Heracleous, Eleni Pachatouridou, Lin Louie, Deepak Dugar, Angelos A. Lappas, An Efficient Route for the Production of Isoprene via Decarboxylation of Bio-mevalonolactone, *ACS Catalysis*, 31 July 2020, 10, 16, 9649–9661.

<https://doi.org/10.1021/acscatal.0c01438>

The screenshot shows the article's title, authors (Eleni Heracleous, Eleni Pachatouridou, Lin Louie, Deepak Dugar, and Angelos A. Lappas), and a chemical reaction scheme. The scheme illustrates the conversion of Mevalonolactone to Isoprene. The process involves the acid-catalyzed decarboxylation of Mevalonolactone to form Isoprene, which is then polymerized into polyisoprene. The reaction conditions are noted as $\text{SiO}_2/\text{Al}_2\text{O}_3$ with 90 wt % SiO_2 at 250 °C and 1.4 h⁻¹. The abstract highlights that this method achieves a yield of ~60% of the theoretical maximum.



★ Second joint scientific publication

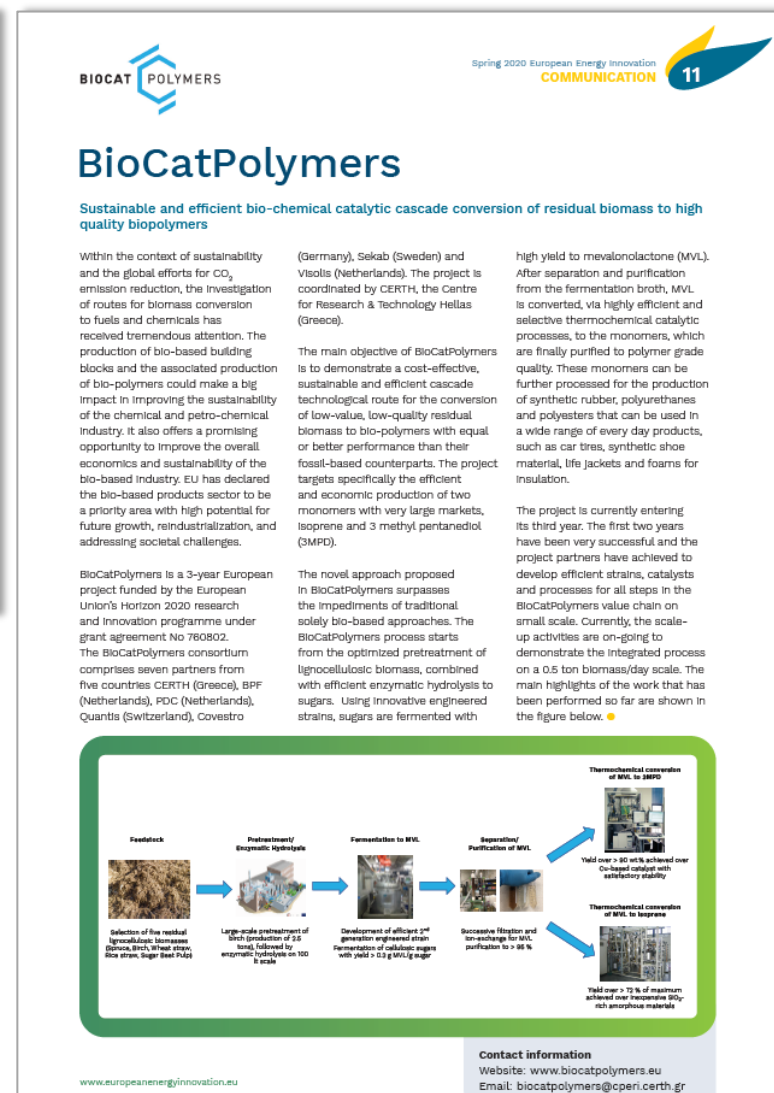
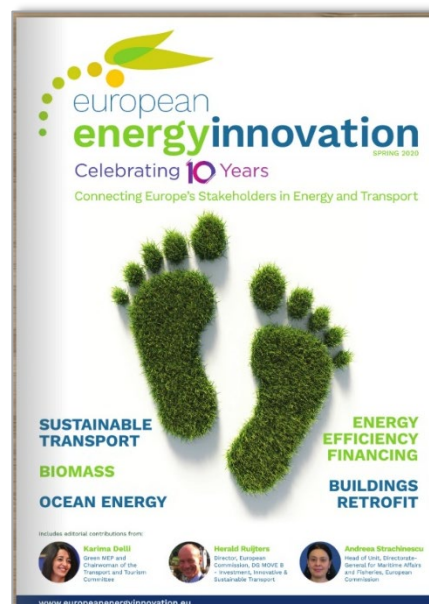
Brett Russell, Jelle Kruijssen, Deepak Dugar, Sander Van Pelt, Stefaan Breestraat, Sanne Dekker, Lotta Regtop, Site-directed mutagenesis of xylR for release of catabolic repression in an industrial *E. coli* strain, *to be submitted*.

BioCatPolymers ARTICLE in EEI MAGAZINE

An article promoting the BioCatPolymers technology was published in March 2020, in the European Energy Innovation (EEI) Magazine – Spring edition 2020. The article presented the project objectives, the members of the consortium, and the first main results and achievements.

To read more about the article visit:

<http://www.europeanenergyinnovation.eu/OnlinePublication/Spring2020/mobile/index.html#p=1>



BioCatPolymers other PRESENTATIONS of the 3rd & 4th year

1. Heracleous E., Engendahl B., Pachatouridou E., Lappas A., Bio-isoprene production via hybrid bio/thermochemical catalytic conversion of residual biomass, *DECHEMA web conference: "NFDI4Cat: Digitalisation in Catalysis"*, 16 June 2020
2. E. Heracleous, E. Pachatouridou, B. Russell, B. Lee, D. Dugar, A.A.Lappas, A novel hybrid bio-thermochemical route for the production of bio-isoprene via decarboxylation of mevalonolactone (MVL), *web conference: 28th European Biomass Conference and Exhibition (EUBCE)*, 6-9 July, 2020



BioCatPolymers CONSORTIUM



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