Valorisation of urban wastes to new generation of bioethanol

LCC Webinar (WASTE2ROAD project)

Dr Marcos Latorre

PERSEO Biotechnology SL

22nd September 2021

Funded by the Horizon 2020 Framework Programme of the European Union

WASTE2BIO project

- BESTF3: ERA-NET COFUND BIOENERGY SUSTAINING THE FUTURE 3
- BUDGET: €1.75 MILLION GRANT: €955,960
- DURATION 3.5 YEARS (March 2017-October 2020)

PERSEO

Project coordinator; biofuels technology provider

CIEMAT

Biofuels process specialist

IMDEA ENERGÍA

Anaerobic digestion specialist

INEUVO

Process design and validation specialist; communications

perseo biotechnology

Development and Engineering of Biotechnological Processes for Waste Valorization

Development of Biotechnological Waste Valorization Processes, producing added value bioproducts, from laboratory scale to industrial implementation.

- **Laboratories.**
- **Semi-industrial Demo Plant of 25 t/d capacity.**
- **Process engineering and development of industrial projects with own patents.**
- **Highly qualified multidisciplinary team.**
- **More than 15 years of experience in development and scaling of biotechnological processes from waste.**

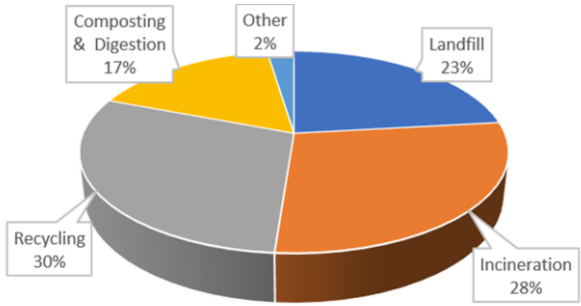
https://www.perseobiotech.com/

Background: MSW, a growing social and environmental problem

- Current global MSW generation levels are approximately 1.3 billion tons/yr, and are expected to almost double to 2.2 billion tons/yr by 2025 . *(World Bank Group, 2018)*

- 250 million tons in Europe = 486 kg/habitant

(Eurostat, 2019)



- 100 million tons of biowaste are generated every year in Europe, which is about 46% of the total municipal waste.

- Only about a third (30 Mt) of this is separately collected and composted and/or digested

Background: EU legislative drivers for the valorisation of MSW into biofuels and bioproducts

EU action plan for the Circular Economy

The revised legislative framework on waste entered into force in July 2018:

- A common EU target for recycling 65% of MSW by 2035 (Directive 2018/851/EU).
- Separate collection obligation of biowaste by the end of 2023 (Directive 2018/851/EU).
- A target to reduce landfill to maximum of 10% of MSW by 2035 (Directive 2018/850/EU).

Renewable Energy Directive 2018/2001/EU

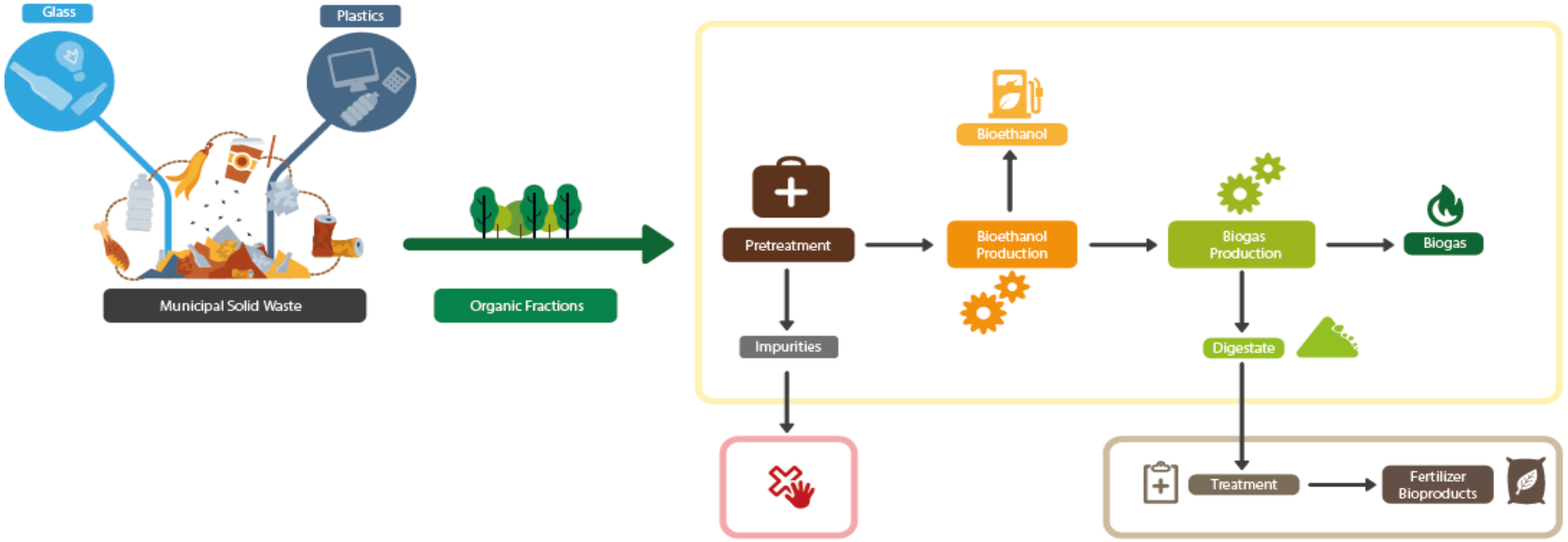
- 12 % share of energy from renewable sources in transport by 2030.
- Maximum 7% of 1st generation biofuels in transport.
- Advanced biofuels shall be at least 0,2 % in 2022, 1 % in 2025 and 3,5 % in 2030.
- "Double energy counting" of advanced biofuels and biogas in transport.

EU Bioeconomy Strategy COM (2018) 673

- A sustainable bioeconomy is essential to tackle climate change and ecosystems degradation.
- EU must improve and innovate the way we produce and consume products and materials within healthy ecosystems through a sustainable bioeconomy.

Main objective of WASTE2BIO project

- **Demonstrate a global process for the production of bioethanol as liquid biofuel and biogas from the remaining recoverable organic fraction from MSW**

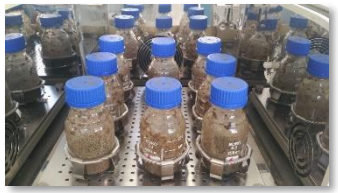


- **Enhance valorisation of OFMSW, reduce energy costs and impacts from waste management to contribute to waste reduction and renewable energy objectives of EU**

First actions and optimization of processes at lab

- Improvement and implementation of a more efficient **pretreatment** for the OFMSW

- **Characterization** of OFMSW samples from separate and non separate collection to evaluate seasonal and geographical variations.



- Improvement of the **bioethanol process** (enzymes cocktail, fermentation step, pH, T, etc.)

- Improvement of the **biogas process**

- **Engineering modifications** in the plant to efficiently operate the raw material and integrate new technologies to the PERSEO bioethanol® process

Demonstration activities at PERSEO Biorefinery

After optimisation of conditions at lab scale, demo stage took place at PERSEO semi-industrial plant

Separately collected OFMSW

Bioethanol (EN 15376:2014)

By-product

Biogas

Digestate

Bio-based fertiliser

Main technical results of WASTE2BIO project

- The **pretreatment** step performed by PERSEO to remove inert materials contained in the biowaste was key for the process improvement efficiency.

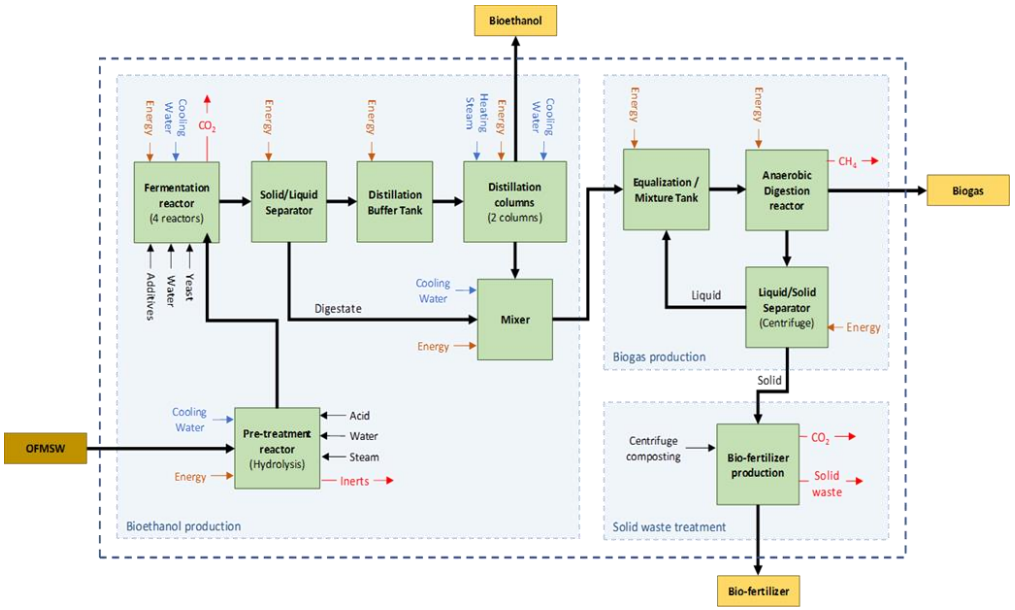
- During the **scaling up** the process engineering has been improved, increasing efficiency and reducing CAPEX and OPEX.

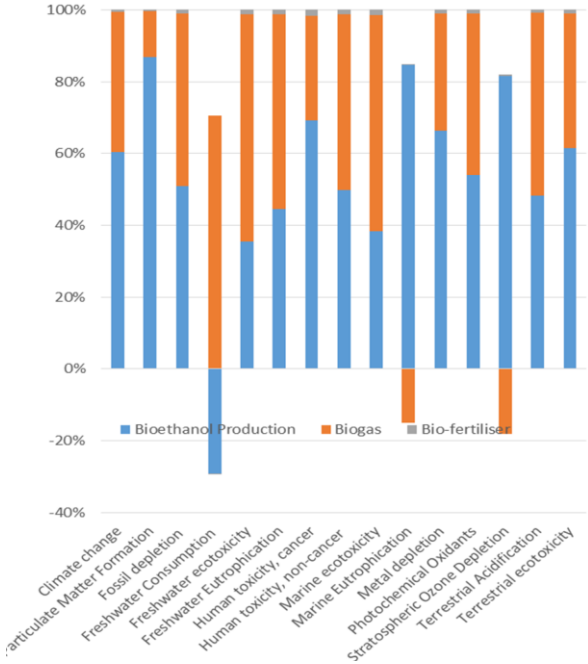
- The highest **ethanol yield** reached in plant was 80% (around 160 L ethanol/dry ton OFMSW), increasing the 75% which was set as objective for the project.

- The **biogas production** achieved from the bioethanol residue was 737 Nm^3/Tvs at OLR 4.9 Kgvs /m^3day at mesophilic conditions, with a content of methane around 70% v/v.

- The **digestate** generated is a safe material for agricultural use (heavy metals and microbiology parameters below permissible limits) and it stimulates plant growth because it contains a certain amount of macronutrients (N, K, P, Ca, S, Mg) and micronutrients (Fe, Mn).

Industrial modelling, simulation and LCA





Waste treatment	kg CO_2 eq / ton OFMSW
WASTE2BIO	170
Incineration	556
Composting	574
Landfill	1048

Impact Category	Unit	Plant of 50000 t/y
Climate change	t CO_2 eq	8,430
Ozone depletion	t CFC^{-11} eq	0.008
Terrestrial acidification	t SO_2 eq	44
Freshwater eutrophication	t P eq	2
Marine eutrophication	t N eq	1.22
Human toxicity, cancer	t 1,4-DB eq	180
Human toxicity, non-cancer	t 1,4-DB eq	6100
Photochemical oxidant	t NMVOC	17
Particulate matter	t $PM_{2.5}$ eq	54
Terrestrial ecotoxicity	t 1,4-DB eq	11,400
Freshwater ecotoxicity	t 1,4-DB eq	315
Marine ecotoxicity	t 1,4-DB eq	340
Water depletion	m^3	-78
Fossil depletion	t oil eq	2910

Thanks for your attention!!

Waste2Bio

www.waste2bio.com

marcos@perseobiotech.com

Partners:

perseo biotechnology

IMECAL

GOBIERNO DE ESPAÑA · MINISTERIO DE ECONOMÍA, INDUSTRIA Y COMPETITIVIDAD · Ciemat Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas

instituto IMDEA energía

iNeuvo

Funding:

BESTF³

MINISTERIO DE ECONOMÍA, INDUSTRIA Y COMPETITIVIDAD

CDTI Centro para el Desarrollo Tecnológico Industrial

Department of Energy & Climate Change

Funded by the Horizon 2020 Framework Programme of the European Union