Environmentally friendly electronics for circular economy

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Motivation for sustainability in flexible electronics

The **global electronic waste is increasing rapidly** and will reach 74 Mt by 2030, **almost doubled** in just 16 years[1] with only **20% collected/recycled** properly[2].

Global consumption of material resources expected to **more than double** between 2015 and 2050[3]

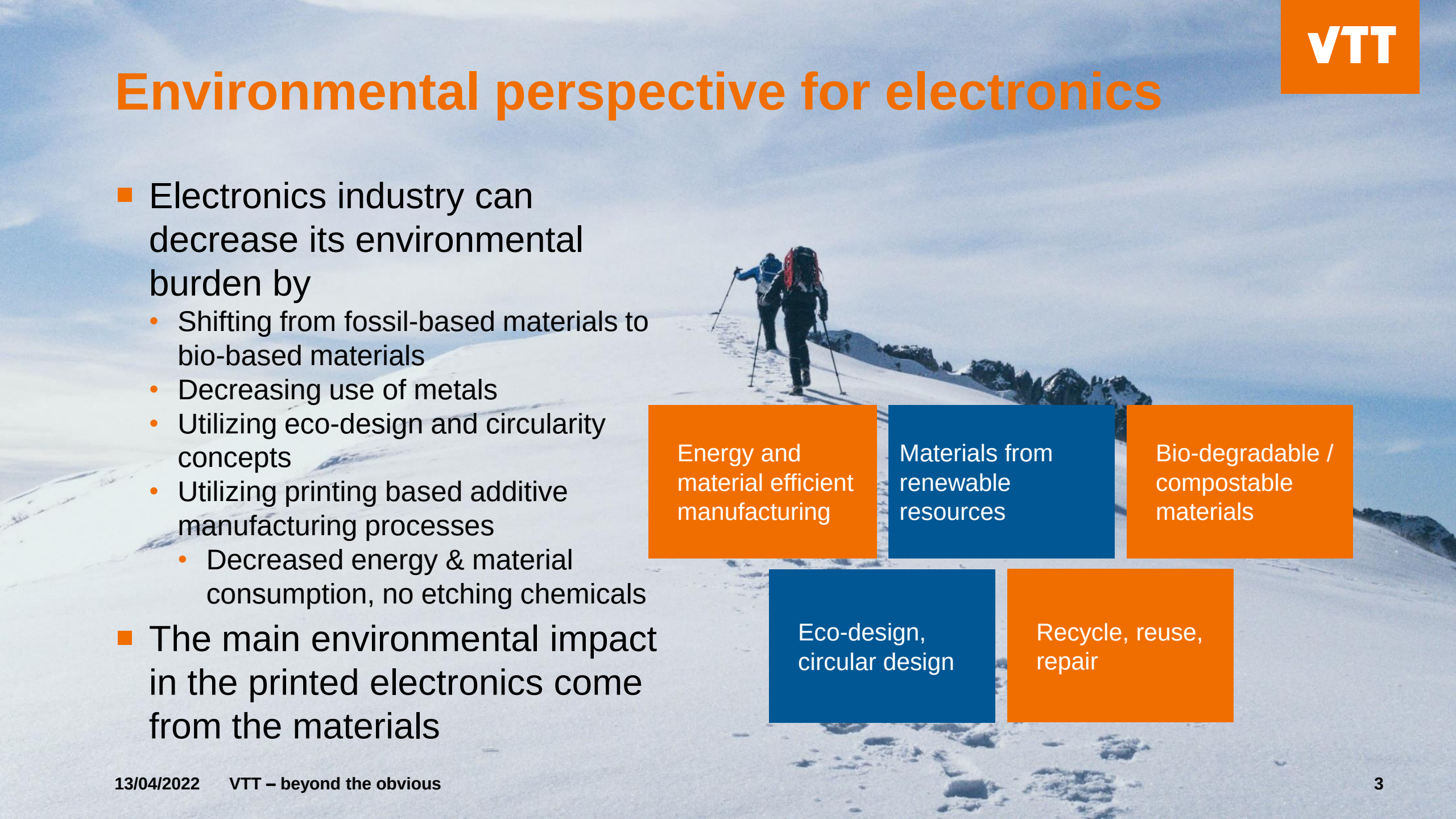
Access to raw materials at risk

European and global **environmental agendas**

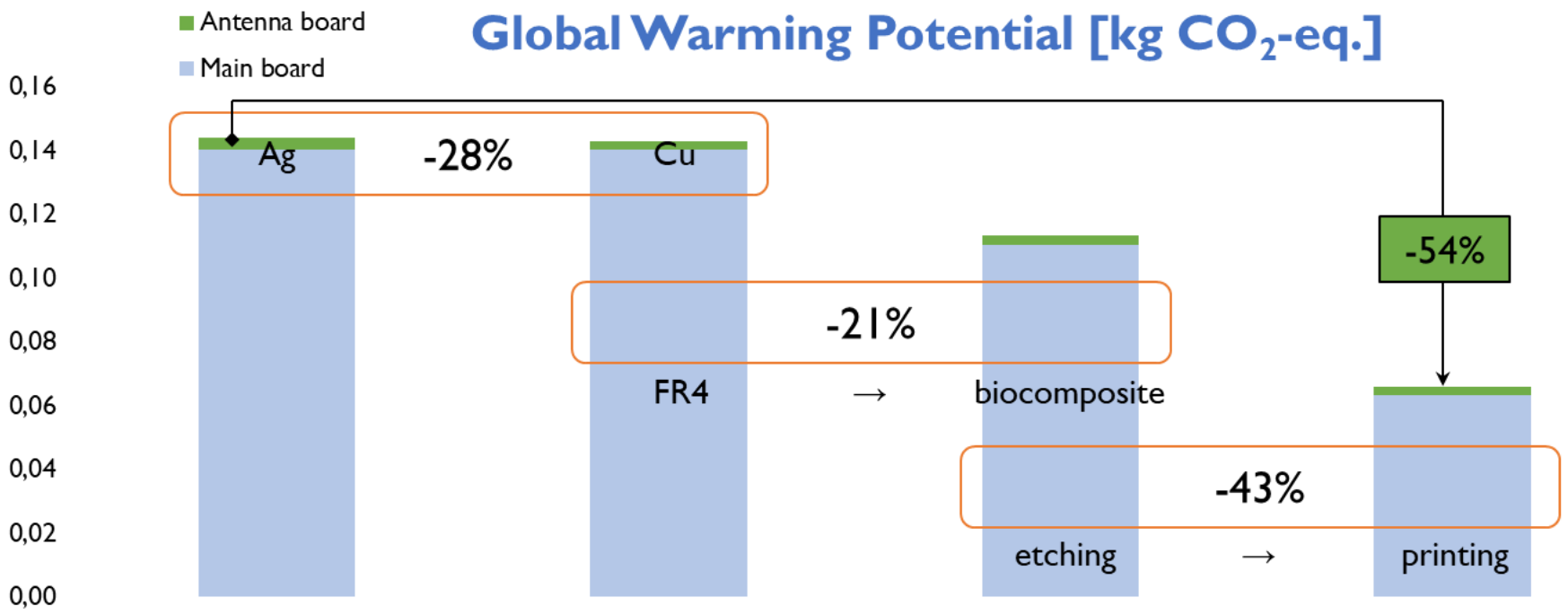
[1]*Vanessa Forti, V. et al.The Global E-waste Monitor 2020. UNU/UNITAR and ITU, 2020.*
[2]*Ellen MacArthur Foundation. Circular consumer electronics: an initial exploration. 2017*
[3]*European Union reflection paper. Towards a Sustainable Europe by 2030. January 2019*

Environmental perspective for electronics

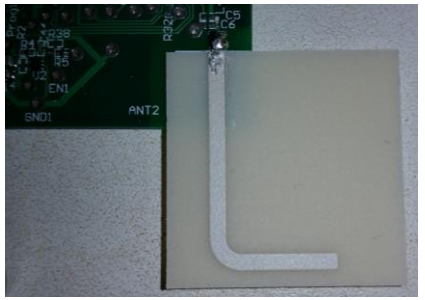
- Electronics industry can decrease its environmental burden by
  - Shifting from fossil-based materials to bio-based materials
  - Decreasing use of metals
  - Utilizing eco-design and circularity concepts
  - Utilizing printing based additive manufacturing processes
    - Decreased energy & material consumption, no etching chemicals
- The main environmental impact in the printed electronics come from the materials



Environmental impact of PCB - example



Graph: Ivan Deviatkin, Mohammad Naji Nassajfar, LUT University



ecotronics
Sustainable Electronics & Optics
www.ecotronics.fi

Mohammad Naji Nassajfar et al, Sustainability 2021
https://doi.org/10.3390/su132112126

VTT tackles sustainable electronics development through multidisciplinary competences in

bio-based material development, and printed and hybrid electronic

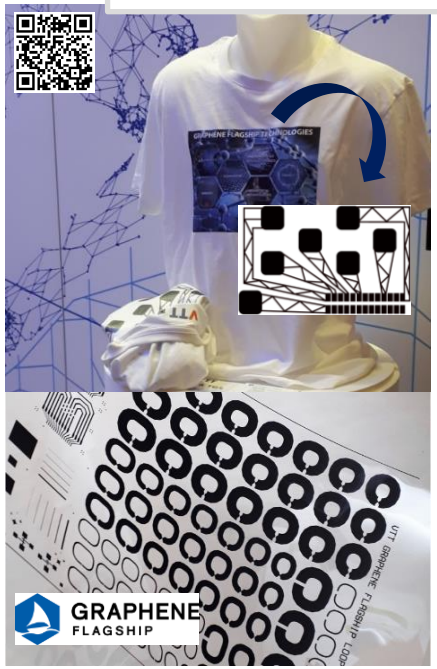
- **Additive manufacturing process – low emissions and losses**
- **Possibility to use wide selection of substrate materials including biobased, compostable and recyclable materials**
- **New functionalities through bio-based materials**

Our goal − Implementation of bio-based materials as a new normal in electronics.

Achievements in sustainable electronics

Pioneering work in paper based electronics

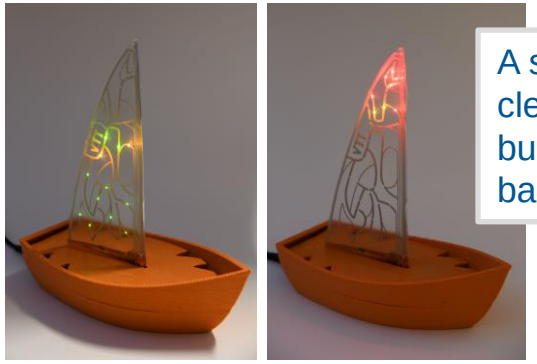
Flexible and textile integrated electronics based on graphene



Winner of the OE-A Competition 2022
Best Publicly Funded Project Demonstrator

Sustainable electronics and optics: Intelligent packaging for monitoring food quality & biodegradable environmental sensor

Batteries with high safety and lower environmental impact



A sensor for clean indoor air built using bio-based materials

Winner of the OE-A Competition 2021
Best Publicly Funded Project Demonstrator

Scale-up of printed electronics materials: anti-counterfeit label on paper

beyond

the obvious

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