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Sustainable and Green Electronics for Circular Economy

Deliverable 5.6

Use case booklet

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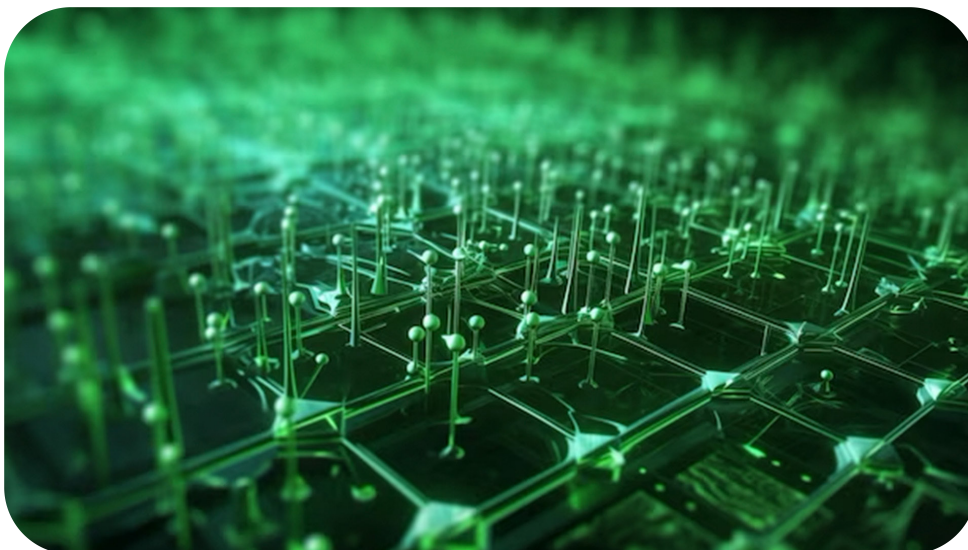
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Use Case Booklet

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Project overview

The main goal of the Sustronics project is to transform the European electronics industry by harnessing the power of sustainable practices and fostering innovation. By combining eco-friendly electronics, increased productivity, and the development of cutting-edge functionalities, the project aims to propel the industry towards a more sustainable and prosperous future. With a strong focus on green technology and novel business opportunities, Sustronics seeks to make a lasting impact on the electronics landscape in Europe.



Objectives

Sustronics' ambition is to become 'the' European flagship project for sustainable electronics by building an ecosystem to demonstrate how the electronics industry can benefit from:

- sustainable materials
- sustainable manufacturing
- eco-design
- energy efficient products
- circular business models

Sustronics brings the whole sector closer to meeting Green Deal objectives while at the same time improving electronics industry's competitiveness and strategic autonomy



Key Performance Indicators

- Achieve 95% production efficiency on sustainable lines.
- Reduce CO₂ emissions and energy consumption for integration by 50%.
- Build around 50 integrated devices in each pilot project in collaboration with users and after their validation.
- Enable the removal of 95% of components for recycling at end of life.
- Develop prototype digital product passports in three pilot projects.
- Engage over 200 external stakeholders and contribute to standard-setting so that the results can be implemented more broadly beyond the consortium.

Use Cases and Pilots

SUSTRONICS designs electronics so that performance, safety, and circularity form a coherent system. The work has been divided into three use cases, each with three pilots.

Use Case I Circular electronic devices

In this use case we will design electronic devices to be compatible with these different strategies while benefiting also from additive manufacturing technologies and bio-based materials. The three pilots will, thus, redesign existing products in line with circularity and sustainability requirements.



Pilot 1.1: Green and circular image guided therapy systems

This pilot aims to reduce the environmental impact of Philips' Azurion systems by reducing energy consumption, reusing parts and better recycling options. At the same time, future designs will become more sustainable by adopting circular-ready requirements in the R&D processes and by making LCA tooling and sustainability data available to incorporate environmental impact in design decisions.



Pilot 1.2: Sustainable system integration and product design of personal health products

By applying Circular Design guidelines, we will develop modular design solutions to facilitate disassembly and repair, extending effective product life cycle, increasing end-of-life disposal opportunities and reuse of materials and modules.



Pilot 1.3: Sustainable luminaire

This pilot will demonstrate how SUSTRONICS technologies and materials can contribute to lowering the ecological footprint of the manufacture of the materials and the light luminaire itself and improve the reparability and recyclability of the final product.



Pilot 1.1 | Description

Green and circular image guided therapy systems

The **Philips Azurion** is an advanced medical imaging system that helps doctors see inside the body in real time during procedures to treat heart problems or remove blockages in blood vessels. It combines X-ray imaging with smart software, so doctors can work more precisely and safely. Overall, it makes complex treatments faster with better outcomes for patients.

Medical equipment has a big effect on the environment. Through the Sustronics project, Philips aims to reduce this impact for its Azurion system by cutting down on the main sources of CO₂ emissions — the energy it uses and the materials it's made from. In this pilot, Philips develops energy saving features and makes new designs of the Azurion system to reduce the amount of material that is required. Philips is also, together with Mirec and Tampere University, improving how new products are developed. By collaboratively developing and embedding special eco-design tools in its development processes future designs can be created more sustainably from the start.

Pilot 1.1 | Partners Involved

Green and circular image guided therapy systems

PHILIPS

MIREC
WORKING FOR THE FUTURE

 **Tampere University**

MIR – MIREC B.V. is a recycling company that works with Philips to make products more sustainable. Together, they've created tools that let **Philips** check how environmentally friendly and recyclable their product designs are. For example, the tools give scores for different eco-design categories, like the ease with which a product can be disassembled, components can be recovered, and recyclability of materials.

TAU – Tampere University – Tampereen Korkeakoulusaatio SR is working with **Philips** to explore new circular business models that support recycling and reuse. While sustainability is important when designing products, companies also need to stay profitable to pay their employees. This research looks for ways to combine both goals – protecting the environment while keeping the business successful.

Pilot 1.1 | Sustainability impact

Green and circular image guided therapy systems

Azurion systems are made up of many parts and use about 2 to 4 kilo Watts of power when running. To save energy, Philips uses both traditional and AI-based methods to find out which parts aren't being used while the system is on, so they can be temporarily switched off. Early estimates show this could save up to **11,265 kWh of electricity each year per Azurion** — about the same as what **three average households in the European Union** use in a year.

To use less material in each Azurion system, Philips is exploring two ideas: reusing metal transport frames and creating a different, lighter design for the C-arc. Together, the two improvements could cut material use by about **860 kilograms**. The new design also takes up **30% less room space** in hospitals and doesn't need such a heavy room structure to support it. Using fewer materials helps lower CO₂ emissions — both because fewer raw materials need to be produced and because lighter systems are easier and more efficient to transport. This particularly makes a difference for transport by air to customers overseas.

Pilot 1.1 | Pictures

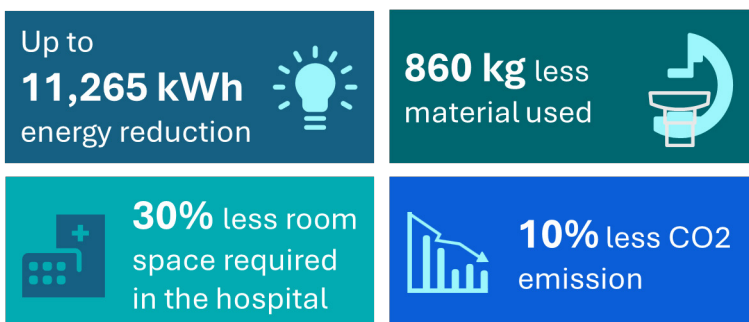
Green and circular image guided therapy systems



Philips Azurion



Transport frames that will be reused in the future.



* The provided numbers are estimations based on an initial analysis and still need to be verified before the SUSTRONICS solutions are released to the market

Yearly sustainability impact of Sustronics per Azurion.



Pilot 1.2 | Description

Sustainable system integration and product design of personal health products

A significant contributor to the impact of **Philips Personal Health** products is the Printed Circuit Board Assembly (PCBA). Therefore Philips Personal Health is focusing on reducing the carbon footprint of the PCBA.

The goal of this Pilot is to explore new technologies for producing more Sustainable PCBAs, and integrate selected solutions into a Grooming and Beauty device. Other key Circular Strategies will be incorporated such as repairability, recyclability and durability.

The Key Activities to achieve this are:

- Improving the Methods to measure PCBA impact.
- Understanding where the key environmental hotspots in a PCBA are located.
- Define New Solutions and test in a small developmental step.
- Develop a New PCBA and Integrate into a device.
- Build Demonstrator Models.

Pilot 1.2 | Partners involved

Sustainable system integration and product design of personal health products



Philips Personal Health collaborates closely with several other partners in the Consortium.

The primary collaboration on New PCBA solutions is with **TNO – Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek**.

To ensure knowledge sharing and alignment on methodology, the **Philips** LCA experts are in close contact with **FHG – Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V** experts. By closely discussing the approaches, ensures that the LCAs coming from respective Partners can be compared and increase our combined learnings.

Lastly, **Philips** collaborates closely with **MIR – MIREC B.V.**. Despite Long Use Life and Repair as important strategies, the device will always reach End of Life. Together; **MIREC B.V.** and other Partners are investigating current recycling PCBAs practices and what Design Rules can be derived.

Pilot 1.2 | Sustainability impact

Sustainable system integration and product design of personal health products

- Preliminary results indicate reduction of PCBA carbon footprint.
- An expected outcome is significant environmental gain on the PCBA sub-parts for which new innovations have been created.
- Some PCBA sub-parts were considered Out of Scope as they cannot be easily redesigned (ie. Integrated Circuits – ICs).
- However it is known that IC's are significant contributor to environmental impact. Use of renewable energy by PCBA Suppliers will result in a significant reduction.

Pilot 1.2 | Pictures

**Sustainable system integration and product design
of personal health products**





Pilot 1.3 | Description

Sustainable luminaire

A luminaire is a complete lighting unit and depending on the application area where the luminaire is used, the specifications of the product can differ.

The goal of the pilot is to design a fully sustainable luminaire, with as low as possible environmental impact as quantified by LCA (Life Cycle Analysis), based on new technologies, materials, and end of life strategies.

The luminaire is based on sustainable LED lighting technology to enable slim designs to reduce materials use. Further, more sustainable materials are explored and applied than in current references. Finally, the luminaire is designed according to the principles of eco-design and has a modular architecture for easy repair, upgrade, or end-of-life dismantling. Dismantling and separation to component level should upgrade the waste streams in which the components and materials can be reused for new luminaires.

This pilot focuses on the main components of a luminaire, viz. the light module, optics, and housing.

Pilot 1.3 | Partners Involved

Sustainable luminaire

UPMRAFLATAC



screen tec

TNO innovation
for life

 **Fraunhofer**

MIREC
WORKING FOR THE FUTURE

THE HOUSING OF THE LUMINAIRE IS 3D-PRINTED. THE MATERIALS USED ARE RENEWABLE, MORE SUSTAINABLE MATERIALS THAT ARE SUPPLIED BY PROJECT PARTNERS **UPM – RAFLATAC OY (WITH IN-KIND PARTNER KCL)** AND **ARNP – AVANTIUM RENEWABLE POLYMERS B.V..**

AS TECHNOLOGY FOR THE LIGHT MODULE, PRINTED ELECTRONICS IS USED. FOR THE PROCESS AS WELL AS THE MATERIALS, THIS PILOT COOPERATES WITH DIFFERENT PARTNERS, VIZ. **VTT – TEKNOLOGIAN TUTKIMUSKESKUS VTT OY, SCR – SCREENTEC OY, TNO – NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK, AND UPM – RAFLATAC OY.**

FOR THE OPTICS, RENEWABLE, MORE SUSTAINABLE MATERIALS ARE USED. IN COOPERATION WITH **VTT** DIFFERENT OPTIONS ARE EXPLORED.

LCA MODELLING IS DONE TOGETHER WITH **FHG – FRAUNHOFER-GESELLSCHAFT ZUR FÖRDERUNG DER ANGEWANDTEN FORSCHUNG E.V..**

FINALLY, ASSESSMENT OF THE DESIGN CIRCULARITY AND RECYCLING PERFORMANCE ARE DONE WITH **MIR – MIREC B.V..**

Pilot 1.3 | Sustainability impact

Sustainable luminaire

For the housing, the focus is on more environmentally friendly materials and manufacturing methods. The housing is made by an additive manufacturing technique (3D printing) and different bio-based materials are investigated. Tests on material properties and design optimization are done to understand the suitability impact of the bio-based materials for a luminaire housing. Issues, like e.g. transparency, are solved by changing the material properties and improving the design. Additionally, the options of an integrated light source and reflector are investigated.

Also for the light module an additive manufacturing technique is used: printed electronics. This results in lower material and energy use during manufacturing. For the light module different designs, substrate materials, and conducting inks are investigated. Examples of more sustainable substrate materials are paper, cardboard, and recycled PET. Here, the most optimal choices are made considering design properties, using the most sustainable materials, and performance.

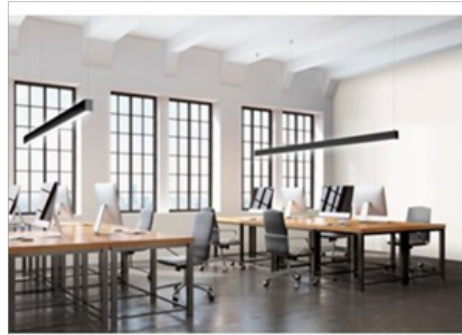
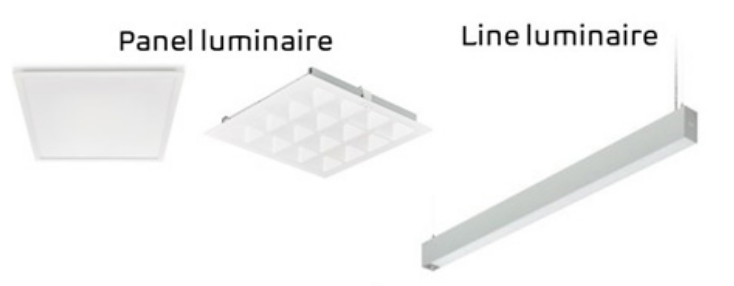
For the optics, bio-based materials are used instead of a fossil-based plastic diffuser. The challenge is to combine the highest transmission with good scattering properties: as much light as possible should be transmitted but the individual LED sources must not be visible. For both the up and the down light the optimal combination of properties is realized for the final demonstrator.

The luminaire is designed according to the principles of eco-design. Circular design principles, like modularity, single material components and reversible connections, are considered. For example, for incorporating the light modules and optics into the housing, no screws or glue are used. These choices contribute to improved repair and recycling options.

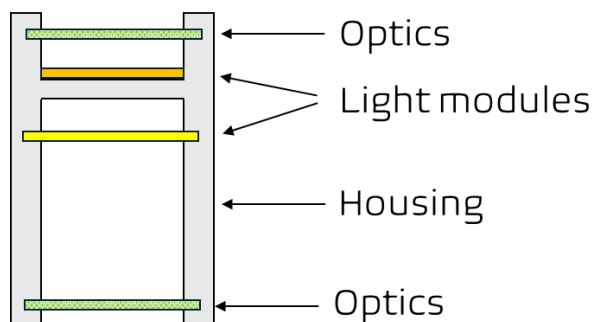
In the LCA modelling, the different options regarding housing, light module, and optics are studied and analysis is done for different impact categories, like climate change, mineral resource use, fossil resource depletion, and water use. It can be concluded that compared to the reference luminaire, all Sustronics versions show an improvement.

Pilot 1.3 | Pictures

Sustainable luminaire

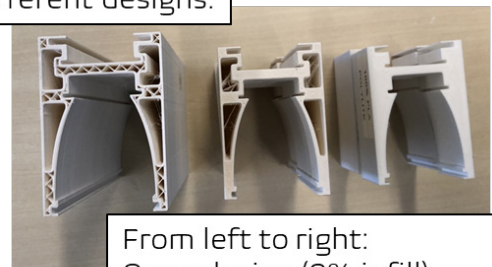


Examples of luminaires and their application areas



Simplified schematic drawing of the luminaire architecture

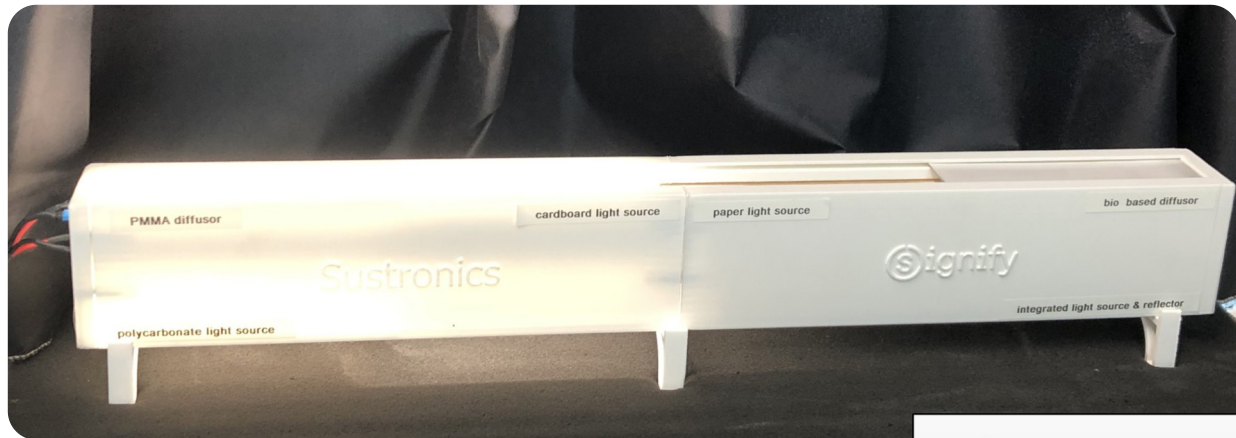
Different designs:



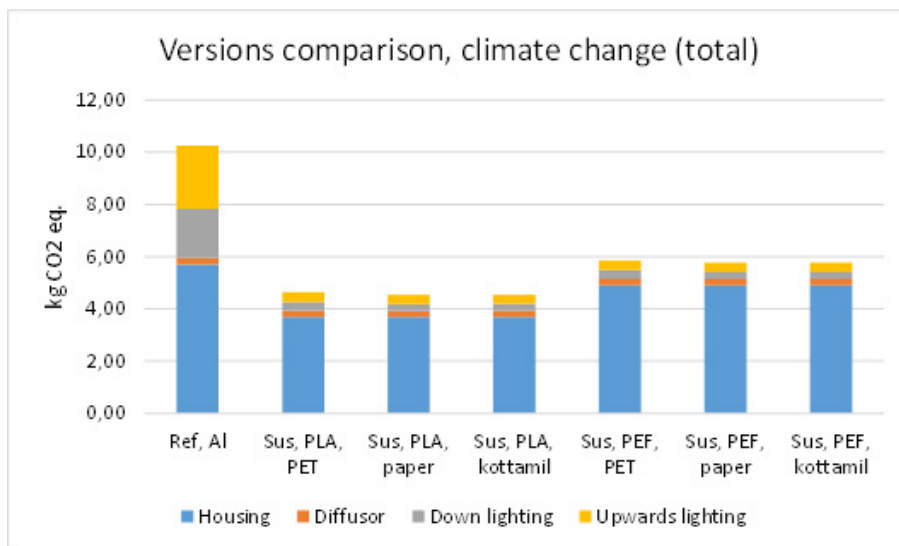
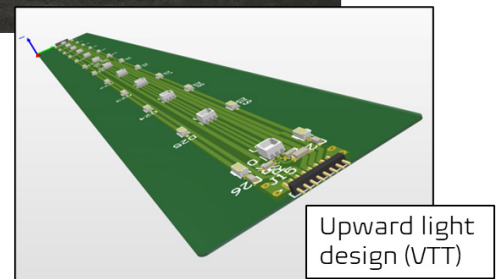
From left to right:
Open design (0% infill)
Partly filled design (10% infill)
Fully filled design (100% infill)

Pilot 1.3 | Pictures

Sustainable luminaire



Gen 2 demonstrator



Results of LCA modelling for Gen 2 (cradle to gate):
impact category climate change

Use Case II

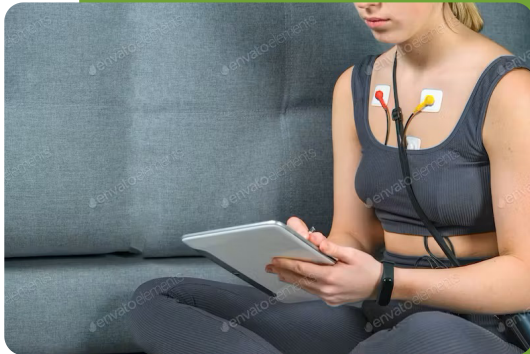
Sustainable manufacturing for electronics

In this use case we will develop different approaches for decreasing environmental footprint as well as specifying new end of life management routes. The pilots are transforming existing electronic products (wearables, automotive) into environmentally friendly alternatives while maintaining the device functionality, specifically focusing on utilization of bio-based materials together with sustainable manufacturing concepts.



Pilot 2.1: Embedded electronics for EEG monitoring

Development of integrated wearable products with needed electronics in more efficient and sustainable ways for monitoring EEG. To reduce waste and increase functionality of the product / system by utilizing eco - / circular design, bio-based materials, and sustainable manufacturing.



Pilot 2.2: Wearable health monitoring

This initiative aims to enhance the sustainability of single-use wearable health monitoring devices. It involves establishing lifecycle design practices, exploring eco-friendly materials (such as replacing silver with copper or carbon, and PET with paper), and designing connector-free electrodes for streamlined production.



Pilot 2.3: Sustainable dashboard for automotive

The pilot introduces an advanced automotive dashboard that merges environmental sustainability and digital innovation. Through the integration of In-Mold Electronics technology, bio-based polycarbonate films, and alternative materials, it enhances user experience while adhering to green and circular design principles.



Pilot 2.1 | Description

Embedded electronics for EEG monitoring

This pilot is developing a next-generation EEG monitoring system that combines embedded electronics with sustainable design principles. Our goals are to lower the environmental footprint of medical devices while preserving—or even improving—signal quality and clinical performance.

- **Eco-friendly sensing hardware:** Screenshot supplies recyclable, printed EEG electrodes, and PIEP is prototyping a fully printed electronic EEG sensor that further reduces materials and waste.
- **Energy-efficient electronics:** Low-power circuitry will be integrated directly with the electrodes, cutting cabling and overall energy consumption.
- **Quantified sustainability:** VTT performs Life-Cycle Assessment (LCA) at every stage, ensuring that material choices, manufacturing, and device operation meet ambitious sustainability targets.

Together, these activities will deliver a high-performance EEG solution that is more environmentally friendly and easier to deploy in modern healthcare settings.

Pilot 2.1 | Partners Involved

Embedded electronics for EEG monitoring



PLUX – Wireless Biosignals S.A. — lead testing and benchmarking the new electrodes developed by **Screentec** with biosignalsplux hub and EEG sensor, validating its performance versus the clinical electrodes that **PLUX** already use in their devices.

SCR – Screentec Oy — eco-friendly electrode design and prototyping. The goal is to develop a recycling and greener electrode with the same performance as the gold standard used by **PLUX**.

PIEP – Associação Polo de Inovação Engenharia de Polímeros — low-power EEG sensor using LDS printed electronics. The goal is to build a more eco-friendly EEG sensor with printed electronics, with a one-layer PCB, and with the same performance as the gold standard of **PLUX** EEG sensors

VTT – Teknologian Tutkimuskeskus VTT Oy — Life-Cycle Assessment (LCA) and Digital Product Passport (DPP). They are responsible for developing the LCA and DPP for the new products that will come from this pilot, the eco-friendly electrode by **Screentec**, and a greener EEG sensor by **PIEP** (this sensor is not in the initial proposal; it's a plus)

Pilot 2.1 | Sustainability impact

Embedded electronics for EEG monitoring

- **The electrode sample 126W tested is pilot-ready**, and it is made with Paper with Cu + Conductive skin adhesive .
- Paper used as a substrate alternative for electrodes, together with a paper liner, accounts for more than **50% of the materials** used in the electrode, so we **achieved the target** of a share of bio-based materials up to 50%.
- Lower environmental footprint with **less than 30%** compared to the reference/baseline.
- **Reusability of the sensor part was achieved**; to decrease electronic waste, the only product disposable is the electrode after being used on the human skin.
- **LCA at each stage** plus a **DPP** to quantify and track impact.

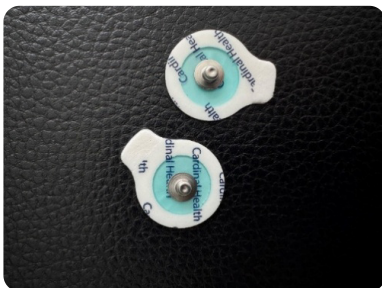
Pilot 2.1 | Pictures

Embedded electronics for EEG monitoring



We tested 3 sample electrodes:

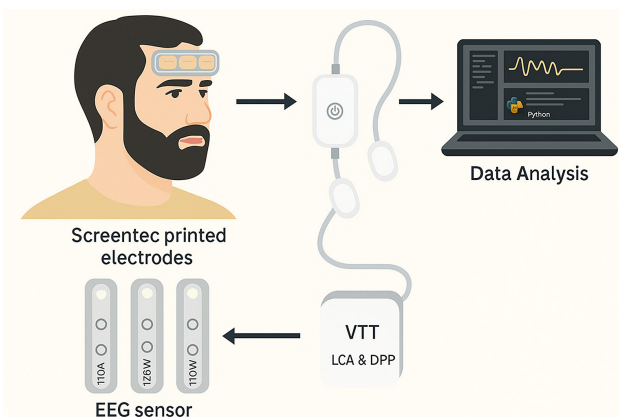
- 110A (PET + hydrogel)
 - 110W (PET + conductive adhesive)
 - **126W (Paper + Cu + conductive adhesive)**
- pilot ready

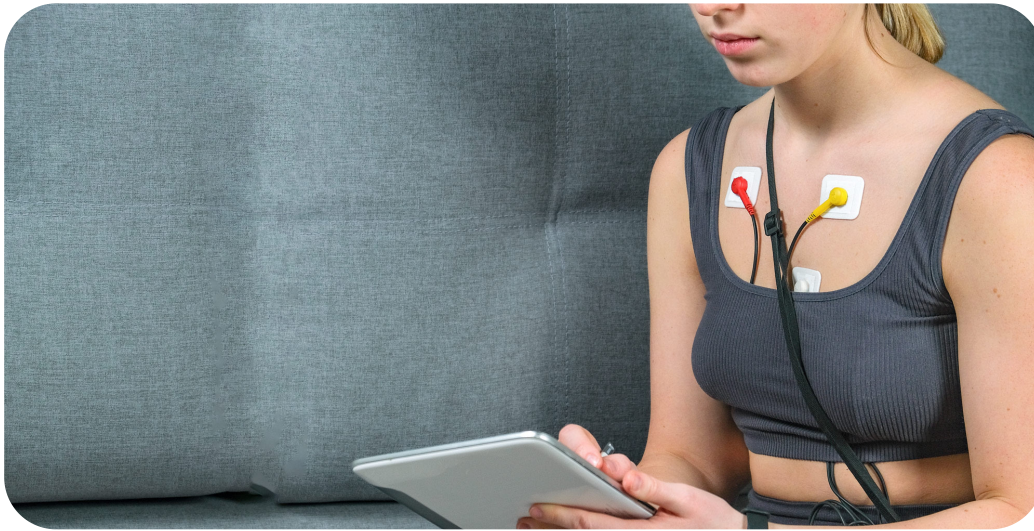


Gold Standard:

CardinalHealth™ hydrogel electrodes
from Kendall™

Testing with the Gold standard using the biosignals plux EEG sensor with an 8-channel hub





Pilot 2.2 | Description

Wearable health monitoring

On pilot 2.2 the goal is to develop more sustainable single-use electrode patches for biosignal measurements. Use of this kind of electrodes is increasing in the healthcare sector especially when moving more to patient care at homes. Currently electrodes are made using fossil-based plastics and conductive silver tracks. By replacing these materials with more sustainable materials like paper, carbon and copper it is possible to reduce the environmental burden caused by these electrodes.

In addition to single-use electrodes also multi-use electrodes will be tested, studied and developed to find out their sustainability in comparison to the developed single-use electrodes.

Pilot 2.2 | Partners Involved

Wearable health monitoring

TERVAKOSKI

UPMRAFLATAC



screen tec



MOVESENSE

TER - Tervakoski Oy and **UPM Raflatac Oy** are providing more sustainable substrate base materials and information of material processability and availability for electrodes developed. **SCR - Screentec Oy** is doing manufacturing of the developed electrodes for biosignal measurements and gathering information of printability and processability of tested substrate and paste materials.

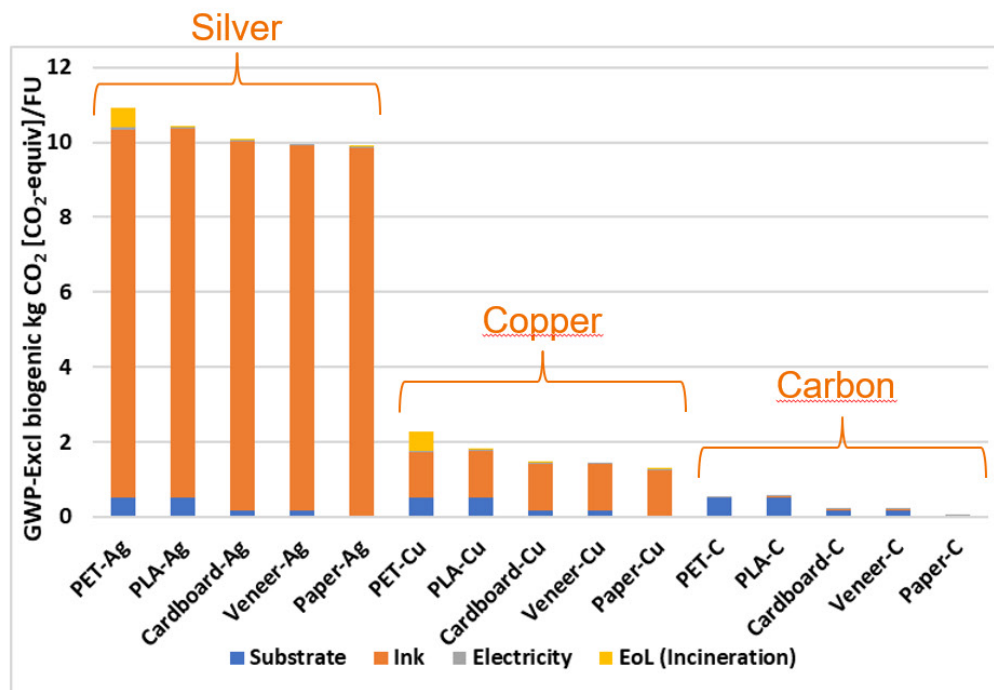
TAU - Tampere University - Tampereen Korkeakoulusaatio SR is making electromechanical testing for the printing samples made out of different materials. With these tests it can be verified their suitability for conductive structures and also suitability of using different materials together. **VTT - Teknologian Tutkimuskeskus VTT Oy** is doing characterization of printed samples and preparing the LCA calculations for the used materials.

EDI - Elektronikas un Datorzinatnu Instituts is developing electronics for bioimpedance measurements and makes functionality tests with electrodes for bioimpedance measurements to compare reference electrodes with developed electrodes. **MOV - Movesense Oy** is similar testing with ECG measurement.

Pilot 2.2 | Sustainability impact

Wearable health monitoring

Based on studies made before the project it is possible to reduce the Global Warmth Potential of printed electronics and medical electrodes if the substrate used is changed from PET to paper and conductive paste from Silver to Copper or Carbon. By developing these more sustainable electrodes for biosignal measurements it is possible to reduce the burden what they are causing to the environment and also making them better available to users around the world due cheaper price.



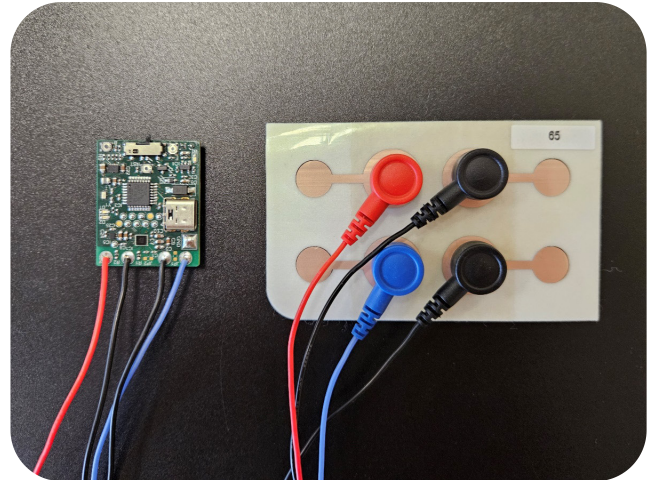
Comparison of Global Warmth Potential caused by electrodes made with different material combinations.

Pilot 2.2 | Pictures

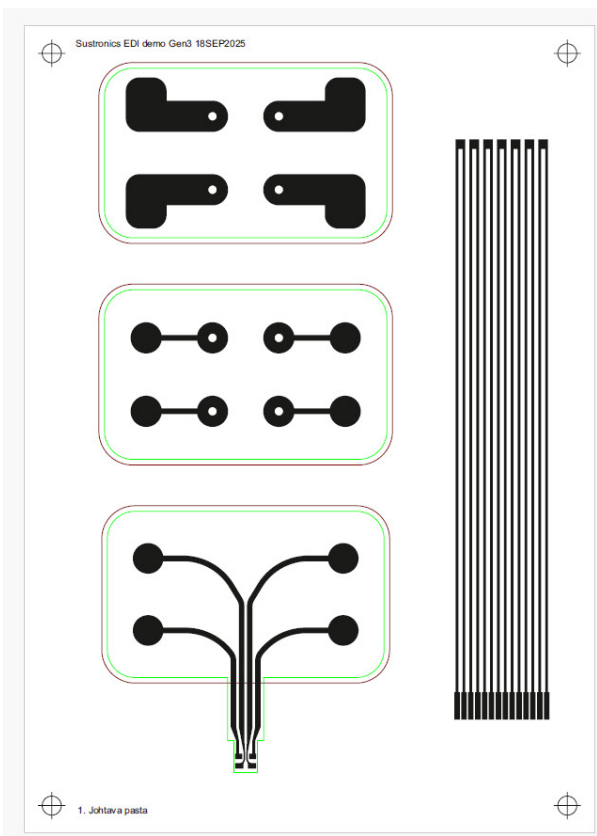
Wearable health monitoring



Generation 2 Movesense electrodes developed in the Sustronics project



Generation 2 EDI electrodes developed in the Sustronics project



Design for Generation 3 EDI electrodes developed in the Sustronics project



Pilot 2.3 | Description

Sustainable dashboard for automotive

The pilot 2.3 is an innovative automotive dashboard offering a more comfortable and pleasant user experience for drivers, while answering the need for a green and circular approach.

This dashboard will be based on the combination of In-Mold Electronics as an alternative to conventional Printed Circuit Boards (PCBs) and bio-based substrates. Ways to improve end of life of the device are also explored (components disassembly and material recovery).

The dashboard has two specific areas :

- Left side is a dynamic lighting composed of various Surface Mounted Devices (SMDs), a microcontroller to drive the LEDs (Light-Emitting Diodes) and 8 color changing lamps called RGB LEDs.
- Right side is an active command with one capacitive back lighted slider on the top and 3 capacitive backlighted buttons below. 2 RGB LEDs per button and 4 RGB LEDs are reported on this part of technical film together with a microcontroller, resistors and capacitors.



Pilot 2.3 | Partners Involved

Sustainable dashboard for automotive



FORVIA provides specifications and requirements for the automotive control panel, as well as specifications of materials regarding their optical, mechanical and thermal properties. **FORVIA** is also in charge of product qualification regarding the automotive field, including environmental and mechanical tests.

CEA - Commissariat à l'Energie Atomique et aux Energies Alternatives is responsible for preliminary validation of commercial materials and materials developed in the project (printing and resolution, electrical validation). **CEA** will perform the characterization and validation tests at film level.

SYM - Symbiose designed the building blocks of the device (decorative and technical foils, thermoforming and injection tools) and is responsible for all the integration steps (printing, thermoforming, pick and place of SMDs and assembly by injection on the building blocks), of previously validated materials in the demonstrator. **CEA** and **SYMBIOSE** work closely together. **SYMBIOSE** has also designed the PCB board that drives the demonstrator.

VTT - Teknologian Tutkimuskeskus VTT Oy provides substrate material and is also in charge of the Life Cycle Assessment of our Pilot.

ARNP - Avantium Renewable Polymers BV will provide sustainable material (PEF = PolyEthylene Furanoate) for substrates and pellets for injection.

RISE - Research Institutes of Sweden AB will provide conductive and non-conductive adhesives and methods for forming interconnects.

Finally, **MIR - MIREC B.V.** will intervene for recycling and re-use of materials, components or system parts.

Pilot 2.3 | Sustainability impact

Sustainable dashboard for automotive

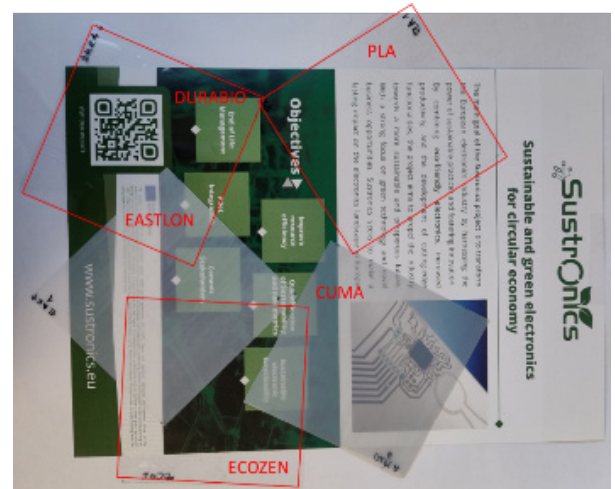
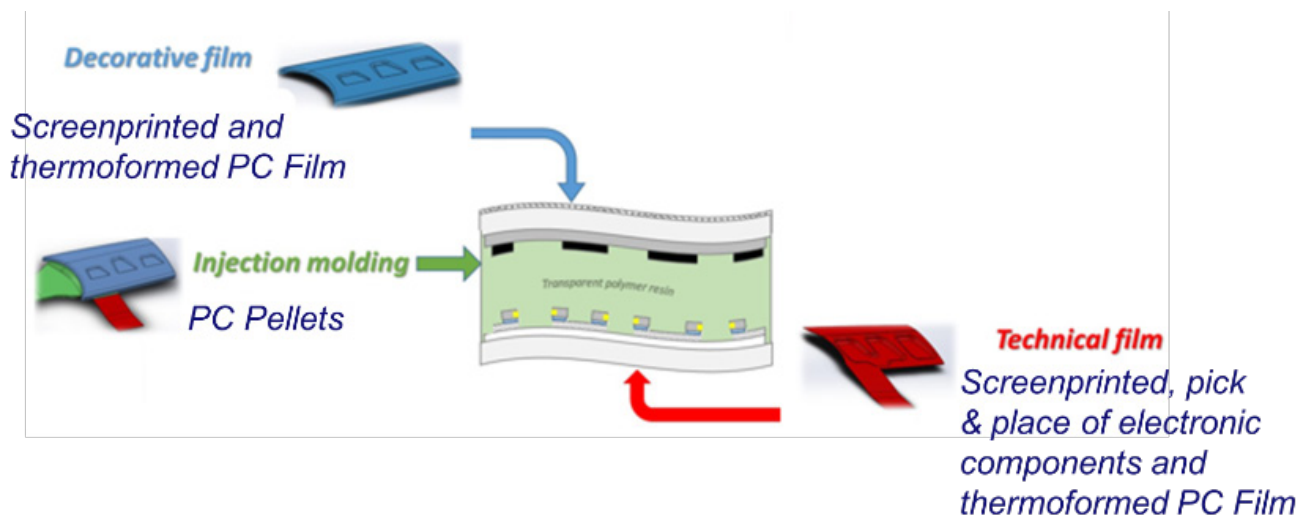
The Life Cycle Assessment on the Dashboard reveals that replacing the polycarbonate used in current products has the greatest environmental impact. That's why, to reduce environmental impact, we choose bio-based materials to substitute the standard polycarbonate used in both technical and decorative films, as well as in the injection molding

Our Dashboard will use up to 50% bio-based materials. These include alternatives to conventional polycarbonate, offering high thermal resistance, excellent optical clarity, and strong mechanical properties. Structural and conductive adhesives will also be optimized for shear resistance.

On the product side, the control panel will achieve up to 50% weight reduction and up to 50% lower energy consumption during manufacturing — while maintaining the same performance.

Pilot 2.3 | Pictures

Sustainable dashboard for automotive



Pilot 2.3 | Pictures

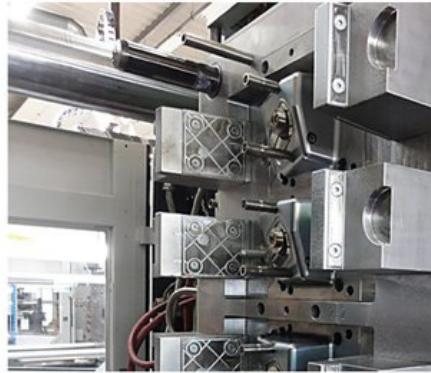
Sustainable dashboard for automotive

Injection Molding

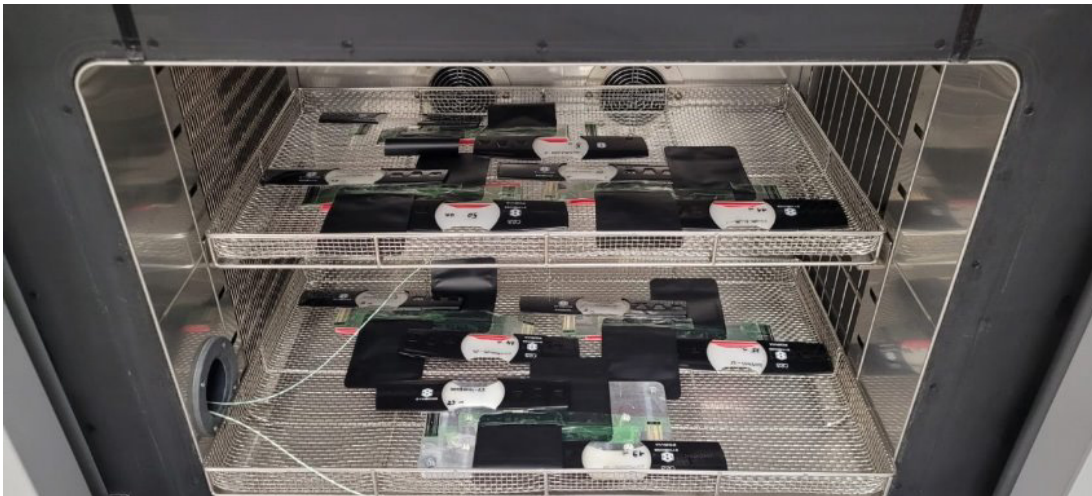
Decorative Foil Injected Plastic



Electronic Foil



Plastic Injection Tool



Use Case III

Environmentally compatible single-use electronics

In this use case, we will integrate pilots in healthcare areas towards reducing waste, shortening therapy time and improving patient quality of life. The three pilots represent innovative new products for diagnostics purposes also from a technical perspective. In this sector specifically, new sustainable technologies will offer sustainability benefits such as no need for separate dedicated readout device when using already available infrastructure of smartphones. This has all the capabilities to replace bulky and expensive laboratory equipment.



Pilot 3.1: Single-use diagnostic platform

This project aims to deliver a novel solution for home testing of glucose metabolism that is both environmentally superior to the current state-of-the-art and provides an extended view of glucose metabolism.



Pilot 3.2: Smart hygiene

This pilot involves the integration of a sensor system into an incontinence product, aiming to enhance healthcare quality and reduce costs. The sensor measures temperature, humidity, and enzymes. It comprises wireless connectivity to cloud services via a base station, providing data insights through AI algorithms to users' smartphones.



Pilot 3.3: Smart wound dressing

The pilot project focuses on creating an innovative solution by integrating a sensor label into dressing materials. This label will be used to measure critical wound parameters such as temperature, pH and relevant biomarkers. The aim is to enhance patient comfort while simultaneously reducing healthcare costs.



Pilot 3.1a | Description

Single-use diagnostic platform

We are developing a novel solution for at-home metabolism testing that aims to provide environmental superiority over current methods and offer an extended view of the metabolism for at-risk patients (pregnant women, elderly and patients with metabolic disorders). Our focus is on using c-peptide and creatinine to develop an easy-to-use disposable point-of-care device that connects to a smartphone app for patient biomarker monitoring. Ratio of c-peptide and creatinine levels in urine provides valuable information on patients metabolism, e.g early detection of pre-diabetes.

The sensor principle is based on lateral flow, well known to the user from Covid-19 antigen or pregnancy tests. Here, quantitative read-out is enabled by electrochemical biomarker detection and a highly integrated microchip. Maximum sustainability of this single-use device is achieved by integration of the newly developed components and materials within Sustronics.

Pilot 3.1a | Partners Involved

Single-use diagnostic platform



- **IFAT – Infineon Technologies Austria AG:** Microchip and firmware development, layout design and pilot lead
- **URV – Universitat Rovira i Virgili:** Bio-electrochemical lateral flow assay
- **CSEM – Centre Suisse d'Electronique et de Microtechnique SA:** Design of electrical layout, incl. NFC (near –field communication) antenna, and 3D housing
- **TER – Tervakoski Oy:** Paper substrate and paper-based alternative for nitrocellulose
- **SCR – Screentec Oy:** Screen-printing
- **VTT – Teknologian Tutkimuskeskus VTT Oy:** Assembly of components, chip bonding, lateral flow integrated in paper substrate
- **TAU – Tampere University – Tampereen Korkeakoulusaatio SR:** Development of supercaps
- **CAN – Canatu Oy:** Carbon nanotube films for electrode functionalization
- **CSIC – Agencia Estatal Consejo Superior de Investigaciones Cientificas:** Screen printed electrodes on lateral flow strip
- **CBM – CBMed GmbH:** Bio-electrochemical lateral flow assay, preparation and analysis of clinical data
- **MEDUG – Medizinische Universität Graz:** Bio-electrochemical lateral flow assay, clinical tests, preparation and analysis of clinical data
- **STS – SteadySense GmbH:** Custom app software for smartphones and dashboard
- **FHG – Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V.:** Life-Cycle Assessment

Pilot 3.1a | Sustainability impact

Single-use diagnostic platform

The Point-of-Care (PoC) diagnostic device enables for the first time at-home testing of the urinary c-peptide and creatinine ratio (UCPCR). That brings social and environmental benefits, including:

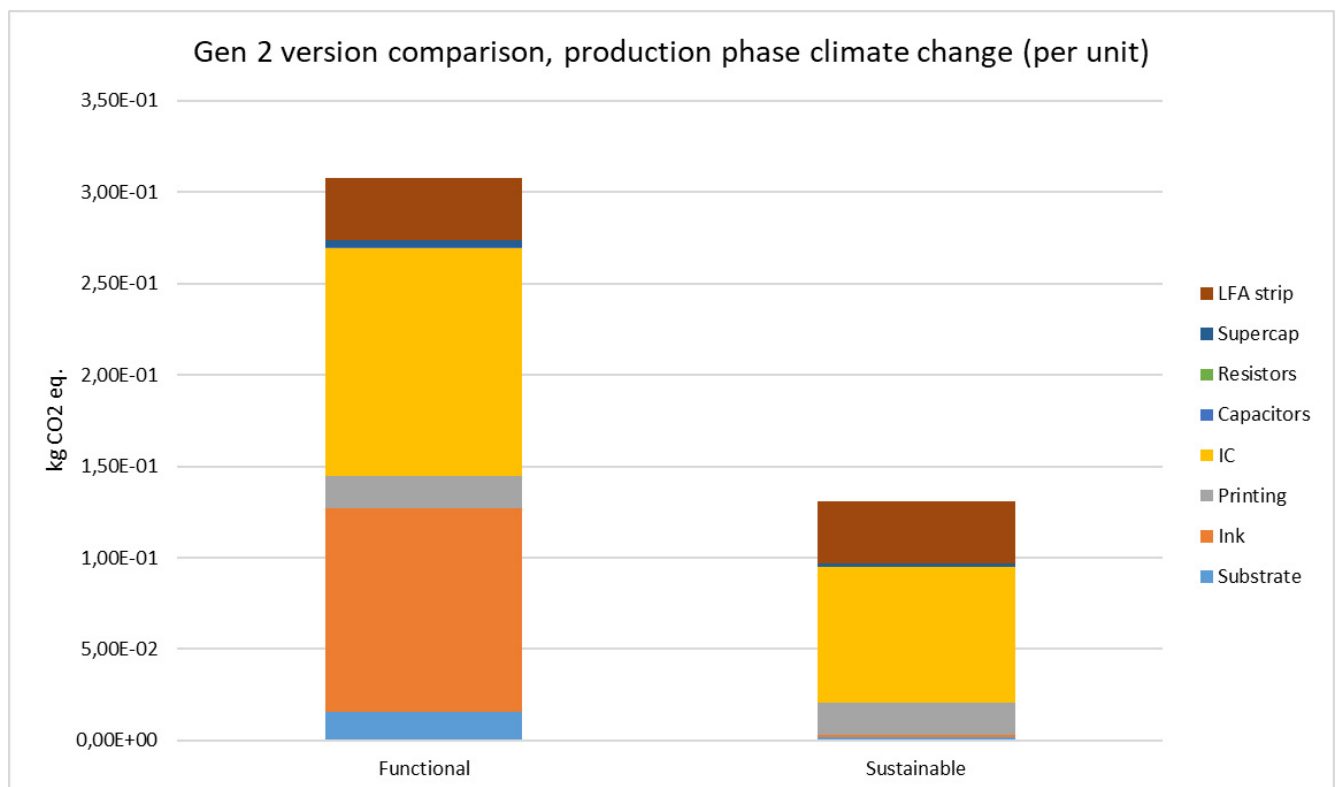
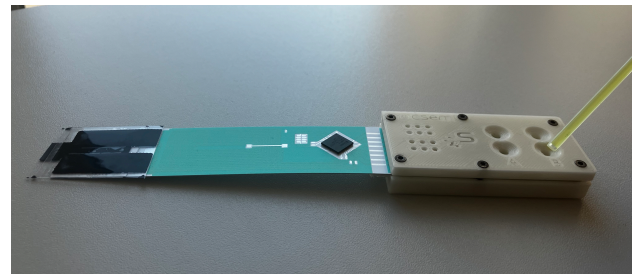
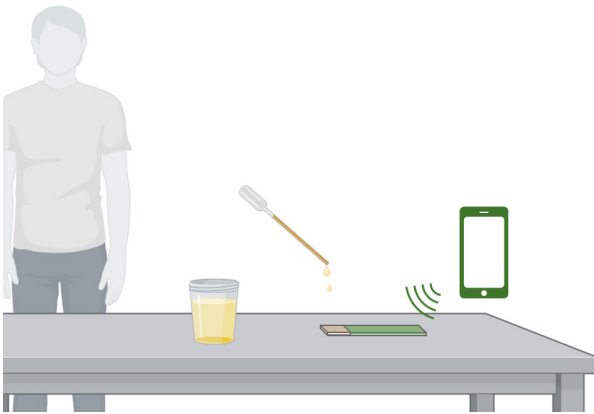
- Better access to healthcare, frequent monitoring helps prevention of metabolic disorders
- Independence on medical standards or clinical settings
- Less commute necessary
- Decrease costs

In the final PoC diagnostic device, sustainable components are used significantly reduce the kg CO₂ equivalents compared to traditional materials.

- Paper-based substrate
- Cu-ink instead of Ag-ink for printed electronics
- Minimal number of electronic components: Highly-integrated system-on-chip that is assembled as bare die (without packaging)
- Reuse of existing infrastructure (smartphone)
- Supercaps using more sustainable materials (e.g. electrolytes)
- Paper-based alternatives for nitrocellulose in the lateral flow strip

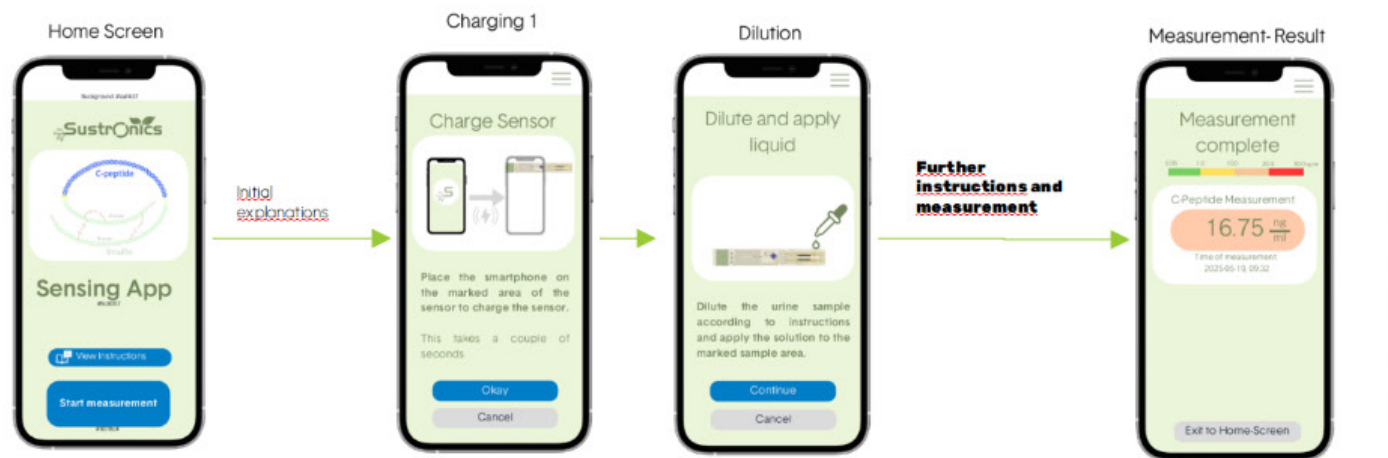
Pilot 3.1.a | Pictures

Single-use diagnostic platform



Pilot 3.1.a | Pictures

Single-use diagnostic platform



Screenshots from the dedicated smartphone app



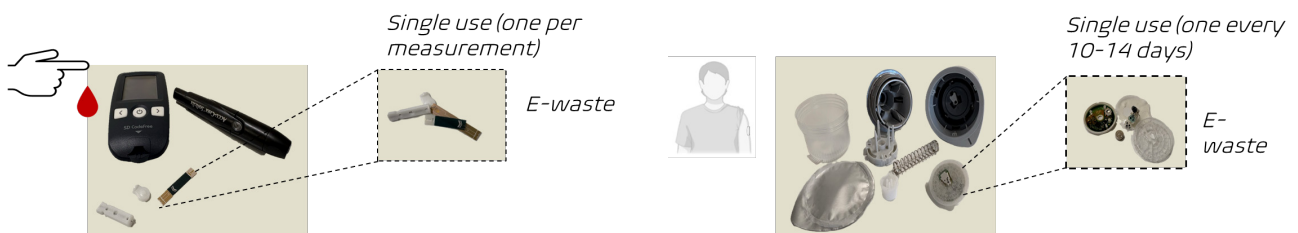
Parts were generated with AI

Pilot 3.1b | Description

Single-use diagnostic platform

Effective diabetes management heavily relies on monitoring blood glucose levels to adjust medication, diet, and lifestyle accordingly. Currently, various solutions are available in the market.

Our innovative device redefines diabetes management by utilizing continuous glucose monitoring from sweat, eliminating the need for single-use strips and minimizing consumable material waste like the one in CGM.



State-of-the-art glucose monitoring have a short lifetime and strongly contribute to e-waste generation.

- **Eco-Friendly Design:** A simplified consumable part significantly reduces material use, helping to tackle the 80% of device waste that ends up in landfills.
- **Multi-Bioparameter Monitoring:** Beyond glucose, the device tracks key health parameters like pulse rate, providing a more comprehensive health overview.
- **Lifestyle Integration:** The companion App delivers personalized lifestyle recommendations, empowering users to make informed decisions for improved health outcomes.

Pilot 3.1b | Partners Involved

Single-use diagnostic platform



Fraunhofer

SIGMA • COGNITION

(consumable)

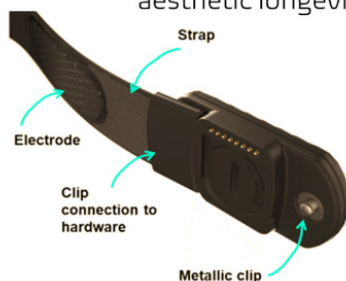
**Smart Sweat
Collector
Patch**



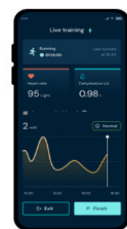
| onalabs)



(durable) designed to focus on
aesthetic longevity



CONNECTIVITY 
| onalabs)



FIRMWARE



App



AI



| onalabs)

SIGMA • COGNITION



Fraunhofer

Pilot 3.1b | Sustainability impact

Single-use diagnostic platform

1. Sustainable Materials & Manufacturing

- The new Smart Skin Patch is designed to cut single-use environmental footprint dramatically.
- Use of greener materials to lower carbon emissions, reduce resource use, and make production cleaner and more efficient.
- Future versions will use fewer materials and simpler manufacturing, further reducing waste and energy needs.

2. Environmentally Friendly End-of-Life

- Because the patch uses sweat (a non-biohazardous sample), it doesn't need to be burned like most medical devices.
- Parts can be separated for recycling or reuse, and users will get clear disposal guidance to minimize waste.

3. Long-Term & System-Level Benefits

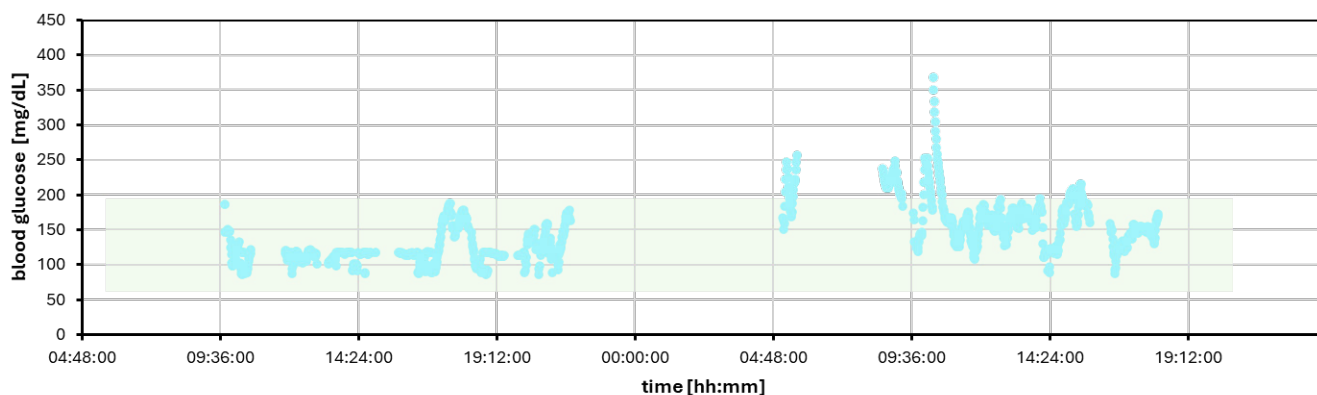
- The patch's use with AI-driven insights will help patients monitor their health more effectively, reducing hospital visits and preventing complications.
- This means fewer medical treatments, less travel, and lower overall emissions related to diabetes care.
- In the long run, the technology supports a more sustainable healthcare system by improving well-being while reducing environmental impact.

Pilot 3.1.b | Pictures

Single-use diagnostic platform



- **150 minutes** of weekly physical activity
- **healthy diet** (low in sugar and saturated fat)
- **healthy body weight**
- **monitoring** glucose levels
- **appropriate medicines**
- **Insuline** injections





Pilot 3.2 | Description

Smart hygiene

This pilot project introduces a new smart sensor label for use in incontinence products such as Essity's TENA products. It's designed to improve comfort for users and help caregivers provide better, more efficient care.

The label includes tiny sensors that can detect moisture, temperature, pH and enzyme activity. These sensors indicate when to change the incontinence product. The sensor label is connected to a small reusable device that collects this information which is wirelessly transmitted to a phone or computer. Using smart technology and artificial intelligence, the system analyses the data and gives helpful advice through an easy-to-use app. Using this, the caregivers are well informed as to when it might be time to change a product—helping avoid discomfort for the user and reducing waste.

This early version of the Smart Hygiene sensor system is a step toward more sustainable and smarter healthcare. By attaching directly to incontinence products, it helps ensure timely care and better use of resources.

Pilot 3.2 | Partners Involved

Smart hygiene



A wide team of partners is working together to bring the Smart Hygiene sensor system to life. Each partner contributes something unique:

TER - Tervakoski Oy provides the base material made of paper onto which **UPM - Raflatac Oy** applies special adhesives to enable sticking this label in the incontinence product. Printed temperature and humidity sensors are provided by **RISE - Research Institutes of Sweden AB**, **ACC - Accensors GmbH** provides the pH sensor, and **UGOT - Göteborgs Universitet** developed a new enzyme sensor. These sensors are controlled with a microchip from **IFAT - Infineon Technologies Austria AG**. The sensor labels are designed and manufactured at lab scale by **RISE**. **BEN - Beneli AB** and **VTT - Teknologian Tutkimuskeskus VTT Oy** are making these labels at larger volumes using advanced roll-to-roll manufacturing.

Several teams such as **CSEM - Centre Suisse d'Electronique et de Microtechnique SA**, **GUT - Politechnika Gdanska**, **SWA - Swiss Vault Systems GmbH**, **HTEC Group** and **LWE - LearningWell East** are focused on how the device reads, stores and sends data, including designing the app and making sure everything works smoothly together. Others like **ESS - Essity Hygiene and Health AB** are working on the outer materials that protect the label and testing new versions.

Finally, **FHG - Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V.**, is studying the environmental impact of different sensor system concepts. This information is utilized in the development to make sure that the developed pilots become sustainable.

Together, these partners are combining science, technology, and care to create a smart, helpful, and eco-friendly solution for better incontinence care.

Pilot 3.2 | Sustainability impact

Smart hygiene

Understanding the Environmental Impact of the Smart Hygiene sensor label system

As part of improving the next generation Smart Hygiene sensor label experts have looked closely at how the product affects the environment throughout its entire life—from production to use and disposal. Two different design options are being compared that show how each one impacts climate change over a typical month of use.

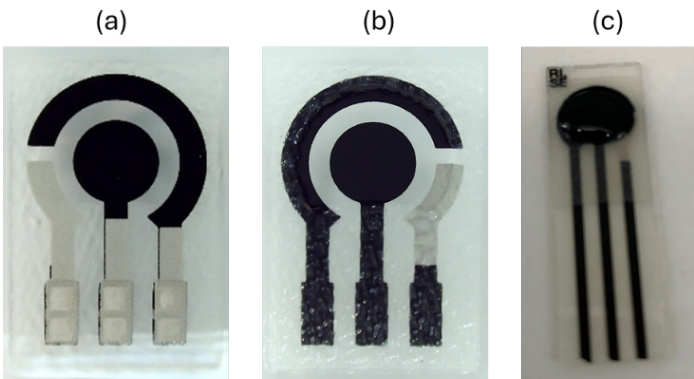
Here are the key takeaways:

Making the device has the biggest environmental impact. This means that how the product is designed plays a major role in how eco-friendly it is. In the first version (Gen 1), the sensor label was thrown away after use—up to four times a day. This led to a new idea: making the design more modular, so fewer parts are disposable. Even with improvements, the part that gets thrown away still causes most of the emissions. One of the new designs (Gen 2b) has more electronics in the disposable part, which increases its environmental footprint. This could be improved by using printed parts (like antenna coils) or choosing more eco-friendly electronic components. Although not the biggest issue, replacing silver-based inks with greener alternatives could also help. The material used for the label itself doesn't have a huge impact, but choosing recyclable materials—especially for the disposable parts—could make the product more sustainable in the long run.

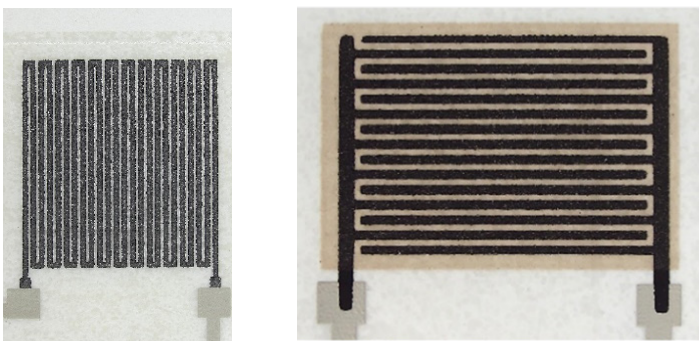
In short, smart design choices—especially around what gets thrown away—can make a big difference in reducing the environmental impact of this helpful healthcare technology.

Pilot 3.2 | Pictures

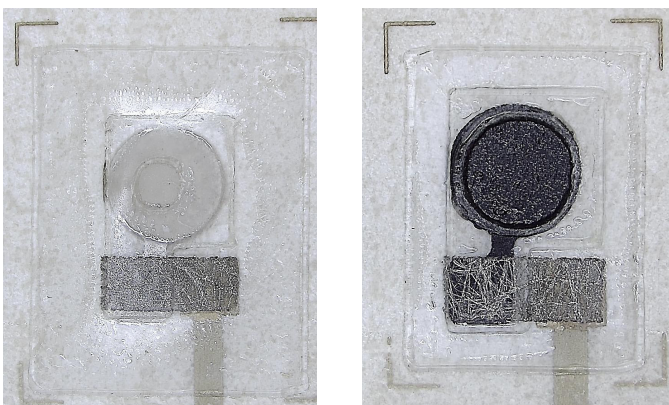
Smart hygiene



Enzyme sensor



Temperature (L) and Humidity (R) sensor



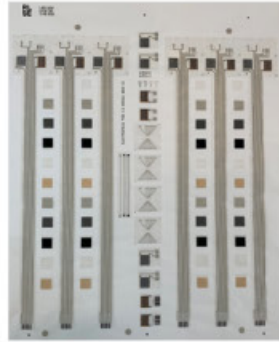
pH sensor

Pilot 3.2 | Pictures

Smart hygiene



Humidity sensor ink

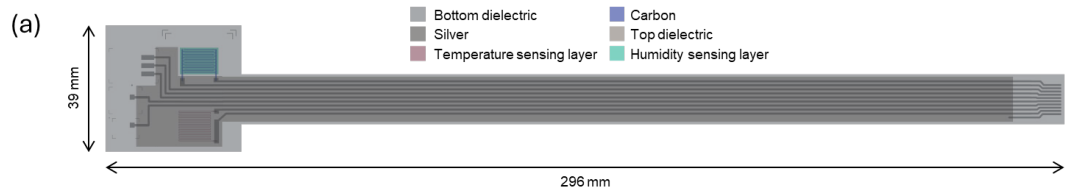


Screen printed on sheet

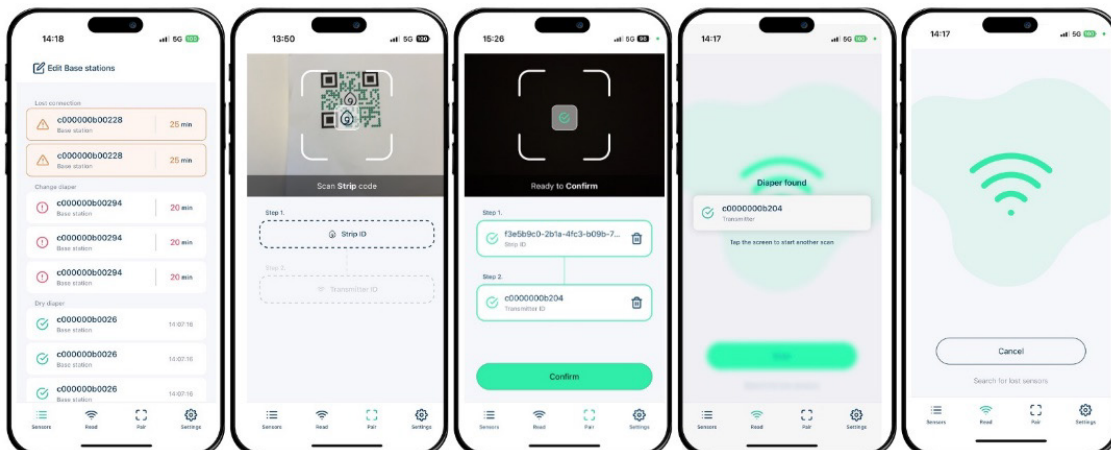
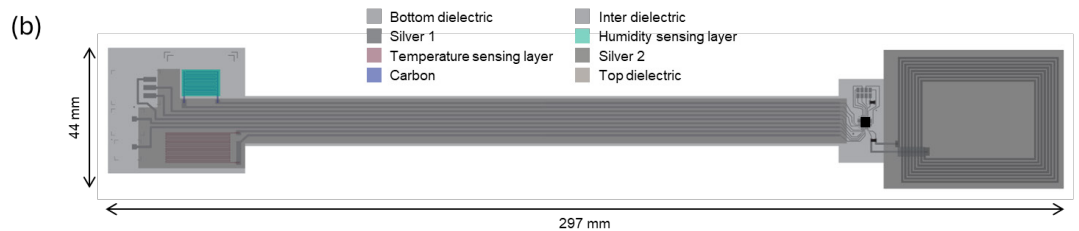


Printed on roll

Gen 2 (a)



Gen 2 (b)



Mobile app



Pilot 3.3 | Description

Smart wound dressing

Smart sensing patch for wound care integrated in the dressing material that measure the temperature, pH and/or other biomarkers for infection. This will increase the comfort for the patient, reduce medical waste and decrease the cost for health care. Sustainability benefits proven and optimized based on conducted life-cycle-assessment (LCA).

The innovation work is distributed into Building Blocks:

ASIC – sensors – energy management – Communication – Algorithms / data processing – Materials / Sustainability – System integration – Application.

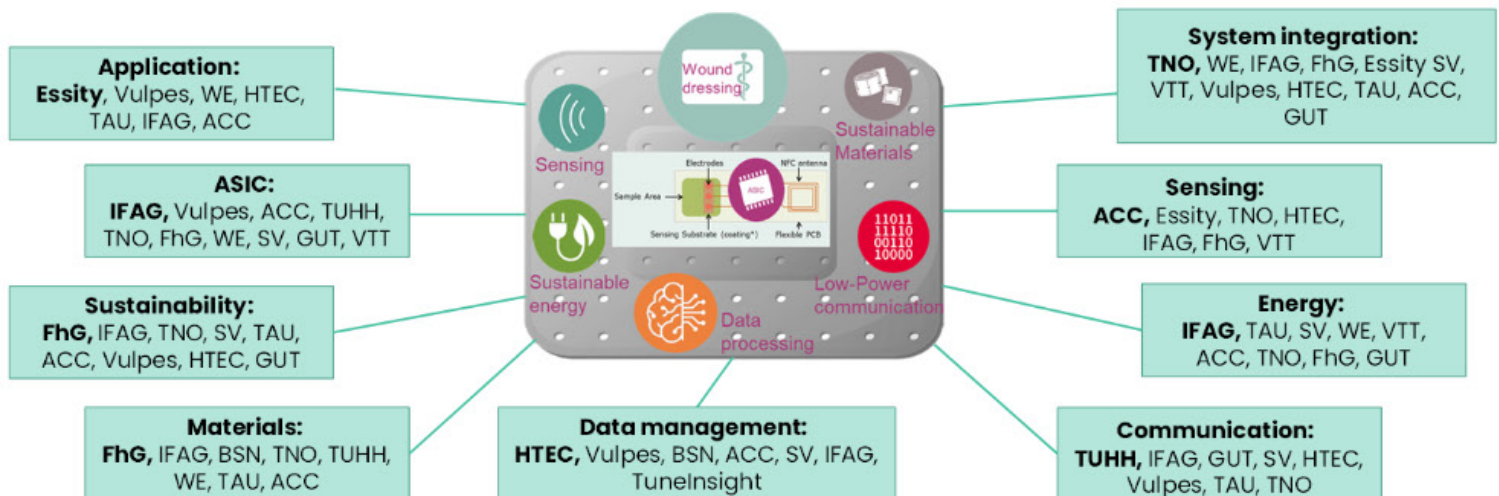
We are developing a flexible electronic test platform to explore new chemical sensors that could improve wound care, while also checking how sustainable these devices can be. The platform is designed with plug-in contact points for different sensors.

Importantly, the platform can use both sustainable materials like carbon inks, bio-based TPU, and paper, as well as conventional materials such as silver and regular TPU, so their performance and environmental impact can be directly compared. This approach makes it possible to quickly test new sensing materials, while collecting essential data on accuracy, reliability, and environmental footprint. The goal is to guide the development of smarter, more sustainable wound care technologies that work for both patients and healthcare systems.

Pilot 3.3 | Partners Involved

Smart wound dressing

Partners involved distributed to Building Blocks



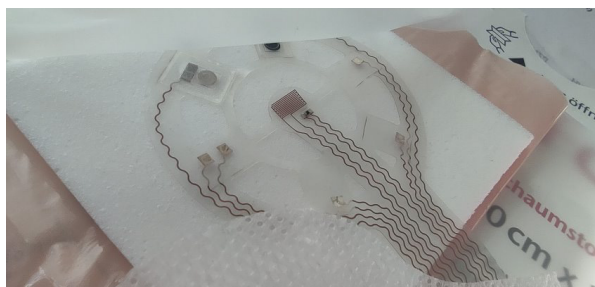
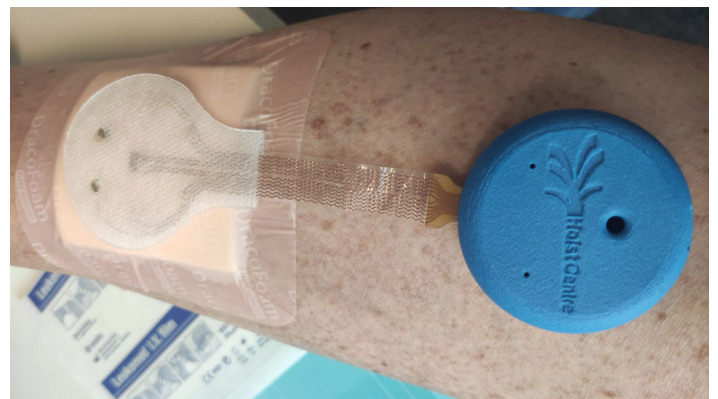
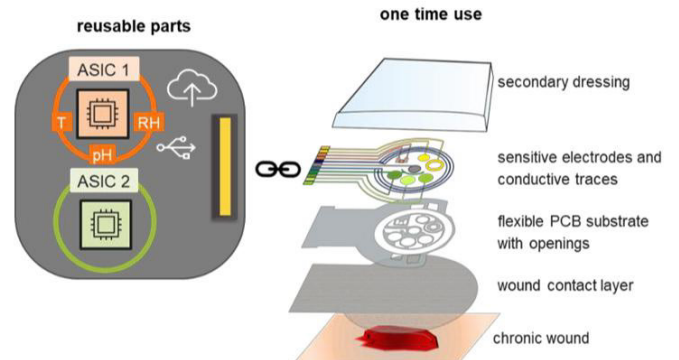
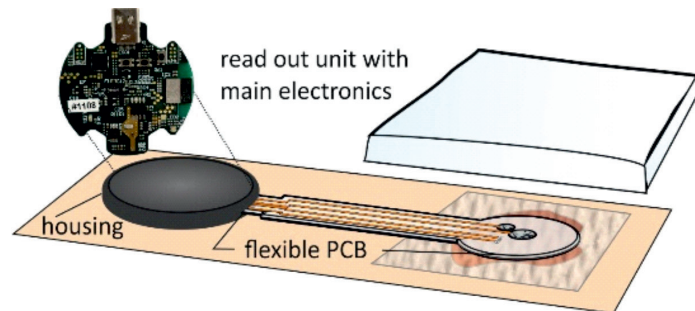
Pilot 3.3 | Sustainability impact

Smart wound dressing

- Apply dressing for longer period and thereby decrease use of materials but increase comfort and healing potential of patient, reduce effort and transport for changing of dressings.
- AI capabilities can reduce the need of patients to go to the hospitals and waste products, because they can detect possible infections
- Exchanging current used materials with more environment friendly ones will increase the effect on sustainability further. E.g cellulose based, bio degradable materials, carbon ink, reduce silver concentration
- designing efficient scripts to not waste energy/resources during the AI model execution, preprocessing techniques to reduce energy in data analytics
- employing low power technologies in the communication as well as in the data handling on the server solution to minimize the consumed energy, integration of PCB technology on sustainable material
- Re-Use of readout unit, Recyclability of non hazardous parts, defined waste stream for non-recyclability parts

Pilot 3.3 | Pictures

Smart wound dressing



Information and contact

Official website: www.sustronics.eu

LinkedIn: www.linkedin.com/company/sustronics-project



Partners



Co-funded by
the European Union

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