KEEP: Keeping Electrical and Electronic Products

A traceability system for electrical and electronic products in circular economies

Preface

This document introduces the "Keep Electrical and Electronic Products" (KEEP) project to organisations interested in traceability for electrical and electronic products by describing what the project has done so far, the major advantages of traceability system and the plan for the project's next phase and how you can be a part of it.

Contents

1.   The KEEP project's vision

The overall vision of the "Keep Electrical and Electronic Products (KEEP)" project is to develop a traceability system for electrical and electronic (EE) products, that lays the foundation for a European wide or worldwide system. Due to the inaccessibility of information about EE products' origin, composition, as well as repair, dismantling and end of life handling possibilities, a traceability system urgently needs to be developed to *keep* track of that information. The system will help all actors involved in the products' life cycles to extend the life of the products, maintain their value and, in turn, reduce waste. Beyond that, traceability systems answer the European Union's call, first issued in 2019, for electronic passports able to provide information about EE products, including their origins, their composition and their capacity to be dismantled and handled once their life cycles end.[1]

Financed by Vinnova, Sweden's Innovation Agency, the KEEP project began with a pre-study in 2018. Now in its second phase, the project has developed a proof-of-concept, or as we call it, a *prototype*, available at https://keepelectronics.com/. On the website, you can engage in a demo of the traceability system by assuming one of six possible roles of actors involved in product life cycles and tracking information about certain products provided by the project's partners. At present, the project has 14 partners—producers, reusers, material recyclers, information-sharing organisations and standardisation organisations—as well as representative end users.

For the KEEP project's next phase, we plan to develop the prototype into a complete traceability system by performing full-scale tests throughout the value chain. To that purpose, we first want to expand the project's group of partners.

Interested? Join us!

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[1] The European Green Deal, COM (2019)

2.   Why a traceability system?

The overall goal of any traceability system is to offer a platform for tracing electrical and electronic (EE) products. Actors along the value chain and life cycles of products have access to value-specific product information and historical information about key events in the product's life, including production, distribution, purchase, repairs and services, reuse and recycling. Any such system is based on the product labelling of all products in the system, reminiscent of ubiquitous labelling with barcodes and/or QR codes seen on numerous products. Ideally, the architecture of traceability systems is designed such that the systems can be scaled up globally.

Join the KEEP project's group of partners for the opportunity to not only influence how traceability systems are designed and used but to also edge ahead of the competition.

2.1   Benefits of a traceability system for different actors

Traceability systems can help economies to transition into resource-efficiency. For each actor involved, the benefits of such a traceability system are numerous and growing, some of which are listed below.

Producers and retailers

- **Every product has a story:** A traceability system can help your brand to tell the story of where your products have been, how they have been made and how they are being used.
- **Monitor your supply chain:** A traceability system can help you to collect information from your suppliers more easily.
- **Develop better products:** A traceability system provides specific, reliable data about how your products have been used and for how long—data that you can use to create more sustainable, optimised products.

- **Make logistics and handling efficient:** By tracing products with a traceability system, you can cut costs, tighten logistics and improve handling processes.
- **Win more tenders:** A traceability system gives you easier access to product information, which means less work and better odds of winning tenders.
- **Gain a competitive advantage:** A traceability system allows comparing products' environmental impact and helps you to differentiate your sustainably manufactured product from the products of competitors.
- **Implement take back systems:** A traceability system makes it easier to repossess your old products and, from them, create new projects in order to save costs and reduce environmental impact.
- **Make recalls easier:** As a direct line to your customers, a traceability system allows you to send push notifications about recalls.
- **Get everyone on board:** A traceability system can be used to not only communicate beyond your organisation but also to increase transparency about sustainability within your company and, in turn, create a shared vision.

Purchasers
- **Access data about sustainability:** A traceability system provides easier access to data about sustainability and allows you to compare the environmental impact and social conditions of various products.
- **Monitor your inventory:** A traceability system helps you to monitor and track purchased products currently being used or stored within your organisation.
- **Get everyone on board:** A traceability system enables you to create a common vision at your company and ensures that products are used in sustainable ways.
- **Expand reuse and improve recycling processes:** A traceability system can help remanufacturers and material recyclers to take better care of products that you no longer need.

Certifiers
- **Collect data more easily:** With a traceability system, you can more easily collect more data that you can trust.
- **Reach purchasers and consumers:** With a traceability system you can reach purchasers and consumers more easily, providing them with a better overview of products' certifications and makes it easier for them to learn more.

Consumers and users
- **Buy better products:** A traceability system helps you to select and compare products based on performance and environmental impact.
- **Feel safe when buying used products:** A traceability system affords you access to a product's history when buying used products and helps to ensure that the product has not been stolen.
- **Keep your products longer:** A traceability system gives you access to repair guides that make it easier to fix broken products and thus extend their lifetime.
- **Declutter your space:** With a traceability system, you gain access to information and reminders about what to do with products that you no longer use.

Service and support agents

- **Check and update the service history:** A traceability system allows you to access a product's service history and update its information once it has been serviced.
- **Access warranty information:** With a traceability system, you can be quickly determining whether the product is covered by a warranty.
- **Recommend good products:** A traceability system can be used as a guide, both for performance and environmental impact, when recommending products to your customers.
- **Ease access to troubleshooting and repair guides:** A traceability system offers you information about why products may be malfunctioning and how they may be fixed.
- **Buy back products:** A traceability system provides you with options to buy back old products from customers and remanufacture them.

Remanufacturers

- **Buy back products from consumers:** A traceability system provides you with options to buy back old products from customers to remanufacture them and sell them again.
- **Sort products based on use and wear:** The product history in a traceability system can inform you how much the product has been used and what parts may need to be replaced.
- **Ease access to information about parts and components:** A traceability system can show you high-value products, parts and components that can be remanufactured and resold.
- **Access repair and disassembly guides:** A traceability system can accelerate the repair and disassembly of projects with guides that show you how.
- **Achieve a transparent remanufacturing process:** With a traceability system, you can trace your own processes and guarantee your customers high quality.
- **Get stats on CO_2 savings:** Use a traceability system to aggregate and visualise your reductions in CO_2 emissions achieved by remanufacturing.

Recyclers

- **Optimise material recycling:** A traceability system can inform you about the material composition of each product and thus allow optimising the recycling process and avoid the downgrading of resources.
- **Separate products with hazardous materials:** A traceability system can allow you to easily identify hazardous materials in products that need to be sorted separately in order to protect your workforce.
- **Ease access to information about parts and components:** A traceability system can help you to pinpoint high-value products, parts and components that can be remanufactured and resold and/or that need special care.
- **Access disassembly guides:** A traceability system can afford quick access to disassembly guides that can help to accelerate your processes.
- **Get stats on your recycling processes:** A traceability system can help you to trace your processes and relay information to customers about what and how much you have recycled.

Regulators and authorities

- **Enhance national statistics:** A traceability system can grant you better statistics regarding the waste electrical and electronic equipment (WEEE) directive.
- **Make follow-up efficient:** A traceability system can help you to monitor whether companies are acting in compliance with laws and regulations.
- **Adjust the responsibilities of producers:** A traceability system makes it possible for you to adjust the responsibilities of producers regarding the regulations for different types of products.

Society

- Did you know that, on average, more than 20 kg of EE products per person are put on the market in the European Union every year, including household appliances (e.g. washing machines, vacuum cleaners, refrigerators and freezers) and electronics such as computers, TVs and mobile phones?[2] A traceability system can help society to track and extend the lifetime of EE products, which can delay obsolescence, significantly reduce environmental impact and contribute to meeting countries' objectives for the environment, climate and circularity.

2.2   Product passports

As awareness of a circular economy has expanded, traceability systems have been identified as enablers of increased circularity and sustainability, even at the EU level.

> *Digitalisation can also help improve the availability of information on the characteristics of products sold in the EU. For instance, an **electronic product passport** could provide information on a product's origin, composition, repair and dismantling possibilities, and end of life handling.[3]*

With those words, issued in 2019, the product passport first appeared on the agenda for sustainability at the EU level. As we understand it, a traceability system such as KEEP is exactly that: *a product passport.*

Sweden's government has announced its active cooperation in developing product passports, which form a pillar of its circular economy action plan.[4] Thus, as we transition into sustainable societies, product traceability will be required by legislators, partners and customers. That challenge is one that all companies need to overcome in order to remain financially and environmentally sustainable.

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[2] Eurostat, 2019, 'Annual detailed enterprise statistics for industry (NACE Rev. 2, B–E)'. https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=sbs_na_ind_r2&lang=en (retrieved 4 Nov. 2019)

[3] The European Green Deal, COM (2019)

[4] For more information see, https://www.regeringen.se/informationsmaterial/2021/01/cirkular-ekonomi---handlingsplan-for-omstallning-av-sverige/

3. The KEEP project's next phase

The first draft of a structured plan for the KEEP project's next phase has been divided into three work packages (WPs). WP1 will develop and information-sharing standard and backend solution and WP2 and WP3 will develop front-end solutions for uploading and accessing data from unique identifiers. WP2 focuses on the first phases in the product life cycle—production, wholesale, retail, and point of purchase and WP3 on remanufacturing and material recycling.

3.1 WP1: Information-sharing standard and backend

The hypothesis-driven development of the KEEP project has two major objectives to be worked towards in parallel.

A first objective of WP1 is to develop a common standard for information sharing and access. To gain acceptance, the standard should be based on the existing standards and conventions. We propose to continue working with GS1, a global organisation for the standardisation of product labelling and transactions in distribution and production. GS1 is behind the globally used European Article Number (EAN) standard for barcode marking and support a new standard for flexible product labelling, GS1 Web URI Structure Standard (also known as *Digital Link*),[5] which contains a key, or link, to access additional information in the cloud, along with information about the product and a unique identity code.

In the traceability system, each individual electronic product handled by the system has to be labelled in order to assure access to its contents and historical information: not only *when*, *where* and *how* it was manufactured but also key events until the end of its life cycle.

The second objective is to develop and implement an architecture platform for trusted data access. The plan is to launch a functional implementation of the system to be tested in a pilot study, with the focus on developing a testable version, a *prototype*, that implements all necessary protocols and procedures but also has an architecture with the capacity to be scaled up for global supply chains.

3.1.1 Activities

Development will be conducted in iterations until a prototype emerges. To allow the refinement of knowledge and hypotheses, the requirements and specifications for the prototype will be validated and tested in the pilot study in WP2 and WP3.

1. As a starting point, all of the cases of use among the different actors along the chain will be determined in order to capture the needs of all actors in all roles.
2. A data-sharing concept will be created to provide secure, trusted access to the means to update information about individual products—that is, to determine who owns that information and who has the right to access and update it.
3. Next, the platform architecture for a long-term solution able to be scaled up globally will be specified. The specification will define interfaces and protocols for the data-sharing concept, which supports the identified needs of data sharing for actors along the chain. Existing projects that address similar challenges of scalability and that ensure secure data sharing and data integrity over time will be exhaustively

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[5] For more information, see: https://www.gs1.org/standards/gs1-digital-link.

consulted, guided by the goal of building the underlying technical solution with existing technologies and practices whenever possible.

4. After that, the prototype of the system for secure data sharing to be used in following WPs will be implemented. The system will allow access to data in two ways: (1) with direct access via application programming interfaces (APIs) that allow the automated updating of information and (2) for web clients for viewing and information updates.

5. Last, the above specifications will be revised based on new knowledge and lessons learned in the other WPs.

3.1.2   Expected outcomes

- Requirements for the platform will be identified, including a model for the data-sharing platform's architecture, data storage requirements and access protocols.
- A functioning prototype will be produced for use in the other WPs to disseminate knowledge, to showcase the project's progress and to inspire future work.

3.2   WP2: Production and sales

WP2 considers the first phases in the product life cycle—production, wholesale, retail, and point of purchase—with the aim to test how products can be tagged and what information can be stored to create value for actors in the early parts of the life cycle.

3.2.1   Activities

1. To begin, all information to be tested will be identified. Designing the pilot test requires determining what type of information will be added, from the very outset to the prototype, and shared with other actors. Aspects to consider include the information's value for the recipients as well as the producer's potential to provide the information in the first place. Methods can include workshops, meetings and user studies.

2. A database and connections to unique product IDs will be built. To that end, databases will be constructed to collect the information needed for the products included in the tests and enable the data to be accessed via unique product IDs. (A local database is a temporary solution until the decentralised system in Section 3.1 is ready to be tested and/or used).

3. Interfaces and/or apps will be developed so that resellers and consumers can access the information. The activity will ideally be undertaken in collaboration with one or several project partners with a pre-existing ambition to develop such apps.

4. The test will be divided into two steps:

    a) Producers will tag one or multiple products destined for certain markets with unique product IDs and upload information about the products to the database.

    b) The products will be sold on the market, preferably with an omni-perspective including both online sales and stores.

5. Data will be collected to analyse how other actors in the value chain can use the collected information, guided by the following questions:

    o How do resellers use the system? How is the system perceived by their customers?

    o How do consumers and/or product users use the system? What information are they most interested in?

o How can authorities use the aggregated statistics from the database?

Methods may include user studies, surveys, focus groups and interviews.

3.2.2 Expected outcomes

- The WP will give a better understanding about how producers can collect and share the data that will be available to other actors, while at the same time apps for sharing data with resellers, purchasers and consumers will be tested and evaluated;
- The technical process of tagging products in the producers' processes will be tested.

3.3 WP3: Use and end of life

In the long run, the aim of the KEEP project is that all EE products will receive an identifier with a unique product ID at the production stage. Until that point, however, possibilities exist to give those unique identifiers to products at a later stage in their life cycles.

The point of arrival at a remanufacturing facility was identified in Phase 2 as a promising opportunity to start tracing products not already assigned a unique product ID. The products are often of high value, have great potential for continued use and are therefore reasonable to trace. The data are relevant for both for users and material recyclers downstream as well as for public authorities and producers.

3.3.1 Activities

To continue working in that direction, Phase 3 will involve:

1. Building a solution that makes it possible to:
   a) Tag products with unique identifiers;
   b) Collect data from the remanufacturing process and add the data to a database with links to the unique product IDs;
   c) Ensure that the data collected in the solution can be accessible to other actors in the system by using the backend solution; and
   d) Design an application for potential buyers and/or users of the product to get information about it if scanning the unique product IDs.

   The solution can be built by one or several IT developers. Several solutions may be developed for a, b and c, with a joint solution for d.

2. Testing and implementing the solution. The test will be executed together with the IT developers and several remanufacturers of EE products.

3.3.2 Expected outcomes

- The WP will produce a proven solution that enables remanufactures to tag products and upload data about steps in the remanufacturing process that can be shared with other actors throughout a product's life cycle.

3.4 Funding opportunities

To fund the next phase of the KEEP project, it is possible to apply for financial support from both Sweden and the European Union. The funding agencies often require organisations involved to co-finance the projects, mostly done by implying that they should contribute human resources to collaborate on the project.

Swedish funding

The current KEEP project is financed by Vinnova, Sweden's Innovation Agency. Since 2018, when a pre-study was commenced (i.e. Phase 1) to map the challenges that traceability could face, the KEEP project has followed Vinnova's challenge-driven project process. Currently in Phase 2, the project can most convincingly apply for the continuation of funding and for funding for Phase 3 from Vinnova.
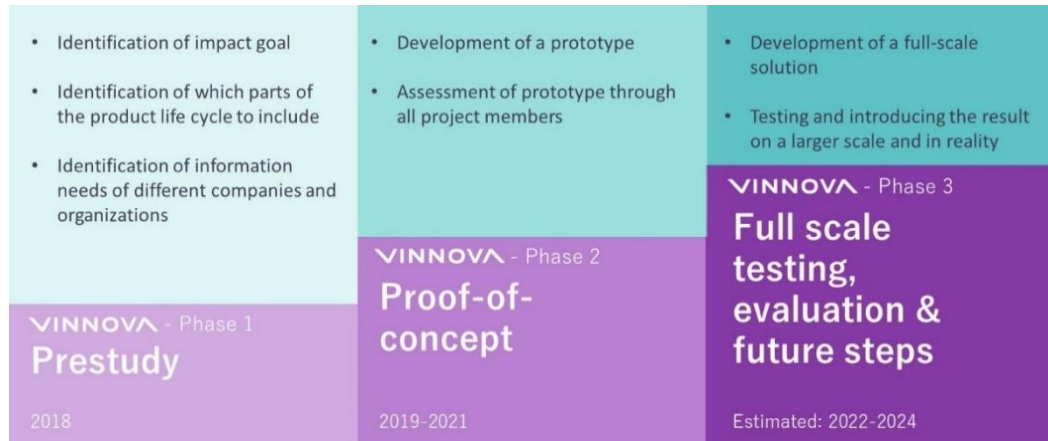
Vinnova describes a project process in Phase 3 as focusing on testing and introducing the results on a larger scale. The work also includes laying the foundation for what the business model looks like and how distribution and upscaling should occur for utilisation. In the third and final phase, projects can apply for a maximum of SEK 20 million.[6]

As for the timeline, the application will be submitted in fall 2021, and the project will be expected to commence in January 2022.

For foreign partners, the funding strategy precludes funding. Nevertheless, foreign partners are welcome to engage in the project, because we believe that an international project consortium is the more beneficial way forward for the KEEP project.

EU funding

Because a traceability system needs to extend beyond a country's borders, we plan to ensure international collaboration. With the emergence of an EE product passport, we believe that a European-level consortium is an appropriate way forward. We are thus interested in all input about how to expand the KEEP project across Europe.

4. Contact

For all questions regarding the KEEP project and future collaboration, please contact:

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[6] For more information, see https://www.vinnova.se/e/utmaningsdriven-innovation-steg-3-implementering/