Inspired by nature: on the road to maximum circularity for consumer electronics boards

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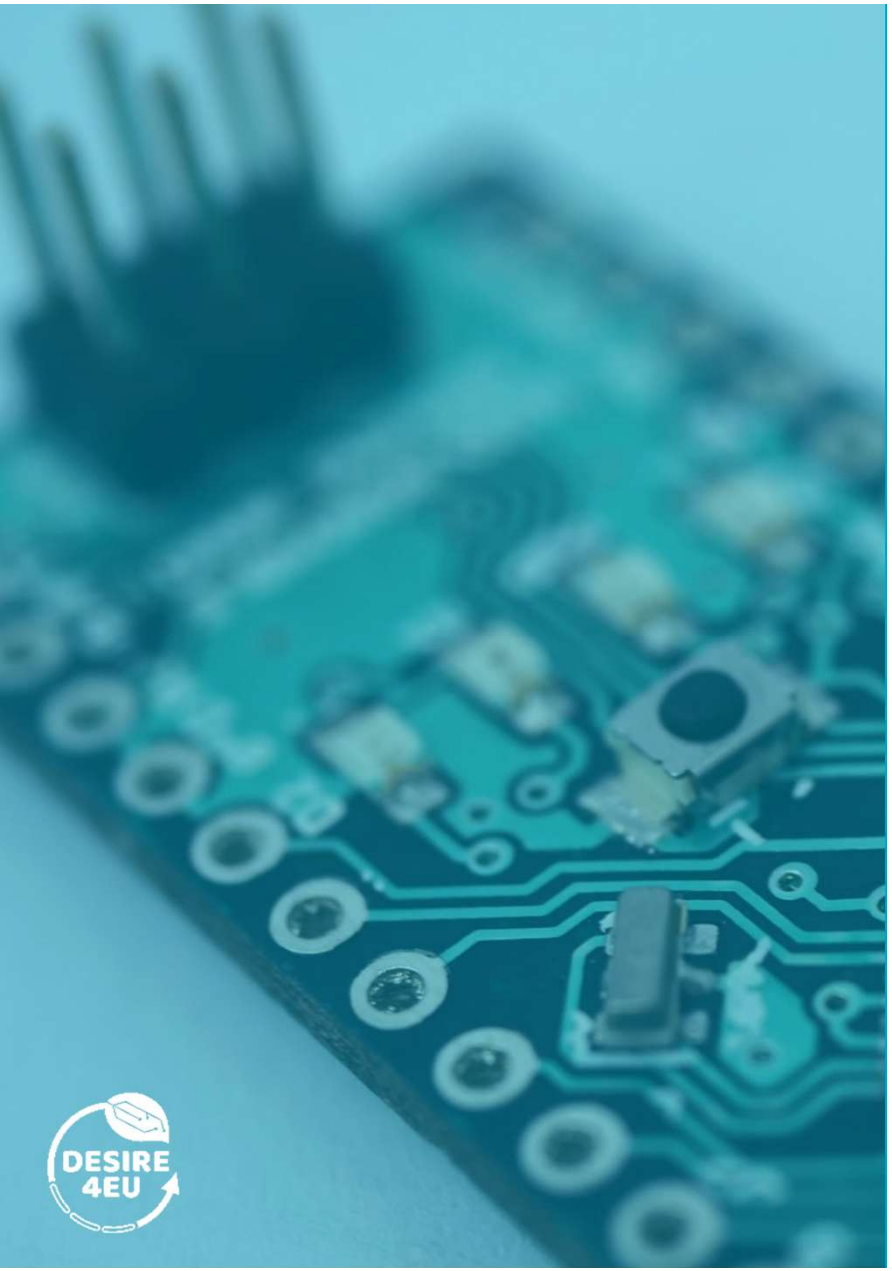
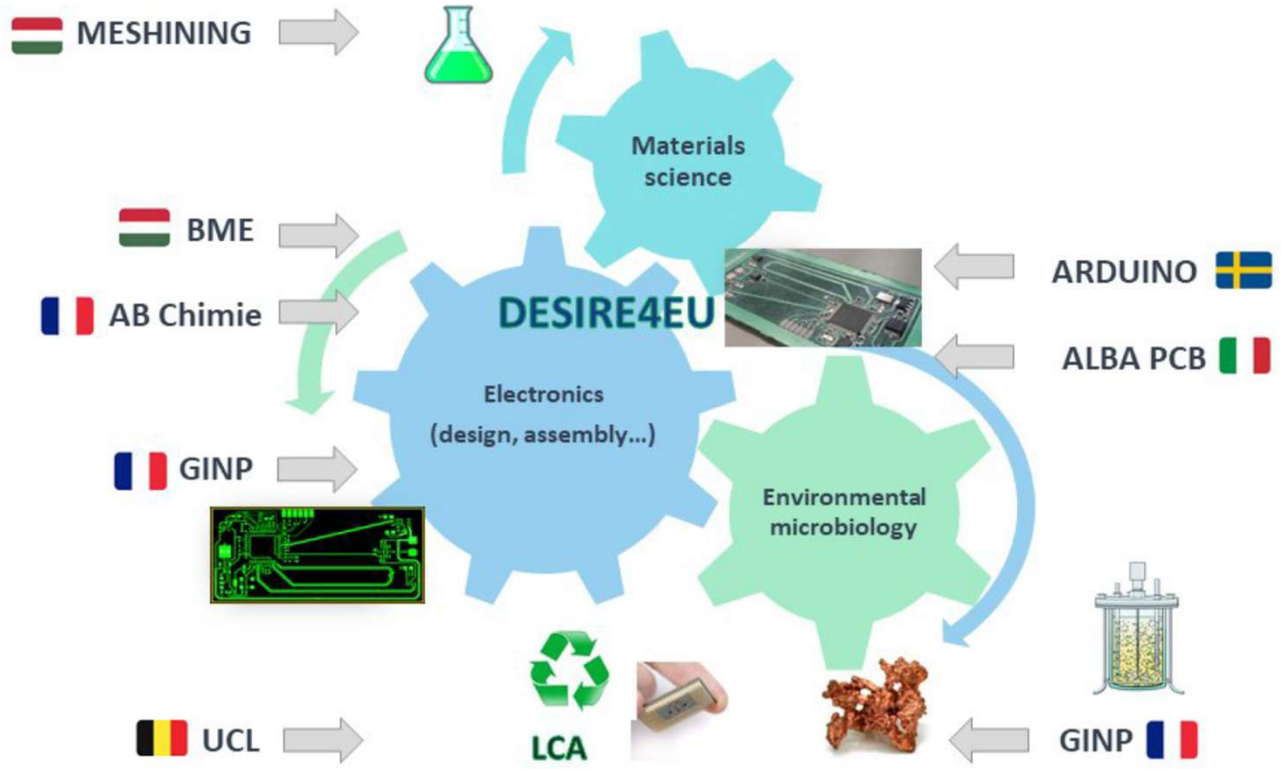
DESIRE4EU

DESIgning and REcycling sustainable Electronic boards for a EUropean circular economy

2024-2028

This project has received funding from the European Union's Horizon Europe research and innovation program under grant agreement No 101161251 - HORIZON-EIC-2023-PATHFINDERCHALLENGES-01-04 « responsible electronics »




MESHINING
BME
AB Chimie
GINP
UCL
Materials science
DESIRE4EU
Electronics (design, assembly…)
Environmental microbiology
LCA
ARDUINO
ALBA PCB
GINP

HORIZON-EIC-2023-PATHFINDERCHALLENGES-01-04 – EIC

The Responsible Electronics portfolio unites 9 groundbreaking projects developing next-generation materials, components, and manufacturing methods that reduce e-waste, avoid toxic substances, and promote circular economy principles in electronics.

SUPERLASER

Room Temperature Superradiant Perovskite Lasers

Grant agreement ID: **101162503**

DESIRE4EU

DESIgning and REcycling sustainable Electronic boards for an EUropean circular economy

Grant agreement ID: **101161251**

STELEC

Sustainable Textile Electronics

Grant agreement ID: **101162257**

ELEGANCE

Green Self-Powered Neuromorphic Processing Engines with Integrated Visual and Functional Sensing

Grant agreement ID: **101161114**

RADIANT

Chiral Light Emitting Diodes based in Photonic Architectures

Grant agreement ID: **101162112**

GreenOMorph

Green materials for neurOMorphic signal processing by organic synaptic transistors

Grant agreement ID: **101161637**

HiSOPE

High-Speed Organic Photonics and OptoElectronics

Grant agreement ID: **101161573**

GRETA

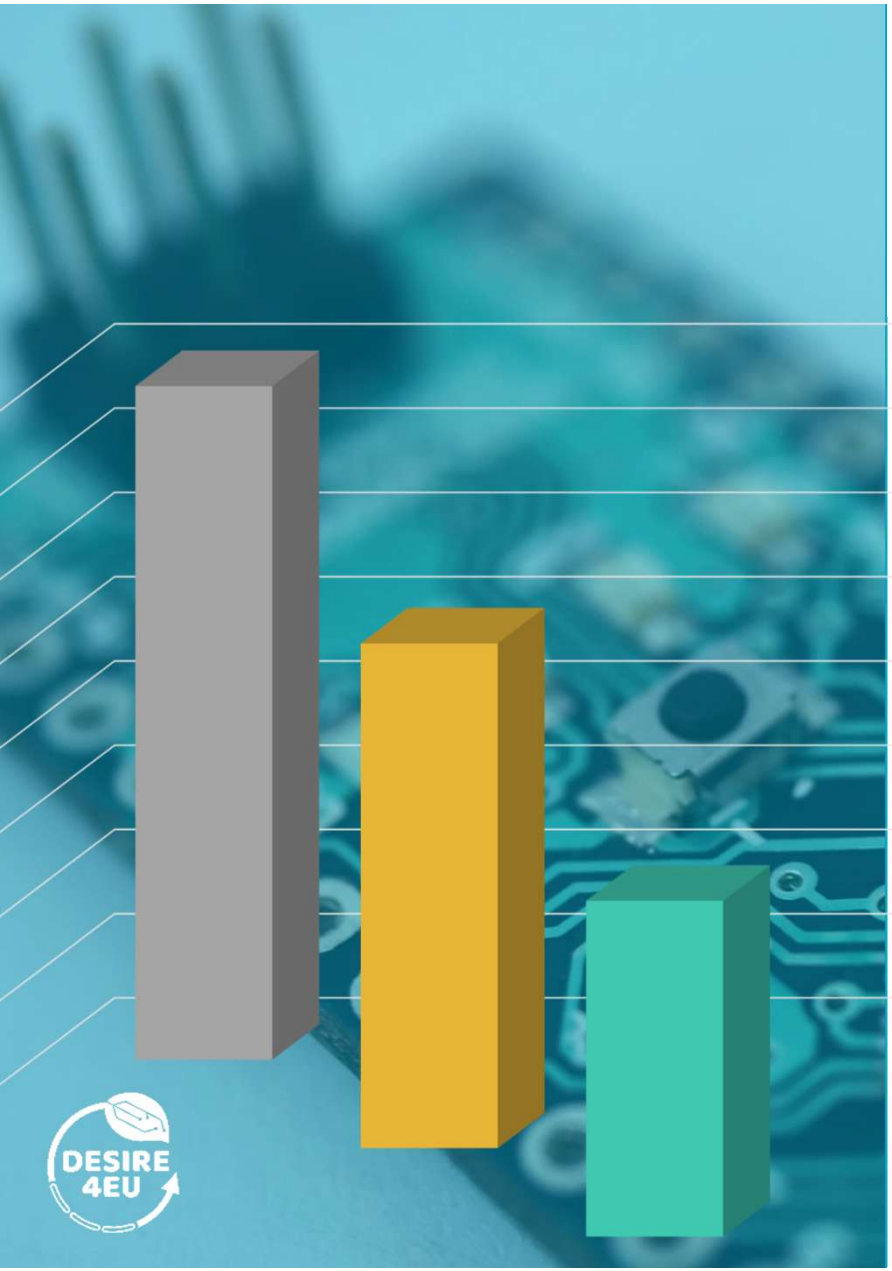
Green, organic and printed ultra-high frequency identification tags

Grant agreement ID: **101161032**

HaloFreeEtch

Novel approaches for halogen-free and sustainable etching of Silicon and Glass

Grant agreement ID: **101161153**



Achieve circularity in consumer electronic boards by 2030

- Manufacturing **biosourced and biodegradable printed circuit board (PCB) substrates compatible with industrial production** equipment and fostering **EU sovereignty**
- Modifying the **design rules** used in professional circuit design to introduce the notion of **circularity**
- Optimizing a low-energy-consuming and low-polluting inspired-by-nature process for **recovering critical metals** at the end of life

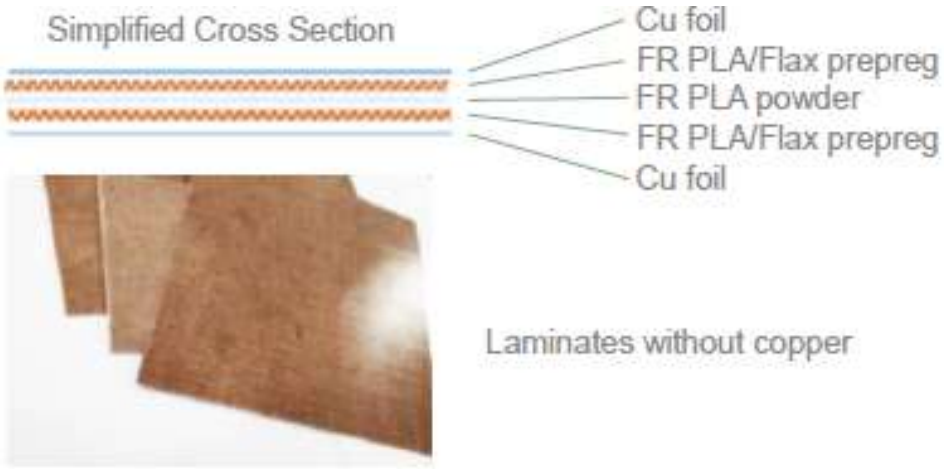
EIC means innovation
→ A 10 years pathway

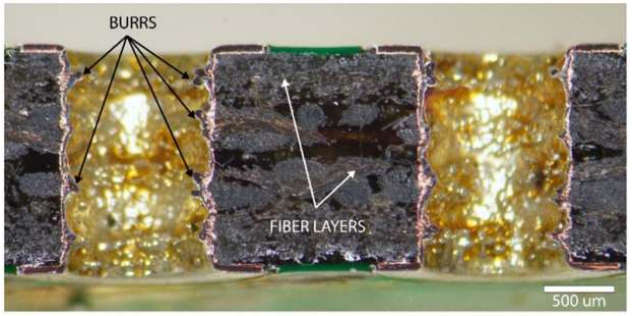
By 2028, 3000 demonstrator boards as a proof-of-conc

→ EI transition project

Biosourced and biodegradable PCB substrates compliant with current industrial manufacturing

- Composite PLA with flax fibres reinforcement mapping
- Incorporating a flame retardant and a bio-based impregnating agent
- Classic subtractive technology (PCB)
- Compatible SMT technology.

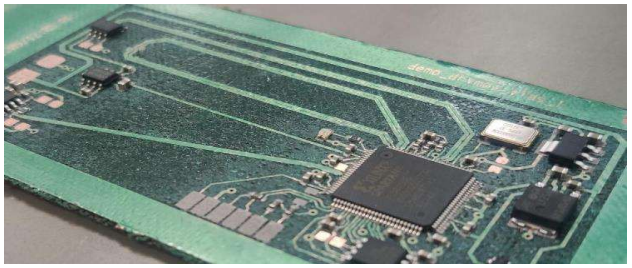




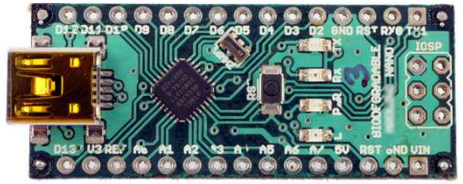
cross section of the substrate presents the structure and through-hole vias

Biosourced and biodegradable PCB substrates compliant with current industrial manufacturing

- Demonstrators

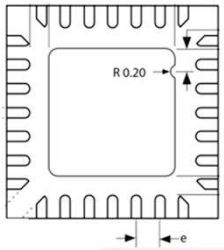


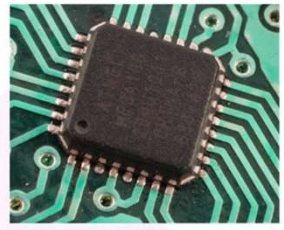
FPGA circuit with high frequency

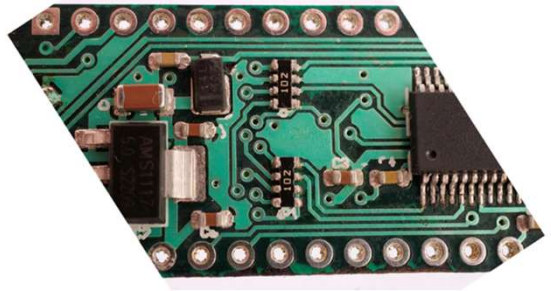


Assembled PLA/Flax demonstrator based on an Arduino Nano design

- Assembly aspects
  - 2 sided SMT + THT assembly
  - ATMEGA168P-20MU: QFN packaging
  - Passives: 0603 (1,5 x 0,8 mm)
  - 125 pads, pad size: ~170 µm
  - 41 vias, diameter 0,5 mm







New design rules in professional circuit design to introduce the notion of circularity

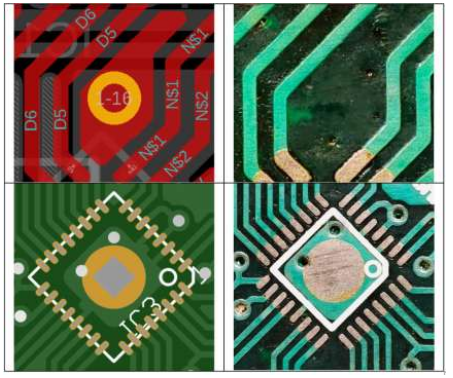
- Modifying the design rules used in printed circuit board CAD software (eg KiCAD) to take account of circularity and the “just enough” concept
  - Use just the right amount of resources, choose just the right amount of complex processes and materials to get the job done.
  - Quality and reliability of tools should be just right for the job.
  - May not work for all industries, but it works for many consumer electronics products.
  - Limit copper usage for short circular loops.

- DOI: 10.1109/SEC62691.2024.00050

Tiny, Distributed, and Eco-Optimized: Proposal of Design Guidelines for Environmentally Friendly ML Devices

David J. Cuartielles Ruiz; Attila Géczy; Vincent Grennerat; Pascal Xavier

2024 IEEE/ACM Symposium on Edge Computing (SEC)

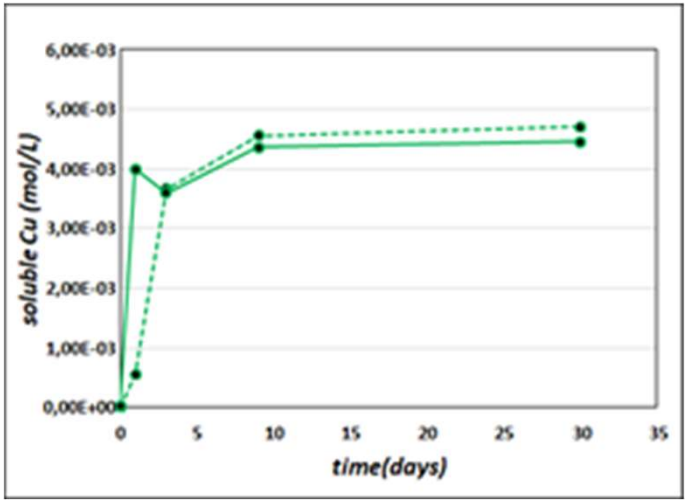


“Just enough” concept

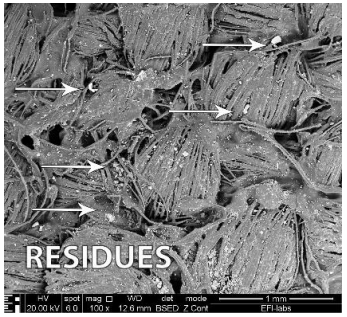
Low-energy-consuming and low-polluting inspired-by-nature process for recovering critical metals (CM) at the end of life

- Optimizing a hydrometallurgical bioleaching process that is **energy-efficient and low-polluting**
  - Using nature-based solution: bacteria, which naturally live in mining areas and tailings: acid production / sulfate oxidation by microorganisms, accelerated dissolution of CM through oxidation by Fe(III) → Dissolution of 100% of copper in 6 days
  - Better economic return is expected

- Around 70-90 wt% (depending on components) **compostable** – the remaining parts are collectible, circular.



Copper recovering with bioleaching



Biodegradation of the PLA/Flax after 7 weeks

Thank you!

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