RESYNTEX

A new circular economy concept from textile waste towards chemical and textile industries feedstock

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We are...



Institute for Environmental protection and Sensors, est. in 2006 in Maribor, Slovenia

- R&D organization, SME → innovative solutions, combine science and economy
- The solutions are environmentally friendly, sustainable, green and in the context of a circular economy
- Experience in management and participation in R&D and demo projects national and international consortiums.

"Creating new knowledge for designing innovative products".











R&D areas

- Recycling & environmental protection
- Optical chemical sensors
- Nanomaterials













Products

- MBR + Wate(R)ecycling technology Wate(R)use concept in water treatment and recycling,
- secondary raw materials chemical recycling of plastic and textile waste
- (wearable) sensor systems healthy living, sensors provide (continuous) info

about the environment, food and ourselves - **SmartLiving® concept**













Recent work on recycling topics



EU Horizont 2020

RESYNTEX – A new circular economy concept: from textile waste towards chemical and textile industries feedstock

Thematic area: WASTE-1-2014: Moving towards a circular economy through industrial symbiosis

Duration: 42 months, 2015-2019

20 partners, 10 countries

EraMin2

MetRecycle: Recycling of Rare Earth Metals using functionalized magnetic nanomaterials

Duration: 36 months, 2018-2021

5 partners: Slovenia, Sweden, Argentina, France

Demo Piloti II

POLYCIRCULARITY: Waste as a source od seconadry raw materials

(POLY KROŽNOST: Odpadki kot vir sekundarnih surovin)

Duration: 33 months, 2019 – 2022

9 partners from Slovenia: Surovina, IOS, MikroPolo, Roto, Messer, Omega, EKTC, Snaga, Tekstina

Eurostars

HMRecycle: Recycling of Heavy Metals using functionalized magnetic nanomaterials

Duration: 36 months, 2019 -2022

2 partners: IOS Slovenija, Roto Hrvaška









MixMatters – Smart and flexible Separation and Valorisation of mixed bio-waste from along the agri-food value chain

Call: HORIZON-JU-CBE-2022

Area: HORIZON-JU-CBE-2022-IA-04 Co-processing of mixed bio-based waste streams

Duration: 48 months, 1.6. 2023 – 31. 5. 2027

18 partners, 8 countries

IOS role: partner, demonstrator (degradation of packaging)











PESCO- UP: Textile fibre recycling from mixed streams of PESCO textiles

Call:HORIZON-CL4-2023-TWIN-TRANSITION-01

Area: HORIZON-CL4-2023-TWIN-TRANSITION-01-42: Circular economy in process industries:

Upcycling large volumes of secondary resources (Processes4Planet partnership) (RIA)

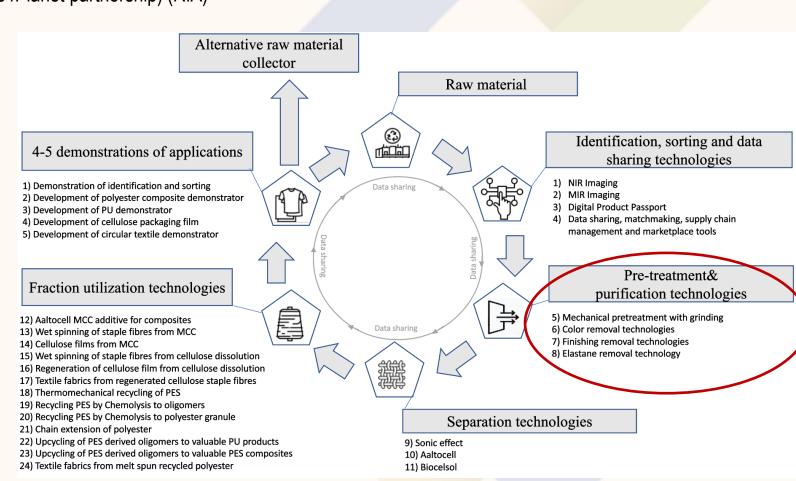
Duration: 48 months, 1.1. 2023 – 31.12. 2027

20 partners, 10 countries

IOS role: WP leader











PESCO - UP: Textile fibre recycling from mixed streams of PESCO textiles



Polycotton raw materials

Dyed

Dyed & finished

Dyed & elastin



Identificati on and sorting

Sorting by fibre composition in textiles

Detecting impurities

Detecting polymer-level fibre properties



Pre-treatment and purification

Mechanical pretreatment

Colour and finishing removal with 1) CS-CO₂, reductive and oxidative chemicals, 2) green organic solvents

Colour, finishing and elastin removal with SC-CO₂, reductive, oxidative chemicals and enzymes



Separation of blend textiles

Mechanical

Aaltocell process

Biocelsol process



Utilization of cotton fraction

Regenerated cellulose staple fibres 1)

Aaltocell, 2) Biocelsol

Regenerated cellulose films 1) Aaltocell, 2) Biocelsol

Aaltocell cotton to composite reinforce material Utilization of PES fraction

Material for textile fibres

(Melt spinning) 1) thermomechanic al 2) chain extension 3)

glycolysis

PU-materials by glycolysis

Composites 1) glycolysis INEOS, 2) glycolysis Cure, 3) glycolysis Vito

4) chain extension VTT



Valuable products

Fabrics & clothing

Non-woven

Cellulose packaging film

Synthetic leather

Composite product







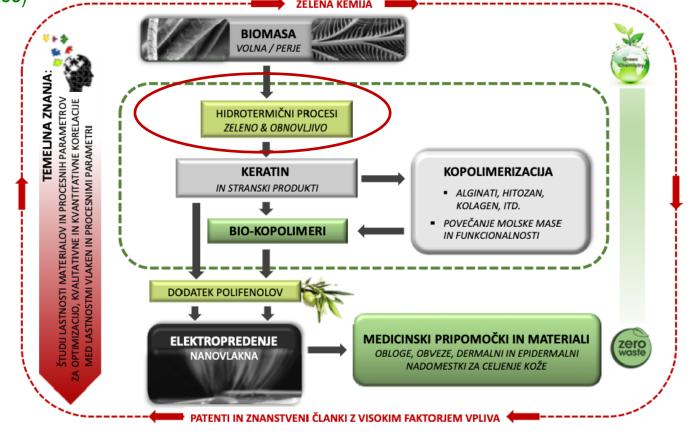
Biomassmedtex - Advanced technological processes for the recycling of <u>waste keratin biomass</u> and the development of new functional keratin-based bio-products

• Call: **ARIS** (national)

• Duration: 01. 10. 2022 – 30.9. 2025

Role IOS: partner (HT degradation of protein substrates)

Project goal → preparation of bioactive nanofibrous structures of keratin, isolated from waste wool and poultry feathers with environmentally friendly processes.









OpenLOOP recycling technology - sustainable and profitable solution to the management of PET/cellulose waste

Call: HORIZON-EIC-2022-ACCELERATOR

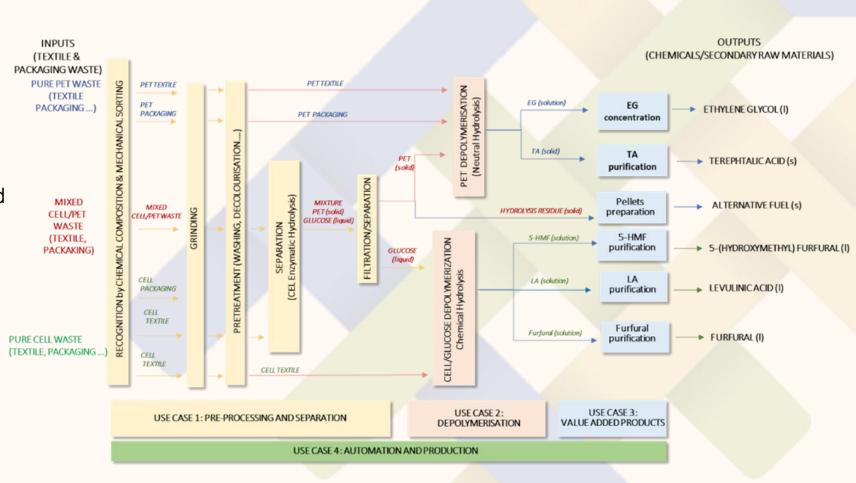
• Duration: 01. 04.2023 – 31.3. 2025 (+ equity phase)

Role IOS: sole partner

Project goal \rightarrow

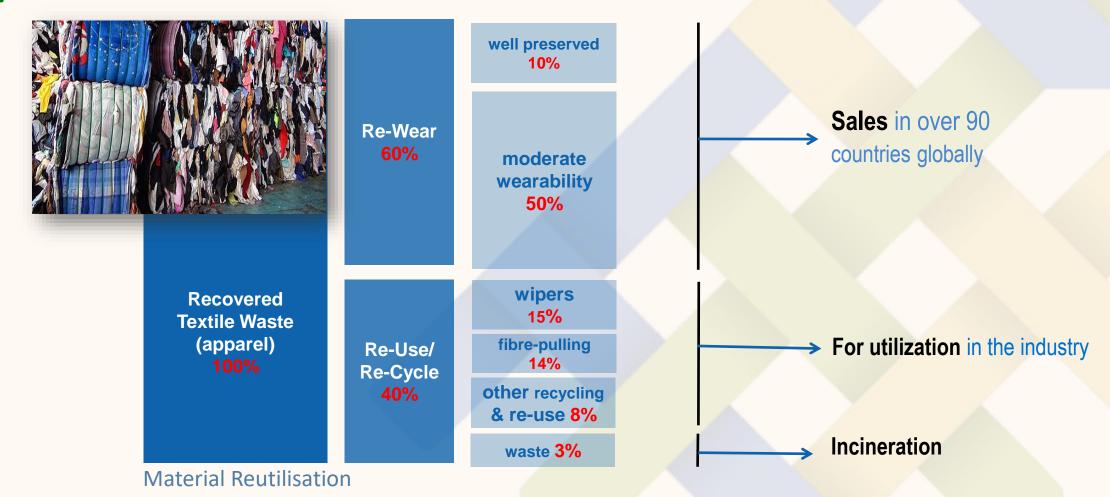
novel chemical recycling technology:

- to degrade any mixture of textile/plastic PET and CELLULOSE waste.
- final output yields high-value feedstock:
 5-HMF, LA furfural, rTA
- environmentally friendly
- successfully implemented in industrial environment.





RESYNTEWhy Resyntex





■ 75 mio. t/y of textile are produced worldwide (EU 16 mio t/y)

Less than 20 % of the overall textile waste (low-valued) flow is recycled (mechanically)

currently ~ 60 mio. tons/y of textiles - sent to landfills or burned



Project vision A new value chain in the circular economy concept

- Project goal: to create the circular economy concept → symbiosis between the textile and chemical industry
- □ Protecting the environment & <u>raising social awareness and responsibility</u> → <u>introduction of</u> the circular economy concept
- ☐ Aim: usage of the <u>innovative recycling concept</u> for production of <u>secondary raw materials</u> for the chemical industry
- ☐ Textile waste becomes a source for the textile and chemical industries



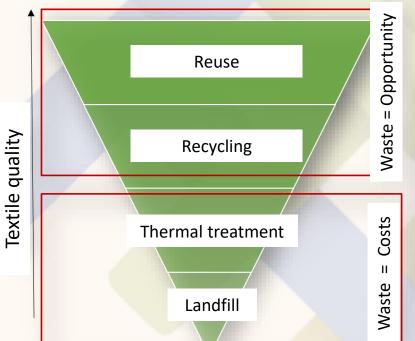




Process input

- Waste textiles low value raw material for recycling in existing recycling processes (disposal, incineration without energy recovery).
- New concept processing of textile wastes and blends (protein, CELL, PET in PA fibres) into secondary raw materials for the chemical industry.
- □ 95% of the weight of low grade waste textiles











Process outcomes

■ Secondary raw materials for the chemical industry

PROTEIN extraction



• Fillers, adhesives for wooden pannels

CELLULOSE extraction and glucose production

- Glucose
- Bio-ethanol
- Levulinic acid
- Furfural

PET depolymerization

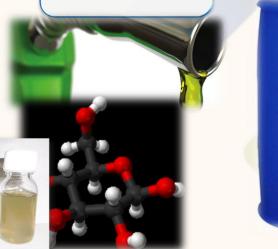
- Terephthalic acid
- Ethylene glycol

PA depolymerization

- Monomers
- Adipic acid
- ε caprolactam
- Aminocaproic acid



Co-funded by the European Union's Horizon 2020 research and innovation programme









Proces demonstration – DEMO pilot

DEMO pilot of a capacity of 30 t/y in Maribor

- Pilot size: cca. 250 m²
- Total area (incl. storages, buffer tanks, etc.): cca. 400 m²
- Purpose: transformation of textile, (bio)plastic and other kind of (bio)waste to (bio)energy
- Main components:
 - 3 reactors (discoloration reactor, synthetic hydrolysis reactor, and cellulosic hydrolysis bioreactor)
 - extruder (mechanical pretreatment of cellulosic and protein fibres)
 - separation systems (tape press filter for L/S separation, drum vacuum filter)
 - automatic chemical dosing system
 - Wastewater treatment plant (WWTP) and WasteToEnergy plant (WtEP)
 - feeding, mixing and storing tanks
 - pumps, pipes, instruments, equipment needed for the safe, efficient operation and control of the pilot



Proces demonstration – DEMO pilot in Maribor

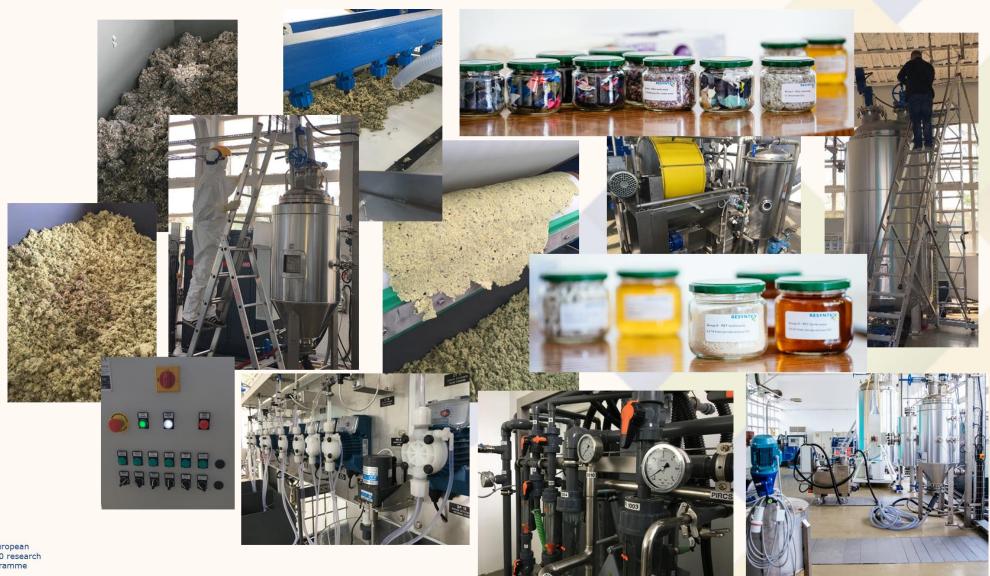








Proces demonstration – DEMO pilot in Maribor





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Project consortium

- 20 partners from 10 EU countries,3 from Slovenia
- ☐ All segments of newly established value chain:
 - waste collectors;
 - end-users of secondary raw materials;
 - academic, expert and consulting organizations;
 - stakeholders at the highest EU level.









Acknowledge

RESYNTEX project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 641942.

