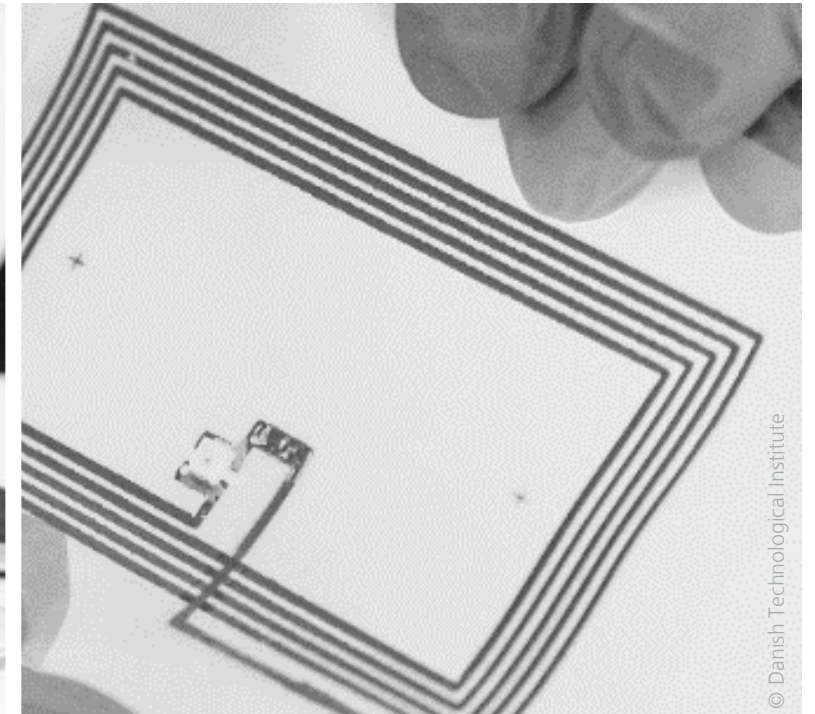


ACCELERATING SUSTAINABLE DEVELOPMENT AND PRODUCTION OF NANO-MATERIALS AND PRINTED ELECTRONICS

The 10th International Conference on Life Cycle Management

Tobias M Prenzel, Florian Gehring, Zachary J Davis; 8 September 2021, Stuttgart, Germany



Sustainable development and production of printed electronics

What's the hype?

DEFINITION

electronic circuits
manufactured through
additive technologies
used for printing
functional materials

PRINTED ELECTRONICS

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Flexible and light-weight
through thin substrates

low-cost due to
high-speed, low-complexity
manufacturing

material efficient
through additive instead of
subtractive processes

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Challenges and obstacles



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GAPS IN KNOWLEDGE

- Potential users don't know **individual benefits** of technology
- Potential users are not familiar with **manufacturing processes**

DIFFICULT ACCESS

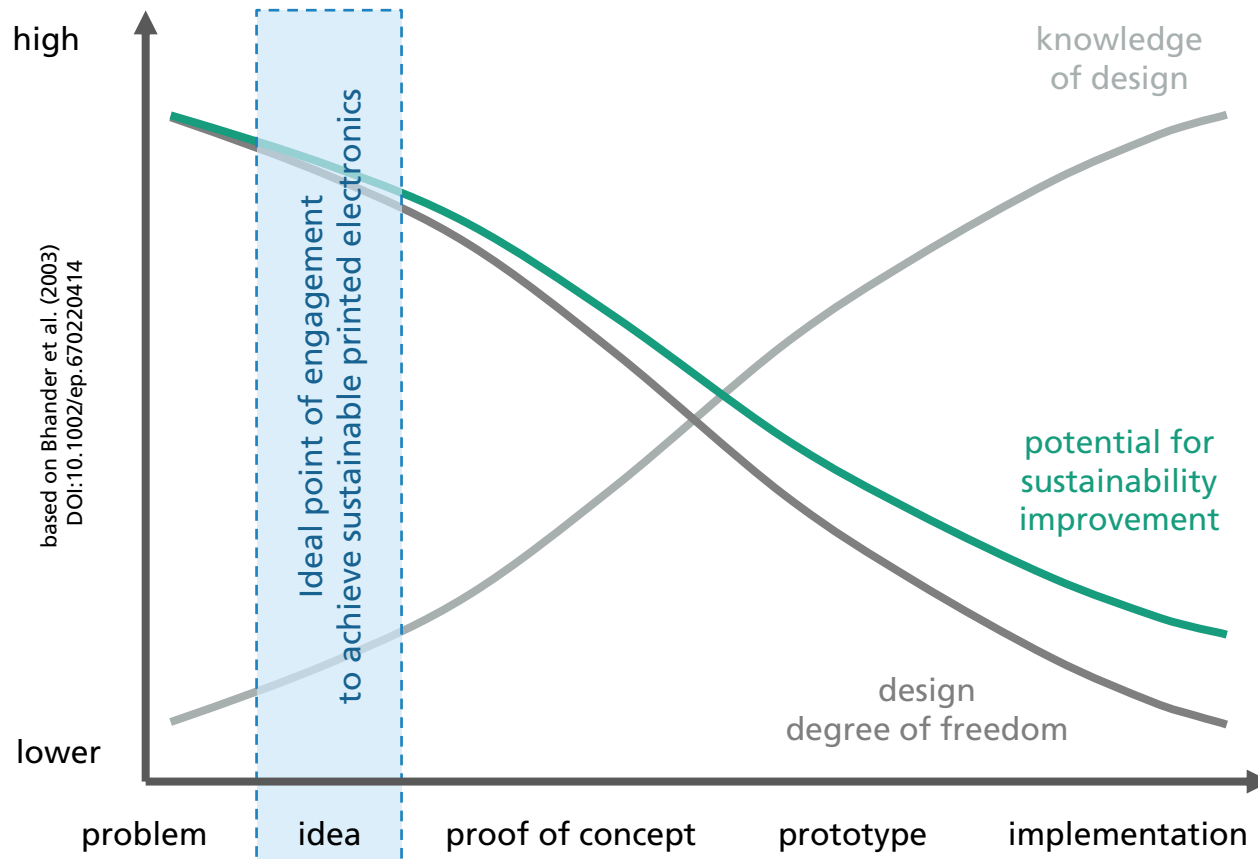
- Little visible **market penetration** of printed electronics
- European **test facilities** are not necessarily known to potential users

INCOMPLETE EVALUATION

- Assessments typically consider **only performance & cost** requirements
- Mostly **qualitative assessments** regarding sustainability ("better than conventional")

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Potentials for sustainable development



STRENGTH

promising technology enabling applications that have not been feasible before

WEAKNESS

specifications are unknown even for experts, causing significant sustainability risks

OPPORTUNITY

large lever to realise significant sustainability benefits during ideation

THREAT

missing the moment to engage in necessary discussions, thus losing options for improvement

Possible users of printed electronics need a multi-perspective assessment to evaluate, easy access to pilot lines to prototype, and knowledge transfer to deploy the technology.



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The LEE-BED approach



Innovation Test Bed for development and production of nanomaterials for lightweight embedded electronics

partners



17

services

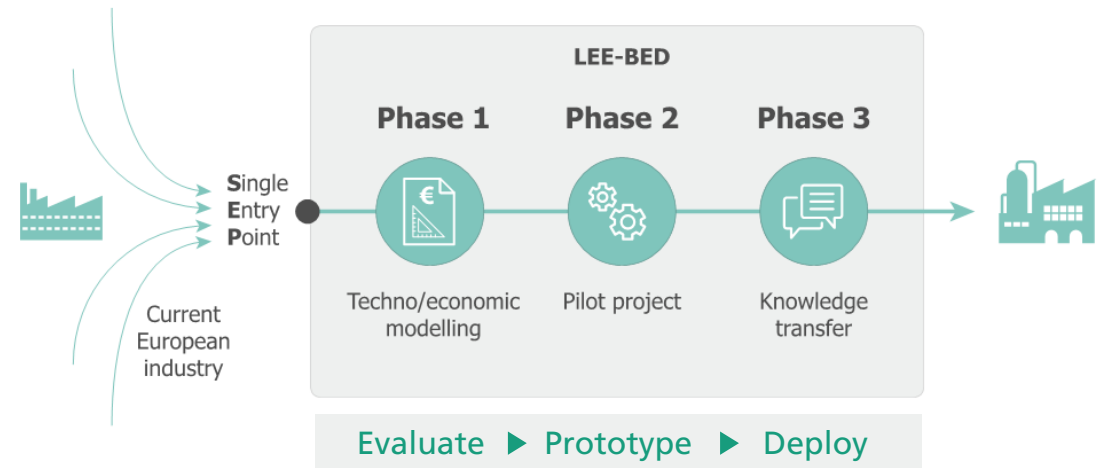


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pilot lines



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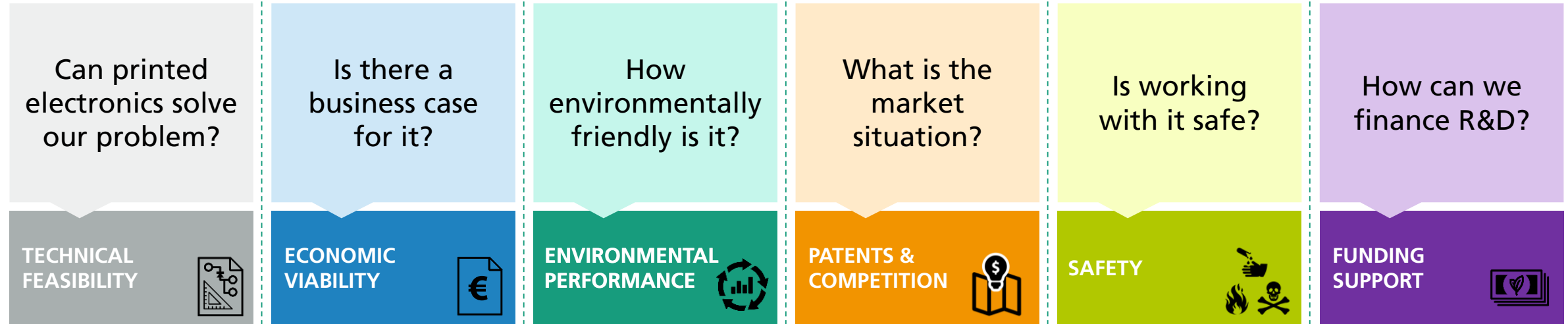


holistic one-stop-shop
for expertise and infrastructure access
within printed and embedded electronics



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Evaluating the sustainability of an idea for printed electronics



Multi-dimensional assessment before start of production is key to sustainable printed electronics

- **Covers the entire value chain:** relevant at any stage of development of printed electronics from nanomaterial to device
- **Suits any previous background:** addressing stakeholders with or without previous involvement with printed electronics
- **Provides high adaptability:** suitable for customers at all sizes from all industries

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Customer journey



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Fostering sustainability for printed electronics

How can an early evaluation be a sustainability enabler?

- Consider sustainability holistically and from the beginning of the ideation phase to avoid later pitfalls
- Avoid the use of resources on a project that does not have a realistic chance of implementation
- Build knowledge and awareness regarding sustainability at potential users of printed electronics



fast fail of unpromising ideas and swift restart of ideation

How can printed electronics be sustainable in general?

- Material selection plays decisive role for overall sustainability per device
- Use-phase should provide benefits for sustainability that outweigh efforts for production & end-of-life
- Use quantitative assessment methods to enable fact-based decisions through comparable results

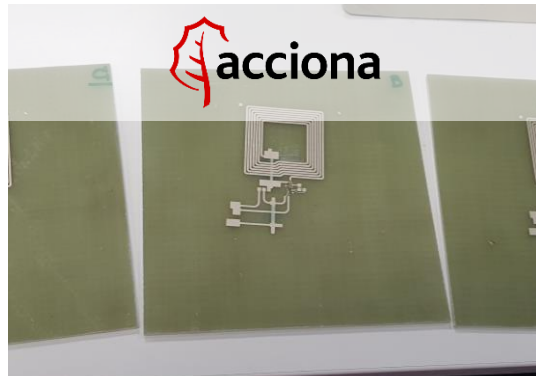


customer-centric assessment of individual use-cases is pivotal



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Successful Phase 1 assessments already led to first industry prototypes



ACCIONA

Construction monitoring

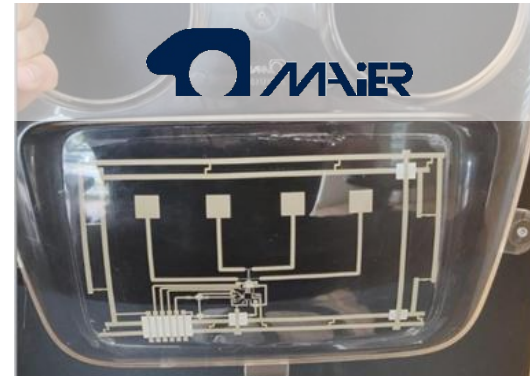
Temperature monitoring and asset tracking functionalities for production sites and buildings



GRAFJETIC

Functionalisation

labels with embedded electronic functionality at as-low-as-possible cost



MAIER

Automotive interior

touch sensors and LED lighting for curved surfaces in the car dashboard



SWAROVSKI

Functional aesthetics

transparent, conductive inks for „invisible circuitry“ underneath crystal elements

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Interested in finding out, if you can benefit from printed electronics?

visit www.lee-bed.com/sign-up



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