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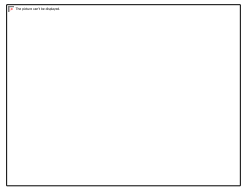
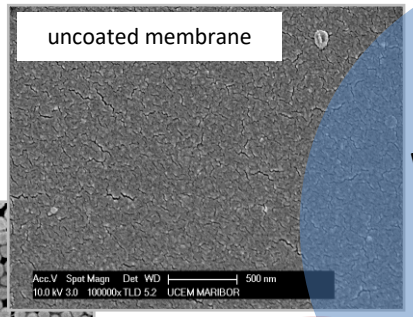
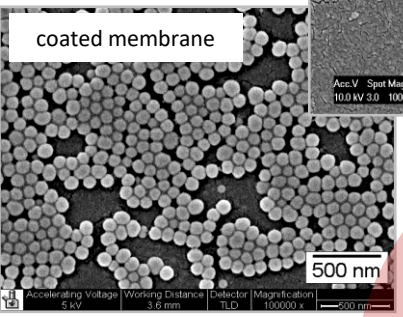
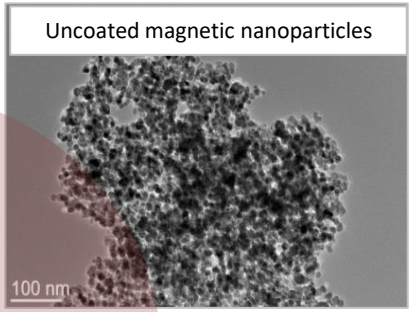


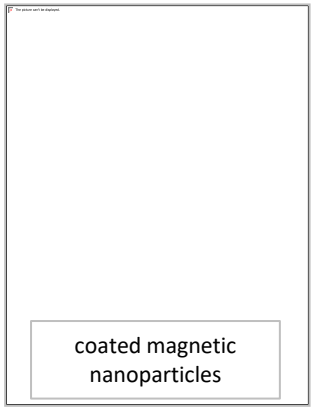




WATER, WASTES RECYCLING PROCESSES

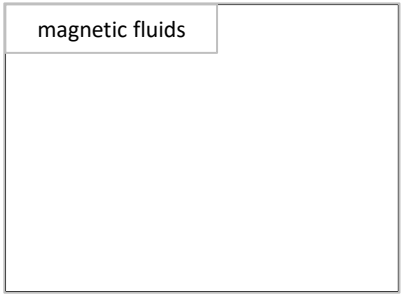
PATENT: NM "20 patent applications" 10 EU and 2 USA
KOŠAK Aljoša, BAUMAN Maja, LOBNIK Aleksandra *"A method of surface treatment of thin film composite (TFC) membranes with tetraalkoxysilanes for retention of heavy metal ions in the membrane filtration processes of waste waters", Patent No. SI 23535 A, 2012,* **The Slovenian Intellectual Property Office, Ljubljana**





CHEMICAL & BIO- SENSORS

NANOTECHNOLOGY & NANOMATERIALS



PATENT:
LOBNIK Aleksandra, KORENT UREK Špela. *"A method and an optical chemical sensor with a sol-gel membrane for the detection of organophosphates",*
EP 2 678 673 (B1), 2016-06-08. Berlin, Germany: European Patent Office, 2016.

COSMETICS & HEALTH

PATENT:
LOBNIK, Aleksandra ***"Sol-gel based optical chemical sensor for detection of organophosphates and method for preparation thereof"***:
RU2013129043 (A), 2015-01-10; RS55040 (B1), 2016-12-30;
RS55040 (B1), 2016-12-30. Beograd. USA patent under considaration.

PATENT:
KOŠAK Aljoša, LAKIĆ Marijana, LOBNIK Aleksandra, *"Process for the preparation of superparamagnetic hollow spherical nanostructures", GB2526659 (A), 2015-12-02.* London: Intellectual property office, 2015.

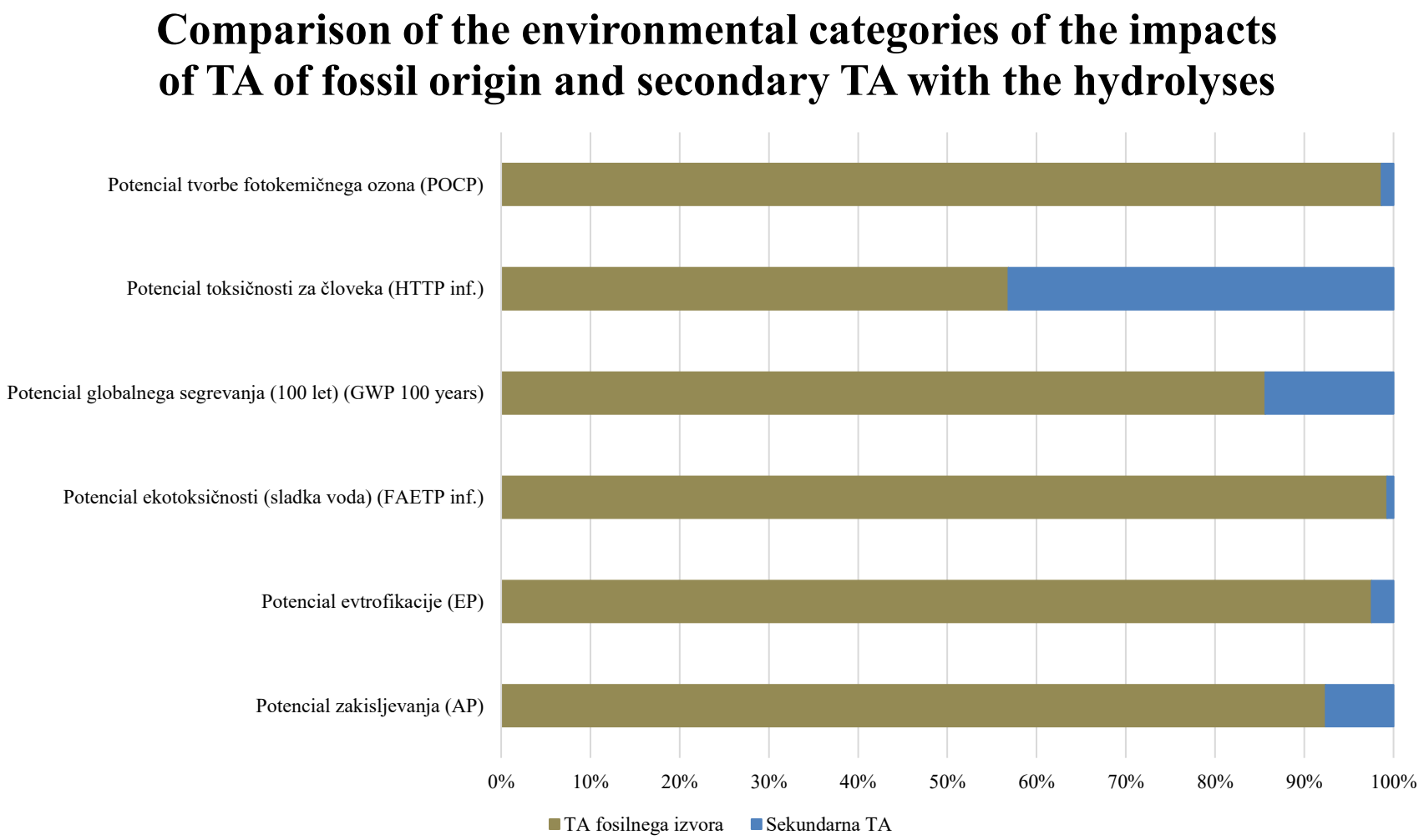
EIC Accelerator OpenLOOP project chemical/biochemical recycling of PET/cell

OpenLOOP

Secondary chemicals of non fossil origin

- rTA – for now
- rGlucose – for now
- r5HMF –for now
- (Also possible)
- rLA
- rFurfurals
- rEG
- Others: Bioethanol, Hydrogen, diols
- Nanocellulose

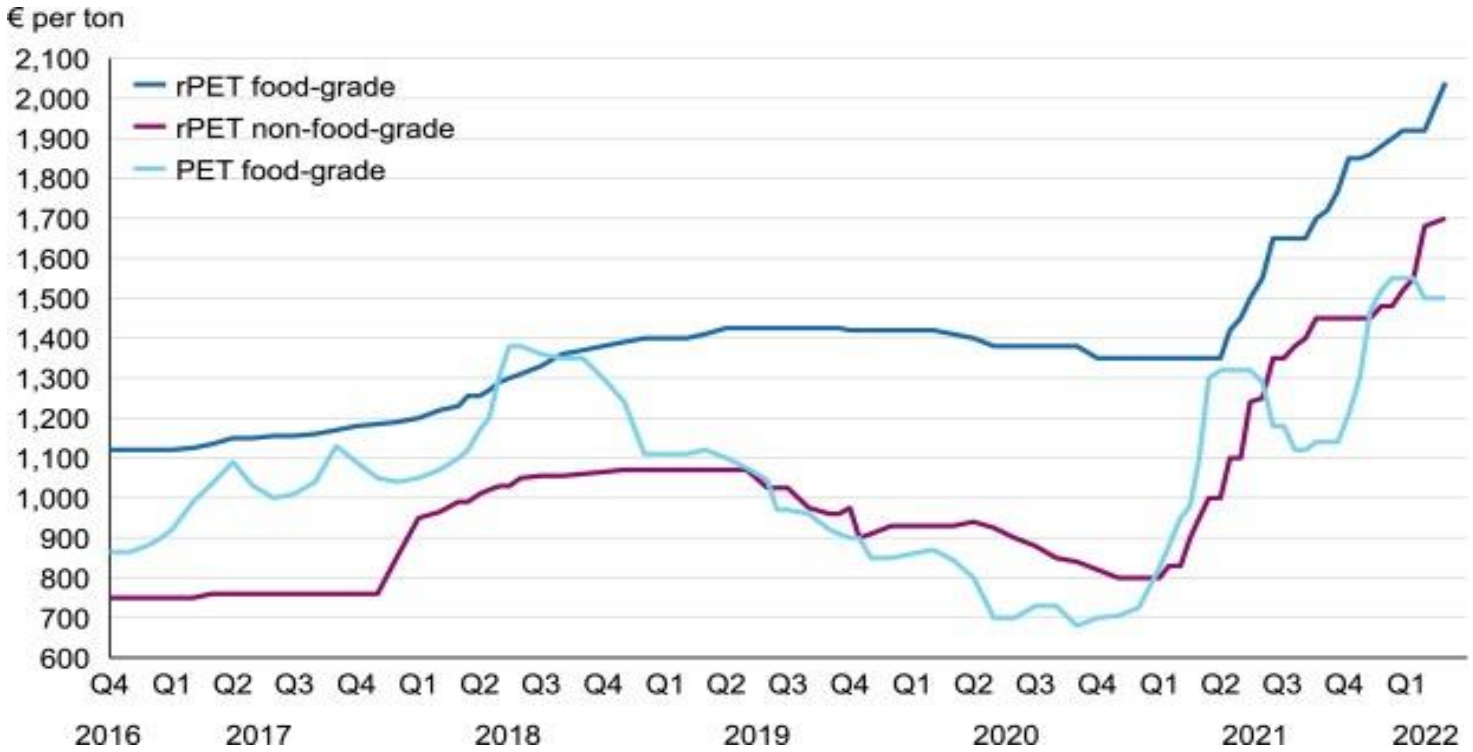
LCA Comparison FOR TA – **(Green colour is TA of fossil origin and Blue Colour is secondary TA)**



Secondary Raw Material Expected Market

In the case of rPET, the industry is concerned that fixed targets on recycled content would result in **fierce competition for recycled plastics.** Already the market demand for **food-grade transparent PET has led to rPET prices higher than the virgin equivalent:**

rTA food grade: 2.050 EUR/t; rTA non food-grade: 1.700EUR/t; TA food grade: 1.500 EUR/t



Robotics in the Textile Industry through Recycling Processes

Robotics is playing an increasingly important role in making the textile industry more sustainable by improving textile recycling processes.

As the fashion industry generates millions of tons of textile waste annually, robotic technologies help automate sorting, processing, and recycling operations, increasing efficiency and reducing environmental impact.

Automated Textile Waste Sorting

One of the biggest challenges in textile recycling is identifying and separating different fabrics.

Robotic systems equipped with:

- Artificial Intelligence (AI)
- Computer Vision
- Near-Infrared (NIR) Sensors

.

1. Automated Textile Waste Sorting

can automatically recognize and sort textiles based on:

- fiber type (cotton, polyester, wool, etc.)
- color
- fabric composition
- presence of contaminants (zippers, buttons, labels)

.

Benefits:

- Faster sorting than manual labor
- Higher accuracy
- Reduced labor costs
- Increased recycling rates

.

2. Robotic Disassembly of Garments

Many garments contain mixed materials and accessories that complicate recycling.
Robots can:
- Remove buttons, zippers, and fasteners
- Cut garments into recyclable sections
- Separate reusable components

This prepares textiles for fiber recovery and minimizes contamination.

3. Material Handling and Processing

Industrial robots are used to:

- Transport textile waste
- Feed shredding machines
- Handle compressed textile bales
- Load and unload recycling equipment
- Automation improves worker safety by reducing repetitive and hazardous tasks.

4. Robotic Fiber Recovery Systems

After sorting, textiles are mechanically or chemically recycled.

Robots assist by:
- Monitoring recycling equipment
- Controlling material flow
- Adjusting processing parameters in real time
- Ensuring consistent fiber quality
- This increases the efficiency of fiber recovery and reduces waste.

5. AI and Smart Robotics for Circular Fashion

Advanced robotic systems integrated with AI can:
- Track textile materials throughout their lifecycle
- Identify reusable fabrics
- Support closed-loop recycling systems
- Improve resource efficiency

These technologies contribute to a **circular economy**, where old textiles are transformed into new products rather than being discarded.

Examples of Companies Using Robotics in Textile Recycling

Tomra – Sensor-based sorting systems for textile waste.

AMP Robotics – AI-powered robotic sorting solutions.

Fibersort Project – Automated textile sorting by fiber composition.
Re:newcell and **Circ** – Advanced textile recycling technologies supported by automation.

Examples of Companies Using Robotics in Textile Recycling

Advantage	Impact
Higher sorting accuracy	Better quality recycled fibers
Increased productivity	Faster recycling operations
Reduced labor costs	More economical recycling
Improved worker safety	Less exposure to hazardous tasks
Environmental benefits	Reduced landfill waste and resource consumption

IOS
Inštitut za okoljevarstvo in senzorje

is with OpenLOOP

ON A MISSION

to change the perception of waste recycling

from PROBLEM to OPPORTUNITY