
# FLEX-ID Digital Passport: Committed to Transparency and Traceability

A VinylPlus® Consortium Project

vinyl plus®
COMMITTED TO SUSTAINABLE DEVELOPMENT

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# Executive Summary

This whitepaper explores the Flex-ID project, an innovative initiative focusing on the development of Digital Product Passports (DPPs) within the European PVC industry. In alignment with the EU Green Deal and Circular Economy Action Plan, the project addresses critical challenges in enhancing traceability, transparency, and circularity across supply chains. By piloting DPPs for three product categories: tarpaulins, cushion vinyl floor coverings, and roofing membranes; the Flex-ID project aims to set a benchmark for material and product lifecycle management.

The project delivered significant insights into the design, implementation, and operationalization of DPPs. Key findings revealed that there is no universal solution for product identification; technologies such as digital watermarks, printed QR codes, and labelling have distinct advantages based on product characteristics and lifecycle considerations. The study also highlighted the importance of maintaining long-term data accessibility, balancing intellectual property protection with transparency, and harmonizing regulatory requirements across sectors. These insights informed practical recommendations for designing flexible, durable, and interoperable DPP systems.

The implications of this work are profound for policymakers and industry stakeholders. Policymakers are urged to adopt technology-neutral regulations, harmonize mandatory requirements across frameworks, and incentivize collaboration to overcome industry-wide challenges. For manufacturers and recyclers, the findings emphasize the potential of DPPs to enhance resource efficiency, enable informed decision-making, and drive sustainable practices. By addressing lifecycle complexities and fostering cross-sector engagement, the Flex-ID project provides a valuable roadmap for implementing DPPs as a cornerstone of the circular economy.

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# 1. Introduction

Digital Product Passports (DPPs) are standardized digital records that contain essential information about a product's materials, composition, lifecycle, and recycling instructions. They aim to enhance transparency, traceability, and circularity across supply chains, aligning with the EU's Green Deal and Circular Economy Action Plan. DPPs also facilitate collaboration between stakeholders, such as manufacturers, recyclers, and consumers, to improve resource efficiency and reduce environmental impact.

## 1.1 Regulatory Background on Digital Product Passports

In December 2019, the European Commission (EC) launched the EU Green Deal [1]. This package of strategies and action plans aims to transform Europe into a modern, resource-efficient and competitive economy. The EC saw it as a growth strategy towards a climate-neutral circular economy, where economic growth is decoupled from resource use. The 2020 Circular Economy Action Plan [2] (CEAP) is an important part of the EU Green Deal. It builds on the work done on circular economy since 2015 and plays a key role in delivering the Green Deal's ambitions. The CEAP is closely linked with the EU Industrial Strategy 2.0 [3], which maps out how industry should develop over the next 30 years: the EC laid the foundations for an industrial strategy that would support the twin transition to a green and digital economy, make EU industry more competitive globally, and enhance Europe's open strategic autonomy.

The Digital Product Passport (DPP) is an important deliverable in this green and digital transition and will simplify access to relevant product-specific information concerning sustainability, circularity, and legal compliance. Consequently, there are a (growing) number of EU policies which rely on DPP or elements of it to make product related information digitally available:

- Ecodesign for Sustainable Products Regulation (ESPR)
- Construction Products Regulation (CPR)
- Batteries Regulation
- Toys regulation
- Detergents regulation
- Critical Raw Material Act
- Green Claims Directive
- [...]

The products investigated in this VinylPlus® project have requirements under the Ecodesign for Sustainable Products Regulation (ESPR) and the Construction Products Regulation (CPR). The EU Strategy for sustainable and circular textiles [4] includes the laws, regulations and guidance specific to the textiles sector and textile products; including the ESPR [5] and within it, the requirement for each product on the European market to have a DPP. The new CPR [6], adopted on 5 November 2024, includes a DPP system for construction products. However, the mandatory content of the DPP under the ESPR and the CPR is not fully aligned.

As another important part of the EU Green Deal, the EC introduced the 2020 European Data Strategy [7] to develop a 'single market for data' in strategic economic sectors and domains of public interest. This means the DPP and the DPP system are set up to incorporate data infrastructures and governance frameworks critical to delivering the EU Green Deal. One of these requirements is that the DPP data will be accessible and interoperable to facilitate the collaboration required for a circular economy.

## 1.2 Introduction to VinylPlus and Related Sustainability Challenges and Goals

VinylPlus is the European PVC industry's commitment to sustainable development aiming to drive sustainability and circularity across the PVC value chain. Through its 2030 Commitment, VinylPlus sets ambitious goals to address environmental impacts, boost recycling efforts, and enhance the circularity of PVC products [8]. With over two decades of progress, VinylPlus has led efforts that have considerably increased PVC recycling rates, ensuring that a substantial portion of PVC waste is repurposed instead of sent to landfills [9].

The PVC industry faces a series of sustainability challenges, particularly concerning end-of-life (EoL) waste management, recycling, and the control of regulated substances. VinylPlus' focuses on reducing the environmental footprint of PVC products, enhancing recyclability, and promoting the use of recycled materials [10]. This project targets several objectives under its 2030 Commitment, such as minimizing resource use, energy consumption, and emissions across the PVC lifecycle.

## 1.3 The Flex-ID Project: Objective and Overview

The Flex-ID project targeted the development of a DPP across three primary applications: tarpaulins, cushion vinyl floorcoverings, and roofing membranes. In an era defined by technological innovation and sustainability concerns, the need for accurate materials and product traceability has never been more crucial. Industries working on sustainability are facing challenges such as controlling the EoL waste streams and ensuring the origin, quality, and environmental compliance of recycled materials. By enhancing transparency, DPPs benefit these stakeholders: by supporting downstream users and recyclers in identifying regulated substances and reuse opportunities; and supporting consumers in making informed environmentally conscious decisions.

The Flex-ID project seeks to pilot the use of DPPs, setting a benchmark for traceability in the PVC industry. Key goals included:

- Develop DPPs for three different plasticized PVC product ranges, i.e. tarpaulins, cushion vinyl floor coverings and roofing membranes, in order to strongly contribute to the traceability of end-of-live products and, thus, stimulate plasticized PVC recycling in Europe
- Based on the three cases, draw conclusions and recommendations on the content and logistics of DPPs during the functional lifetime of the plasticized PVC products
- Dissemination of the project results to relevant stakeholders
- Strongly contribute to materials circularity!

### 1.3.1 Project Participants:

The Flex-ID project combines technical innovation with sector expertise to advance the circularity of PVC products and featured collaboration between VinylPlus and several industry partners: Beaulieu International Group NV, RENOLIT SE, SIOEN Industries NV, and 3E.

**VinylPlus®** is the European PVC industry's commitment to sustainable development. Through VinylPlus, the European PVC industry is creating a long-term sustainability framework for the entire PVC value chain, improving PVC products' sustainability and circularity and their contribution to a sustainable society. It covers the EU-27, the UK, Norway and Switzerland. VinylPlus represents around 200 companies of PVC resin and additives producers and converters and coordinates a network of about 150 recyclers. Since 2000, VinylPlus has invested over €133 million in sustainability in Europe.

**3E** combines expertise and innovative technology to integrate chemical, regulatory, product, and supply chain data and insights into critical decision-making moments. With over 35 years of experience, 3E helps businesses achieve safety, sustainability, and faster market entry by optimizing compliance strategies across the product lifecycle. 3E's platform, 3E Exchange, simplifies supply chain data collection, regulatory reporting, and data management. It features integrated supplier communication tools, expert regulatory support, and 3E Digital Product Passports for seamless data sharing.

**Beaulieu International Group NV (B.I.G.)** is specialized in a broad range of applications starting from raw materials (polymers) over semi-finished engineered products (i.e. fibres, yarns, technical textiles, and technical sheets) to floor coverings and upholstery fabrics. B.I.G.'s headquarter is located in Belgium (Waregem), but the company is internationally represented by 29 plants and 20 sales and distribution offices in 17 different countries in Europe, Asia, USA, and Oceania.

**RENOLIT SE** is a leading international manufacturer of high-quality plastic films, sheets, and other related products. Headquartered in Worms, Germany, RENOLIT operates a global network of production facilities and sales offices spanning over 30 countries. From raw materials to finished products, RENOLIT offers innovative solutions for a wide range of applications, including furniture, automotive, construction, and healthcare. The company's commitment to sustainability and customer-focused approach drives its continuous development of advanced, high-performance polymer solutions.

**Sioen Industries NV (SIOEN)** is a global leader in technical textiles and protective clothing. The company is headquartered in Belgium (Ardooie) and has over 30 plants, facilities and sales offices spread globally over 20 different countries.
It is specialized in developing, producing, and selling coated technical textiles, protective apparel, and fine chemicals, serving diverse markets, including transportation, construction, and public safety.

# 2. Defining the Contents of the Digital Product Passport

A Digital Product Passport (DPP) serves three primary objectives: encouraging sustainable consumer behaviour through environmental transparency, promoting circularity by providing accurate composition data to recyclers, and ensuring legislative compliance through transparent ingredient disclosures. To meet these objectives, a DPP must include critical elements that support both product stewardship and efficient lifecycle management.

## 2.1 Essential Data Elements for Digital Product Passports

The Flex-ID consortium identified both mandatory and voluntary data elements for Digital Product Passports (DPPs) focussing on the ESPR and the CPR. Mandatory elements ensure compliance with sustainability regulations, while voluntary elements enhance transparency and traceability throughout the value chain. The requirements for DPPs specify the data to be included, access levels, and language provisions. Data must be provided in the official language of the Member State or, if not specified, in a consumer-friendly language.

A physical data carrier must link the unique product identifier (UPI) to the DPP and be included on the product, packaging, or accompanying documentation, as required by Delegated Acts. Under the CPR, the product type's unique identification code must also be incorporated into the CE marking.

To ensure long-term reliability, DPPs must remain digitally accessible for at least 10 years after the last product of its type is placed on the market, with the DPP system operational for a minimum of 25 years. Backup copies should be maintained by a DPP service provider to guarantee data availability.

Based on our research and current knowledge, we recommend the following essential data elements for the DPP:

| Category | Data Elements | Details |
|---|---|---|
| **Product and Company Information** | Product Identifiers - Product name, brand - TARIC commodity codes - UPI (ESPR) - Product type ID (CPR) - GTIN (Global Trade Identification Number) | Includes product description, use, lifespan, and materials. |
| | Manufacturer Information - Name, address, email – EORI (Economic Operators Registration and Identification number))/UOI (Unique Organisation Identifier) (Importer) - CPR: Website, contact point | Clear contact information for compliance and support. |
| | Compliance Documentation - DoC, DoPC, technical documentation | Varies by ESPR or CPR regulations. |
| | DPP Metadata - Version, issue date, revision date - Responsible department contact - Backup provider information | Ensures long-term reliability of the DPP. |
| | Third-Party Verification - Verifier name, contact | Required if mandated by Delegated Acts. |
| **Product Composition Information** | Substances of Concern (SoC) - Name, location, concentration - Lifecycle tracking, safe use, EoL instructions | Compliance with environmental and safety standards. |
| | Composition Disclosure - Chemical substance thresholds (e.g., 1w%) - Proprietary information - Third-party validation | Disclosures to enhance transparency while protecting IP. |
| | Recycled Content - Pre-/post-consumer percentages - Hazardous substances - Third-party validation | Focus on circular economy metrics. |
| | Renewable Content - Percentage, certification, validation | Supports sustainable material sourcing. |
| | Environmental Information - Carbon footprint, EPD - Sustainability labels | Enables informed choices for sustainability. |
| **Lifecycle Instructions** | Use, Maintenance, and EoL - Installation, repair, maintenance instructions - Safety and EoL handling | Guides for optimal product lifecycle management. |
| | Disassembly and Reuse - Design for disassembly and recycling - Weight percentage for reuse and recycling | Promotes resource efficiency and circularity. |
| **Reuse and Recycling** | - Extended lifetime: reuse, refurbishment, remanufacturing - Recycling: percentage, technologies, collection systems | Facilitates longer product use and better recycling outcomes. |
| **Product Performance** | - Repairability, durability scores - Environmental impact - CPR: Climate change and human toxicity indicators | Supports compliance and sustainable product design. |

*Table 1 - Essential DPP Data Elements*

### 2.1.1 Balancing Transparency and Data Sensitivity

Balancing data privacy and transparency in Digital Product Passports (DPPs) presents a significant challenge. Detailed product information, such as ingredients, material composition, and end-of-life instructions, is vital for empowering consumers to make informed decisions and advancing circular economy initiatives. However, sharing this data can raise privacy concerns for manufacturers, as it may expose sensitive intellectual property or enable tracking of individual product usage, potentially impacting both businesses and consumers.

To address these concerns, it is essential to carefully determine which information is truly necessary for the passport's intended purpose. Implementing robust data anonymization and aggregation techniques can help protect proprietary details while maintaining the utility of the data. Additionally, providing transparent controls over data access and usage ensures that stakeholders can trust the system. By adopting these strategies, DPPs can maximize the benefits of enhanced product information while minimizing potential privacy risks.

# 3. Linking Digital Records to Physical Products

A Digital Product Passport (DPP) does not store data directly on the product but instead relies on an external database to organize and manage product information. Access to this data is facilitated via the internet using a unique link (URL), directing users to an interface where the product's information can be viewed. A critical challenge lies in linking this URL to the product in a manner that is both durable and easily accessible for stakeholders such as recyclers, manufacturers, and consumers.

The method of connecting the URL to the product must be tailored to the product's specific lifecycle and usage context. Ensuring the chosen approach balances durability, ease of use, and compatibility with current workflows while being cost effective is essential for the success of the DPP system. There will be no one-size-fits-all solution for connecting the DPP to a physical product as each product category will have different challenges.

## 3.1 Overview of Identification Technologies

Technologies for connecting a URL to a product vary in their performance across three key criteria:

- **Reliability:** The ability of the technology to maintain its integrity and function effectively over time and under various environmental conditions.
- **Complexity:** The practicality of implementing the technology at scale, considering both initial and ongoing costs.
- **Accessibility:** The ease with which end users, such as consumers or recyclers, can access the product passport without requiring specialized equipment.

The following technologies were investigated during the pilot phase:

| Technology Description: | Reliability | Complexity | Accessibility |
|---|---|---|---|
| **Printed QR Codes:** Two-dimensional barcodes printed on labels or directly onto the product, storing data that links to a URL. | **MODERATE:** Susceptible to physical wear and fading, especially in harsh environments like outdoor applications. | **GOOD:** Low-cost solution that can be easily implemented by printing on labels or directly on products. | **GOOD:** Can be scanned using smartphones or optical scanners, requiring no specialized equipment. |
| **Chemical Markers:** Invisible markers embedded within the product material, detectable using specialized sensors. | **GOOD:** Indestructible when embedded, ensuring long-term data integrity. | **BAD:** Expensive and limited to closed-loop systems. Requires specialized sensors for decoding. | **BAD:** Inaccessible to most stakeholders due to the need for proprietary reading equipment. |
| **RFID Tags:** Small tags using electromagnetic fields for identification, enabling bulk scanning without line of sight. | **GOOD:** Durable in most conditions; does not require direct line of sight and supports bulk scanning. | **MODERATE:** More expensive than QR codes but reasonable for bulk use. | **MODERATE:** Requires RFID readers, which are not standard consumer devices. |
| **Invisible/UV Ink:** Special ink visible only under UV light, used for printing data directly onto the product surface. | **MODERATE:** Reliable for indoor use but fades in outdoor environments or with prolonged UV exposure. | **MODERATE:** Costlier than QR codes but less than RFID for small-scale applications. | **MODERATE:** Easily readable with standard smartphones equipped with UV scanning capabilities. |
| **Embossed QR Codes/IDs:** QR codes or other identifiers embossed directly onto the product material for added durability and resistance to wear. | **GOOD:** Resistant to physical damage; durability depends on placement and material compatibility. | **MODERATE:**Higher manufacturing costs compared to printed QR codes. | **MODERATE:** Requires high visual contrast to read with smart phone. |
| **Digital Watermarking Systems:** Encoded visual patterns embedded within the product design. | **GOOD:** Secure and tamper-proof, ideal for premium or highly regulated applications. | **MODERATE:** Complex to implement due to the need for advanced (digital) printing and encoding. | **GOOD:** Accessible using smartphone camera with specialised application. |
| **Surface Fingerprint Systems:** Uses the unique surface texture or profile of the product as an identifier. | **GOOD:** Reliable as it uses unique product surface profiles as identifiers. | **BAD:** High costs due to advanced equipment needed for both encoding and decoding. | **BAD:** Inaccessible to standard users, requiring sophisticated hardware for interpretation. |

*Table 2 - DPP Marking Technologies*

## 3.2 Challenges and Opportunities in Product-Record Linking

Ensuring that a Digital Product Passport (DPP) remains accessible throughout a product's lifecycle presents a key challenge for manufacturers. Ideally, the product itself should carry the DPP link to ensure that critical information stay attached, regardless of where the product ends up. Marking the product directly minimizes the risk of information loss during transport, usage, or recycling. However, this is not always feasible, particularly for construction products like membranes, tarpaulins, or floor coverings which are integrated into larger assemblies, such as buildings or composite materials. In these cases, the product may be coated, laminated, or otherwise altered in ways that obscure or damage the identifier. Therefore, the choice of technology must consider the product's lifecycle, exposure to environmental factors, and integration into downstream applications.

While marking the product itself should always be the first preference, the realities of manufacturing and assembly processes mean this is not always possible. For some products, the only practical option is to mark the packaging and product documentation so that downstream actors can integrate the information into their records. There are some situations where this is advantageous even when the product itself is marked. For example, to allow DPP integration without having to remove or open packaging. For this reason, we recommend a pragmatic approach, where the packaging and documentation is always labelled, and the product is marked when reasonably practicable.

The decision tree in figure 1 exemplifies this logic:

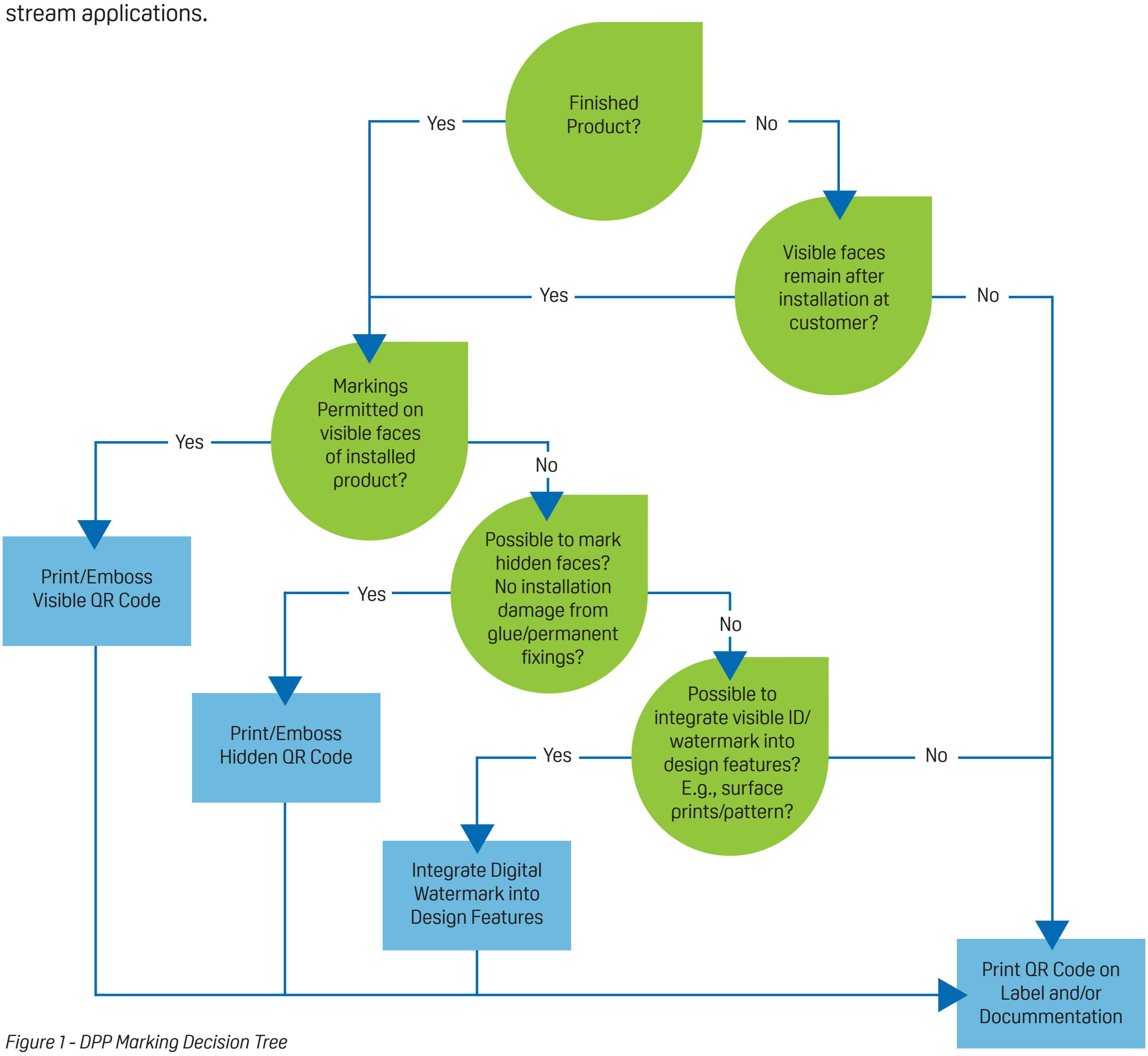


*Figure 1 - DPP Marking Decision Tree*

# 4. Industry Case Studies

## 4.1 Beaulieu International Group NV (B.I.G.)

**B.I.G.** is specialized in a broad range of applications starting from raw materials (polymers) over semi-finished engineered products (i.e. fibres, yarns, technical textiles, and technical sheets) to floor coverings and upholstery fabrics. Within B.I.G. cushion vinyl or flexible PVC floorcoverings was chosen for a first pilot DPP.

Cushion vinyl is a category of indoor floorcoverings that can be used for both residential and commercial buildings. The aim of a DPP for cushion vinyl in this pilot is to connect and inform clients on the product and to enable easier sorting and recycling at the end of life. B.I.G. is also striving for closed loop recycling of flexible PVC floorcoverings, which the DPP will aid by easily distinguishing plasticizer types during sorting and recycling as some plasticizers are not allowed or wanted in our products.

The true value of the DPP for sorting and recycling will not be immediately visible for flexible PVC floorcoverings having a lifecycle of up to 25 years or longer. This also means that the physical connection of the DPP with the product needs to remain readable throughout its lifetime.

B.I.G. is using a Digital Watermark technology for their prototype DPP.

### 4.1.1 Digital Watermarking

Digital watermarking for physical products is an innovative technology that embeds invisible, machine-readable information directly into the physical design of products, packaging, or labels. Unlike traditional methods of marking or tagging, digital watermarks are seamlessly integrated into the product's aesthetic design, remaining imperceptible to the human eye while providing a secure and reliable method of identification. This technology involves embedding patterns or codes into elements like printed graphics, textures, or product surfaces. These hidden marks can be scanned and decoded using devices such as smartphones or industrial readers, to reveal detailed information about the product. The embedded data might include information about the product's origin, authenticity, supply chain details, or instructions for recycling and disposal. This seamless integration of digital watermarking into physical products represents a powerful tool for supporting circular economy initiatives like the DPP but it can also be used to combat counterfeiting and improving supply chain traceability.

A key application of digital watermarking lies in sustainability efforts, particularly in waste management and recycling. Embedded codes on packaging allow advanced sorting systems to identify materials during recycling, ensuring materials are correctly identified and sorted for reuse, significantly improving recycling efficiency.

At BIG, a part of the cushion vinyl flooring is produced with digital printing which could implement digital watermarks easily. In the future, BIG wants to increase the volume of digitally printed floors. Digital watermarking could therefore be a compatible technology. A couple of companies providing the digital watermarking technology were contacted. After the initial inspection of our designs, they performed a feasibility test to enhance our design with a digital watermark.

In Figure 2, you can see both the original and the enhanced design as it would be if they were installed, and a person was looking down at the floor. No visual differences can be seen between both designs.

But there will be a difference when a person would look closely to the floor. Red and green dot patters can be found across the design as seen in Figure 3. These patterns will enable anyone to scan them with a simple app and camera of their smartphone to connect to the database where the DPP of the product can be found.

*Figure 2: Comparison of the original (left) and enhanced (right) designs*

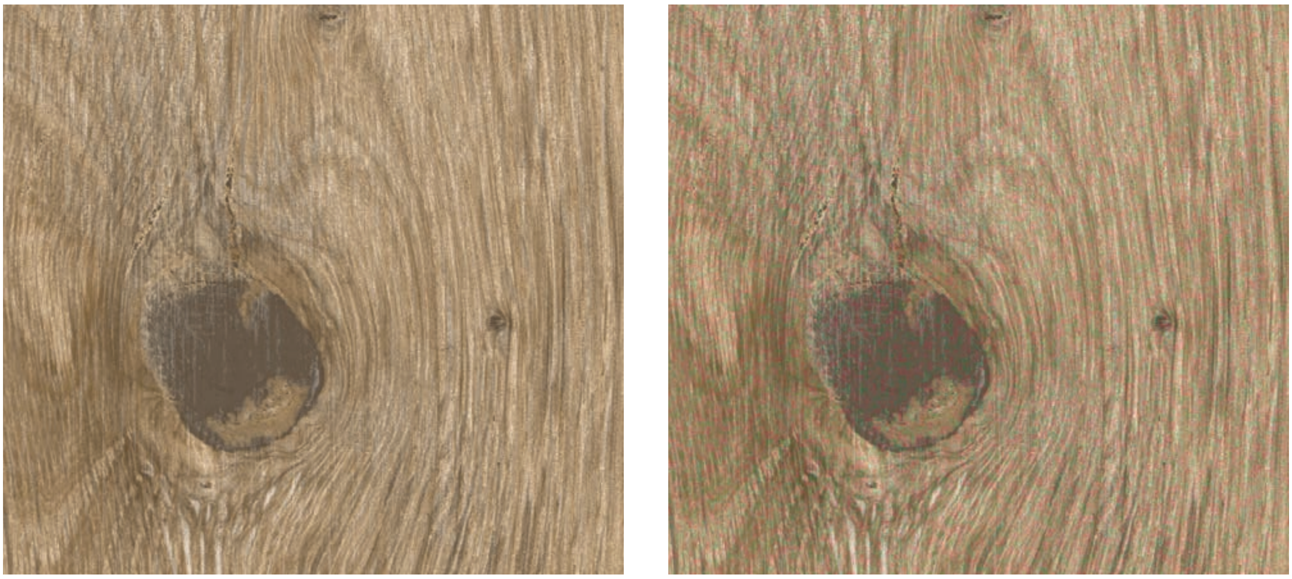

*Figure 3: Zoomed-in comparison of original (left) and enhanced design (right) with green and red dot patterns*

## 4.2 RENOLIT SE

**RENOLIT** manufacture a range of PVC roofing membranes under their ROOFCARE Market Unit. These membranes are primarily designed for flat roofs and provide durable, waterproof protection for both residential and commercial buildings. As a construction industry product these membranes will have requirements under CPR, therefore were selected for RENOLIT's first pilot DPP.

The primary aim of the roofing membrane DPP is to enable end of life recycling. These are heavy gauge products, and a typical installation would contain >1000kg of recyclable material. RENOLIT would also like to encourage closed loop recycling where possible, as the material has maximum reusable value if it is integrated back into RENOLIT products. Work has already started on closed loop "take-back" schemes with some customers, however ensuring an accurate material assessment is a challenge for EoL material. Some ingredients cannot be mixed, therefore manufacturers and recyclers need to be confident on material composition before they can process post-consumer membranes.

DPP is seen as an enabler for future take-back schemes by giving accurate and trustworthy information at the end of the product lifecycle. However, this creates a challenge as the lifecycle can be between 15-25 years. Any markings or DPP technologies will need to be resilient enough to survive 25 years exposure in a harsh rooftop environment.

RENOLIT is using a Printed QR Code for their prototype DPP.

### 4.2.1 Printed QR Codes:

RENOLIT investigated several different technologies for the roofing membrane DPP, including chemical markers, digital watermarks and RFID (Radio-Frequency Identification) tags but ultimately selected printed QR codes applied to the rear edge of the membrane. This decision was made based on cost-effectiveness and compatibility with existing manufacturing processes. Integrating digital watermarks or RFID within the membrane itself presented significant technical hurdles. Many of RENOLIT's products are "plain colours" making it difficult to integrate a watermark without affecting aesthetics and the manufacturing process involves high temperatures and pressures which would damage embedded electronics. Furthermore, some products are sold in narrow rolls (≥200mm) so it would require numerous RFID chips to ensure they were present in the final roll width.


*Figure 4 - Inline QR Code Printing*

Printed QR codes, on the other hand, are a mature, well-understood technology and easily integrated into existing production lines. Many production lines already include some edge printing of some description, and inline printers can be retrofitted to slitting machines for marking narrow roll widths. This offers scalability and requires minimal process adaptation providing a cost-effective solution for putting DPPs into production.

While QR codes have limited data capacity, they are sufficient to encode a unique URL that links to comprehensive digital records through a web browser. This approach allows for a dynamic DPP that can be updated throughout the product lifecycle without requiring modification of the physical product. Furthermore, the ubiquity of smartphone cameras capable of reading QR codes ensures easy access to the DPP information for all stakeholders.

The rear edge placement of the QR code is a trade-off between accessibility and protection from weathering. This location is protected from direct wear and tear when compared to the top surface of the membrane, however it cannot be scanned when the membrane is installed. The primary objective is to support EoL recycling, so this trade-off is deemed acceptable. Rear placement also protects the product aesthetics, unlike front surface printing.

## 4.3 Sioen Industries NV (SIOEN)

**SIOEN** is divided into three divisions: chemicals, protective garments and technical textiles. The technical textiles division is the largest in terms of turnover, with Sioline as its largest product line. Sioline is a manufacturer of coated technical textiles, specializing in direct coating techniques. These semi-finished products are used around the world for a wide range of applications such as side curtains, tents and halls, biogas membranes, tensile architecture, and many more.

The aim of the coated textile (for truck tarpaulin, among others) DPP in this project, is to inform customers on the product specifications, its correct handling, the sustainability parameters and repair, remanufacture and recycling possibilities. While recycling of these materials is difficult (though possible, with more options becoming available as technologies evolve), these products are made to last for up to 25 years or longer, after which repair and remanufacture is often possible. However, remanufacture and recycling may be hindered due to missing information and unknown compositions. By using a DPP, traceability is possible, and the required information is passed along the value chain, allowing informed decision-making.

SIOEN is marking the roll label and packaging for their prototype DPP.

### 4.3.1 Label and Packaging Digital Product Passports:

Sioline (part of SIOEN) is market leader in the production of coated fabrics for side curtains for trailers. Hence, the fabric used for this application (B6000) was chosen as case study in the Flex-ID project.

**Standard technology selection**

Despite having selected truck tarpaulin as the end application for the Flex-ID demo, Sioline only manufactures the semi-finished product. While some fabric qualities are almost exclusively used for specific projects, customers or applications (e.g. coated textiles with low methane permeability, are usually only used for biogas digesters), the end application is usually not yet known during production or sales. This is also the case for the quality used for side curtains (B6000), which is also used for high-speed roller doors. Aside from the application, also the dimension of the end product is often an unknown. While some end products are made with several hundreds or thousands of square metres of textile (e.g. tent halls), other applications may require (much) less than 1 m² (e.g. sports bags). Additionally, the coated textile may in the end application not even be visible or accessible. Or if visible, no visual markings may be acceptable.

Therefore, it is not logical to apply any permanent marking, code or tag on the fabric itself upon production or sales. But instead, the required data needs to be added to the roll label or packaging.

*Figure 5. Rolls of coated fabric in stock (with unknown end application)*

**Tagging options down the value chain**

While physically attaching (permanent) identifiers on rolls of coated fabrics is not required, since it's a semi-finished product, customers down the value chain will have to. In this context, Sioen studied which technologies are best suited for their customers to apply.

One of the most cost-effective methods is to provide a barcode or QR code to the product. Converters may choose to add the code to (existing) labels which are attached to the product. Should they want to provide the coated fabric with the QR code, there are several options.

While laser engraving is a cost-efficient option, it was shown to also create punctures throughout the entire coating layer (back or front), thus making the fabric permeable to gasses and liquids. Embossing allows tagging without puncturing and without having to add other material. But embossing is a less flexible application technique and is more difficult to read out.

Printing seems to be the best option. While "invisible" UV-fluorescent inks results in pristine-looking surfaces, these inks are quickly to degrade upon (sun)light exposure. This thus leaves visible wear-resistant inks, which seem to be the preferred option for many confectioned coated fabrics (aside from adding a label).

# 5. Conclusions

The Flex-ID project has demonstrated a practical approach to implementing Digital Product Passports (DPPs) in the PVC industry, offering insights transferable to other sectors. By fostering collaboration among manufacturers, recyclers, and industry organisations, the project surfaced challenges at a sectoral level, rather than within individual companies. Prototypes were developed across diverse applications, showcasing the real-world complexity of DPPs and their implementation at various stages of the value chain.

## 5.1 Key Findings

The project highlighted that there is no universal approach to product identification, and it is not always possible or practical to mark the product itself. Technologies like digital watermarks, printed QR codes, and labelling have distinct advantages depending on product use cases and lifecycle considerations. Printed QR codes emerged as a cost-effective solution for roofing membranes, while digital watermarking proved suitable for digitally printed items like cushion vinyl flooring. For semi-finished products such as tarpaulins, labelling and packaging IDs were practical alternatives to direct marking, addressing downstream accessibility and variability in applications.

Ensuring the durability and accessibility of DPP links over long lifecycles (up to 25 years) remains a significant challenge, particularly for products exposed to harsh conditions. Semi-finished products often require downstream manufacturers to integrate DPP data from upstream suppliers therefore transferring responsibility for data integrity. The project also outlined essential DPP data elements such as material composition, lifecycle instructions, and environmental impact metrics. However, regulatory requirements can change so the DPP needs flexibility for revisions and updates. The project also proposed balancing transparency with intellectual property protection using aggregation and anonymization techniques.

## 5.2 Recommendations for Policymakers

The findings from the Flex-ID project emphasize the need for policymakers to consider the practicalities and challenges encountered during DPP implementation when designing regulations. Key recommendations include:

1. **Adopt Flexible, Technology-Neutral Regulations:** The project demonstrated that different identification technologies, such as QR codes, digital watermarks, and labelling, are suitable for different product categories. Policymakers should avoid prescribing specific technologies and instead define performance-based requirements, such as durability, accessibility, and data accuracy, to allow manufacturers to select the best solutions for their products.
2. **Address Lifecycle Challenges:** The project highlighted the difficulties of maintaining DPP accessibility over long product lifespans, particularly for construction and outdoor applications. Regulations should include provisions for backup systems and require downstream actors to integrate DPP data for semi-finished products, ensuring continuity of information across the value chain.
3. **Harmonize Regulatory Requirements:** Different frameworks such as ESPR and CPR created implementation challenges. Policymakers should work towards aligning the mandatory content and requirements for DPPs as much as possible to simplify compliance and reduce complexity for manufacturers operating in multiple sectors.
4. **Incentivize Industry-Wide Collaboration:** The collaborative nature of the Flex-ID project, involving manufacturers, recyclers, and industry associations, was essential to its success. Policymakers should encourage similar collaborations by supporting pilot projects and creating forums for stakeholder engagement to develop standardized approaches to DPPs.
5. **Support Smaller Manufacturers:** The project underscored the resource challenges that smaller companies will face in adopting DPP systems. Policymakers should consider providing financial or technical assistance, such as grants, subsidies, or shared digital infrastructure, to ensure SMEs can participate in DPP initiatives without disproportionate burdens.
6. **Promote Education and Awareness:** The Flex-ID project revealed the importance of clear communication about DPP benefits. Policymakers should develop educational resources and awareness campaigns targeting manufacturers and recyclers, emphasizing the role of DPPs in improving traceability, circularity, and compliance.

# 6. Acknowledgements

The success of the Flex-ID project would not have been possible without the dedicated collaboration and contribution of numerous companies and stakeholders across the PVC value chain. This initiative brought together expertise from VinylPlus, Beaulieu International Group, RENOLIT SE, Sioen Industries, 3E, and other industry partners, fostering a shared commitment to advancing sustainability and circularity. We extend our gratitude to all participants for their invaluable insights, technical innovations, and unwavering support, which were instrumental in shaping the outcomes of this project.

The FLEX-ID project team included:

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# 7. Appendices

## 7.1 Glossary of Terms:

- **Circular Economy:** An economic system aimed at eliminating waste and the continual use of resources.
- **Digital Product Passport (DPP):** A standardized digital record containing essential information about a product's materials, composition, lifecycle, and recycling instructions. It aims to enhance transparency, traceability, and circularity across supply chains.
- **Ecodesign for Sustainable Products Regulation (ESPR):** EU legislation aimed at making products more sustainable throughout their lifecycle, from design to end-of-life.
- **End-of-Life (EoL):** The stage in a product's lifecycle when it is no longer functional or useful and is disposed of or recycled.
- **EU Green Deal:** A set of policy initiatives by the European Commission with the overarching aim of making the European Union climate neutral by 2050.
- **Plasticized PVC:** Polyvinyl chloride (PVC) that has been made softer and more flexible by the addition of plasticizers.
- **Unique Product Identifier (UPI):** A unique code assigned to a product to distinguish it from others and enable tracking throughout its lifecycle.

## 7.2 List of Abbreviations:

- **B.I.G.:** Beaulieu International Group NV
- **CEAP:** Circular Economy Action Plan
- **CPR:** Construction Products Regulation
- **DPP:** Digital Product Passport
- **EC:** European Commission
- **EoL:** End-of-Life
- **EORI:** Economic Operators Registration and Identification number
- **ESPR:** Ecodesign for Sustainable Products Regulation
- **GTIN:** Global Trade Identification Number
- **PVC:** Polyvinyl chloride
- **QR Code:** Quick Response Code
- **RFID:** Radio-Frequency Identification
- **RENOLIT:** RENOLIT SE
- **SIOEN:** Sioen Industries NV
- **SoC:** Substances of Concern
- **UPI:** Unique Product Identifier
- **UOI:** Unique Organisation Identifier
- **UV:** Ultraviolet

## 7.3 References

1. European Commission. The European Green Deal. 2019 07/01/25]; Available from: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en.

2. European Commission. Circular Economy Action Plan. 2020 07/01/25]; Available from: https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en.

3. European Commission. European Industrial Strategy. 2020 07/01/25]; Available from: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/europe-fit-digital-age/european-industrial-strategy_en.

4. European Commission. EU Strategy for Sustainable and Circular Textiles. 2022 07/01/25]; Available from: https://environment.ec.europa.eu/strategy/textiles-strategy_en.

5. European Commission. Ecodesign for Sustainable Products Regulation. 2023 07/01/25]; Available from: https://commission.europa.eu/energy-climate-change-environment/standards-tools-and-labels/products-labelling-rules-and-requirements/ecodesign-sustainable-products-regulation_en.

6. European Parliament and Council of the European Union. Construction Products Regulation. 2024 07/01/25]; Available from: https://eur-lex.europa.eu/eli/reg/2024/3110/oj/eng.

7. European Commission. European Data Strategy. 2020 07/01/25]; Available from: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/europe-fit-digital-age/european-data-strategy_en.

8. VinylPlus. VinylPlus 2030 Commitment. 2021 07/01/25]; Available from https://www.vinylplus.eu/about-us/vinylplus-2030-commitment/.

9. VinylPlus. Progress Report 2024. 2024 07/01/25]; Available from: https://www.vinylplus.eu/our-achievements/progress-report-2024/.

10. European Council of Vinyl Manufacturers (ECVM). From Ambitions to Action, Making the EU Green Deal Happen! 2022 07/01/25]; Available from: https://pvc.org/from-ambitions-to-action-making-the-eu-green-deal-happen/.

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