Upcycling of PE and PET wastes to generate biodegradable bioplastics for food and drink packaging

Rendicontazione

Informazioni relative al progetto

upPE-T

ID dell'accordo di sovvenzione: 953214

Sito web del progetto

DOI
10.3030/953214

Progetto chiuso

Data della firma CE
6 Novembre 2020

Data di avvio
1 Novembre 2020

Data di completamento
30 Aprile 2025

Finanziato da
INDUSTRIAL LEADERSHIP - Leadership in enabling and industrial technologies – Biotechnology

Costo totale
€ 7 826 685,00

Contributo UE
€ 7 826 685,00

Coordinato da
ASOCIACION EMPRESARIAL DE INVESTIGACION CENTRO TECNOLOGICO DEL CALZADOY DEL PLASTICO DE LA REGION DE MURCIA
Spain

Periodic Reporting for period 2 - upPE-T (Upcycling of PE and PET wastes to generate biodegradable bioplastics for food and drink packaging)

Periodo di rendicontazione: 2022-05-01 al 2023-10-31

Sintesi del contesto e degli obiettivi generali del progetto

Problem:

Plastic postconsumer waste from food & drink packaging in Europe is still sent to landfill or incinerated.
Mechanical recycling downgrades properties, r-PE is not authorised in EU to produce new food contact packaging, some plastics are difficult to be recycled.
Only 2% of plastic wastes are chemically recycled: high energy and long reaction times for effective depolymerisation are required.
Sustainable alternatives based on enzymatic degradation show high potential for upcycling plastic wastes although the research is still ongoing for future industrial implementation.
Most plastics (>98%) are produced from non-renewable sources, the EU needs their progressive substitution by bioplastics, especially in short shelf-life packaging.

Why is it important for society?

Plastic circularity and the use of bioplastics contribute to environmental protection, plastic waste reduction & marine litter reduction, decreasing CO2 emissions and reduce the tapping of natural resources.
Circular economy and recycling create a favourable framework for a sustainable development of the new plastic industry, boosting the local economy, employment and the links between different sectors and companies.
upPE-T solutions will promote the development of highly skilled bioeconomy-related jobs, which will be a major boost to the EU economy.
upPE-T will increase awareness among citizens among EU citizens of products and materials upcycling capacities.

Overall objectives:

Objective 1: Demonstrate the technical feasibility of enzymatic technologies for degrading PET and PE wastes.
Objective 2: Demonstrate the technical feasibility of the biotechnological production of a range of PHBV biodegradable biopolymers by using the resulting products of PET and PE enzymatic degradation.
Objective 3: Ensure sustainability and market acceptance of the upPE-T products and technologies.

Lavoro eseguito dall'inizio del progetto fino alla fine del periodo coperto dalla relazione e principali risultati finora ottenuti

Enzymatic degradation of polyethylene terephthalate to obtain terephthalic acid and ethylene glycol (WP2). Three effective pre-treatments have been developed to enhance the enzymes PET degradation efficiency. Two mutants of LCC (Leaf-branch Compost Cutinase) have been expressed and PET enzymatic degradation could be scaled up to 150 grams of almost complete degradation of

PET into EG and essentially pure TPA. Two novel enzymes have been developed for the degradation of PET.

Enzymatic biodegradation of PE (polyethylene) to obtain low molecular weight subproducts (WP3). Three effective pre-treatments have been developed in order to facilitate the enzymatic attack of the plastic. Novel enzymes have been found and are being tested together with a new methodology that combines chemical PE waste oxydation plus enzymatic degradation.

PHBV range production (WP4). A novel mutant of extremophilic microorganisms (haloarchaea) was obtained with better performance in the production of PHBV (polyhydroxybutyrate-co-valerate) than the wild strain. The capability of certain types of bacteria to grow with TPA as a sole carbon source has been demonstrated and subsequently the capability of the haloarchaea producing PHBV to grow with this biomass as a sole nitrogen source. PHBV production has been scaled up to 30 litre bioreator.

Development of PHBV based compounds (WP5). The first formulations able to be transformed into packaging have been developed.

Project sustainability assurance, standardization activities & certification schemes (WP7). Deep study research on Finland’s, Italy's and Serbia's legislative and institutional settings, econometric analysis and market research, that affect recycling rates and waste management. LCA, s-LCA & LCC of upPE-T products and processes, a strategy for by-products valorisation and activities to contribute to standardisation and certification are in progress.

Exploitation, dissemination, business plan & IPR management (WP8), elaboration of the Plan of Dissemination and Exploitation of Results (PEDR) and dissemination and clustering activities (oral presentations, posters and scientific papers).

Project Communication and European Citizens Awareness (WP9), the communication plan and materials were developed . Several communication activities have been carried out. Citizens’ awareness digital tools have been developed, a European citizens' awareness platform, a cloud-based MOOC and a virtual reality app . Two policy review are available and will serve as an imput for the preparation of the policy brief.

Progressi oltre lo stato dell’arte e potenziale impatto previsto (incluso l’impatto socioeconomico e le implicazioni sociali più ampie del progetto fino ad ora)

IMPACTS

upPE-T contribution to the expected impacts under CE-BIOTEC-09-2020:

1. 60% FOOD AND DRINK PACKAGING IS UPCYCLED BY 2030

The polymers that feed of upPE-T processes, the PE polymers family and PET, account for around 66% of the total share of demanded polymers for packaging within food and drink market. .

2. A VIABLE ROADMAP TO PROVE THAT BY 2030 60% OF PLASTICS STILL TO BE USED FOR PACKAGING OF FOOD AND DRINKS WITH SHORT-SHELF LIFE WILL BE PRODUCED FROM RENEWABLE SOURCES
upPE-T solution develops, validates and upscales PHBV compounds for packaging manufacturing. PHA family (including PHVB) is currently considered the most promising of the new bio-based materials.

3. CONTRIBUTE TO THE INCREASE IN NEW & UPGRADED WASTE RECYCLING FACILITIES DESIGNED TO FACILITATE RECYCLING VIA BIOTECHNOLOGICAL OR BIOCHEMICAL METHODS

The upPE-T project is committed to biotechnology as the solution to the recycling of non-renewable plastic waste (PET and PE) from food and beverage packaging, especially short-life ones.

4. INCREASED AWARENESS AMONG EUROPEAN CITIZENS OF PRODUCTS AND MATERIALS UPCYCLING CAPACITY
Our strategy aimed at increasing awareness among European citizens of products and materials upcycling capacity, integrating Social Sciences and Humanities (SSH) disciplines and Responsible Research and Innovation processes (RRI).

5. NOVEL STANDARDS AND CERTIFICATION SCHEMES TO BE APPLIED TOGETHER WITH MARKET PULL MEASURES SUCH AS PUBLIC PROCUREMENT AND TAX EXEMPTION
Standardization activities in upPE-T are considered a valuable tool for supporting the exploitation and the dissemination of the project outcomes, by facilitating future replicability and widest use and raising market acceptance.

The upPE-Tproject will is also contribute to other impacts such as:
1. ECONOMIC IMPACTS

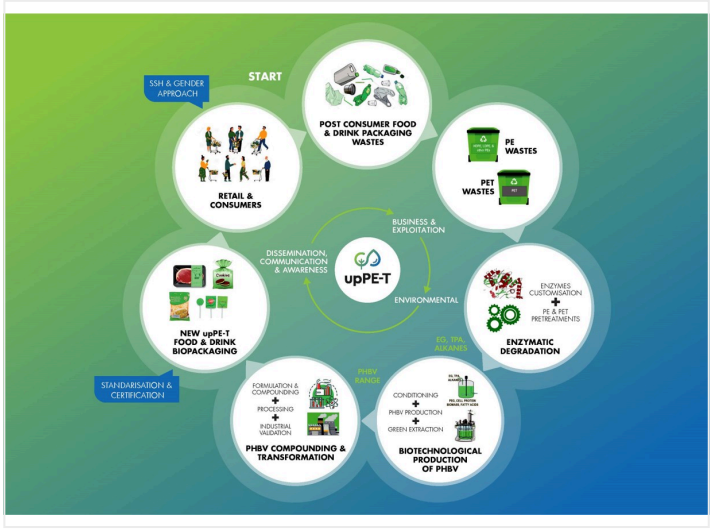
upPE-T solution will allow a PHBV offering that substantially increases in volumes, to ensure that strong market demand is met.

2. OTHER ENVIRONMENTAL IMPACTS
upPE-T will highly contribute to minimize the negative externalities of the use of plastic packaging
3. SOCIAL IMPACTS
upPE-T project pursues to create new job opportunities in the plastic sector through the introduction of biotechnology
4. CROSS-CUTTING PRIORITIES
upPE-T project entails a comprehensive Responsible Research and Innovation process through a multi-actor approach covering the whole value chain for upPE-T and relevant societal actors
5. CONTRIBUTION TO EU POLICIES AND SDGs

upPET contributes to the EC strategy/policy: Gender equality, employment, sustainable development, environment & climate protection, EU plastic strategy, EU Green Deal

6. IMPROVING INNOVATION CAPACITY

upPE-T will contribute to the innovation capacity of partners and the integration of new knowledge, opening new business opportunities to industry and increasing knowledge and services of the RTO and universities.



upPE-T value chain

Ultimo aggiornamento: 8 Luglio 2024

Permalink: https://cordis.europa.eu/project/id/953214/reporting/it