Digital Product Passport (DPP): How RFID Enables Compliance, Traceability and Circular Supply Chains

HID Global: Powering Trusted Identities for a Circular Economy

EBOOK

Executive Summary

The Circular Shift

Global industries are transitioning from linear production models to circular economies focused on reuse, repair and sustainability. This shift is driven in large part by regulatory pressure, environmental responsibility and the need for more resilient supply chains, as well as the desire for improved profitability.

The DPP Mandate

The Digital Product Passport (DPP) is emerging as a foundational regulatory requirement from the European Union (EU) to ensure transparency across the product lifecycle. This technology introduces a standardized way to capture, store and share product data - from raw materials to end-of-life recycling.

The Technology Bridge

To meet these requirements at scale, organizations need a reliable method to connect physical products with digital records. RFID technology provides that bridge, enabling secure, scalable and automated identification that supports compliance while unlocking operational value.

Digital Twin

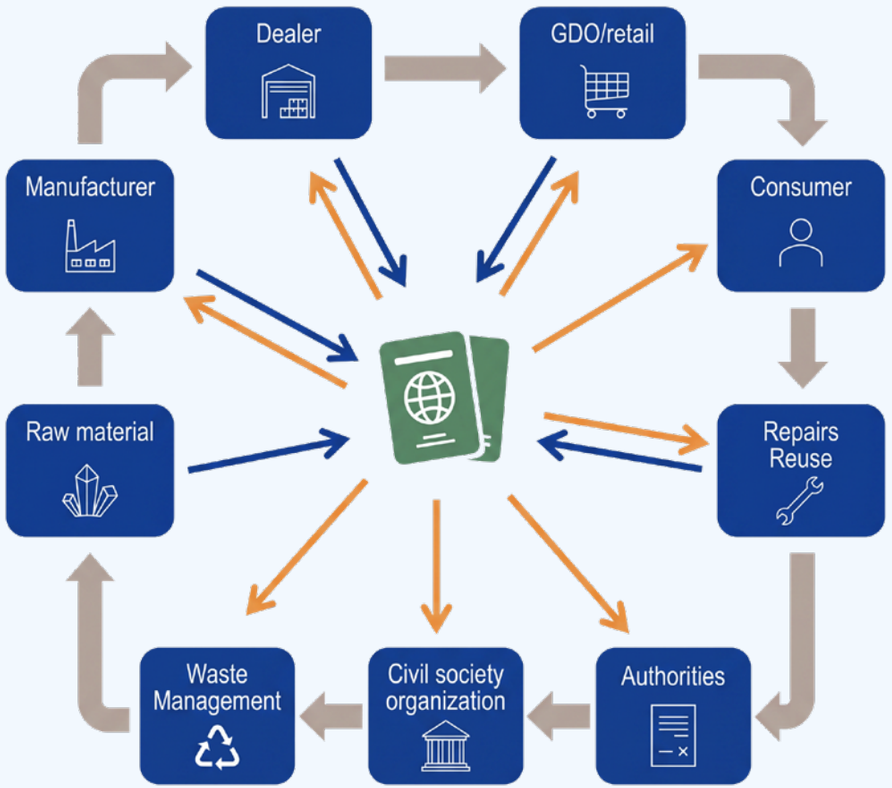
Digital Passport = Digital Twin

At the core of the DPP initiative is the Digital Twin: a dynamic, virtual mirror of the physical product, evolving throughout its entire lifecycle. While a physical product is static once it leaves the factory, its digital twin is “alive,” continuously accumulating data that provides several transformative benefits:

- **Real-Time Transparency & Traceability:** The digital twin provides an unbroken audit trail. Stakeholders can verify the origin of raw materials, manufacturing conditions and carbon footprint metrics instantly, ensuring compliance with global sustainability regulations.
- **Enhanced Product Longevity:** By storing maintenance schedules, repair histories and how-to guides, the digital twin empowers users and technicians to extend the product’s life. This shifts the business model from planned obsolescence to circular durability.
- **Optimized End-of-Life Recovery:** When a product reaches its end-of-use, the digital twin acts as a blueprint for recyclers. It identifies the specific materials and chemicals used, allowing for high-value material recovery rather than low-value downcycling or excess landfill waste.
- **Predictive Insights for Manufacturers:** Aggregate data from thousands of digital twins allows manufacturers to analyze how products perform in the real world. This feedback loop informs future engineering, helping brands design more efficient, recyclable and reliable products.

The digital twin is not just a record of what a product was - it is a roadmap for what that product can become in a circular economy.

Digital Product Passport: Data Flow



Introduction to the Digital Product Passport (DPP)

Defining the DPP

What information is required in a Digital Product Passport?

A Digital Product Passport is a structured digital record that accompanies a physical product throughout its lifecycle. It contains key data such as the following:

Key DPP Data Components	Key DPP Data Components
Manufacturing origin	Name, model, batch number, manufacturing date.
Material composition	Origin of raw materials, composition and supplier information.
Recycling instructions	Carbon footprint, resource efficiency, recycled content and presence of harmful substances.
Logistics	Border crossings, custody changes, transportation documentation
Repair and maintenance history	Information on repairability, reusability and detailed recycling instructions

Rather than acting as a static label, the DPP functions as a dynamic digital identity, continuously updated as the product moves through the value chain.

Regulatory Framework

The DPP is rooted in the EU's Green Deal and Circular Economy Action Plan. In June 2024, the European Parliament introduced initial regulations establishing DPP requirements for select industries.

These regulations aim to:

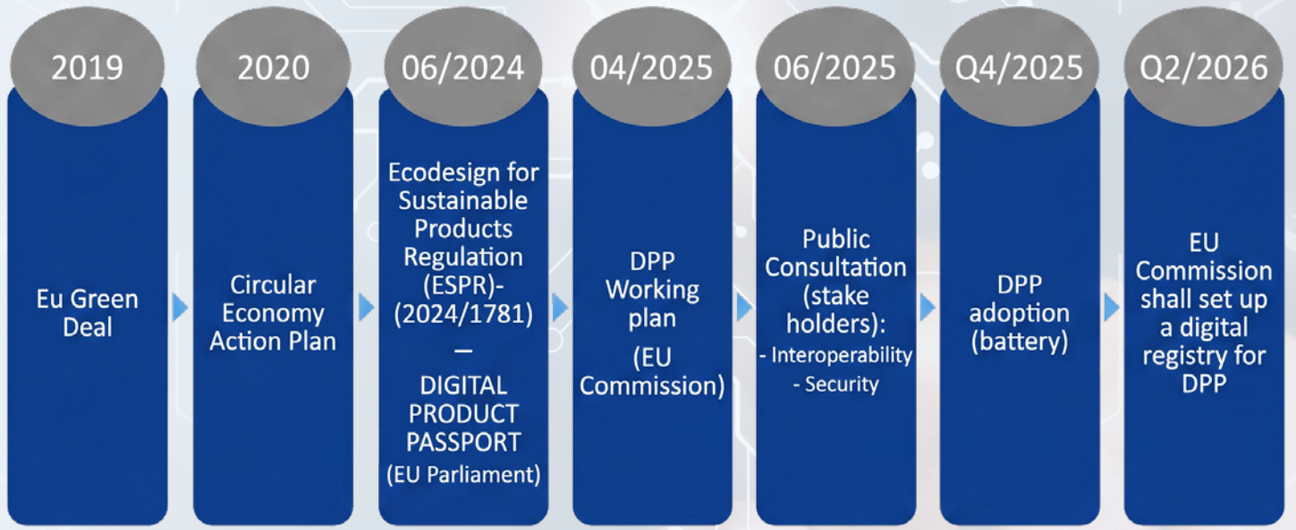
- Increase product transparency
- Enable sustainable consumption
- Support regulatory enforcement.

Specific deadlines and compliance requirements have been identified for each sector, making early preparation essential.

Explore these resources for further insights into the Digital Product Passport Regulations:

- European Commission: ESPR and the Digital Product Passport: The official source for the Ecodesign for Sustainable Products Regulation (ESPR), which establishes the DPP framework.
- GS1: Digital Product Passport Explained: An overview from the global standards organization on how DPPs will work and the standards involved.

Digital Product Passport: Regulations



Digital Product Passport: Markets and Timeline

Products		DPP Introduction				
		2026	2027	2028	2029	2030
Intermediate	Iron & Steel	✓				
	Aluminium		✓			
Final	Textiles/Apparel		✓			
	Furniture			✓		
	Tyres		✓			
	Mattresses				✓	
Horizontal requirements	Repair (consumer electronics and small household appliances)		✓			
	Recycled content and recyclability of electrical and electronic equipment				✓	

DPP Impacted Markets and Product Scopes

The first wave of DPP adoption targets industries with high environmental impact and complex supply chains. The EU aims for comprehensive coverage, requiring around 30 distinct product categories to have DPPs by 2030. These product categories encompass the following industry sectors:

- Metals: Iron, Steel, Aluminium
- Batteries (industrial, and transport batteries on the EU market)
- Tires
- Household Chemicals: Detergents, Paints and Chemicals
- Consumer Textiles
- Furniture and Mattresses
- Electrical and electronic equipment (computers, phones, etc).

These sectors face increasing pressure to provide verifiable lifecycle data. Managing this data at scale manually or through disconnected systems is simply not feasible, highlighting the critical need for automated identification technologies like RFID.

The Role of RFID in the DPP Ecosystem

While the European Commission has not yet mandated a specific data carrier technology for the DPP, the industry is gravitating toward a hybrid approach made up of QR codes and RFID tags. The primary requirement is accessibility, the tag must be easily scannable by consumers and supply chain users alike. Currently, the most pragmatic solution will be a label that includes both: a QR code on the outside for customers, paired with an embedded RFID tag. Manufacturers can combine data carriers by embedding a RAIN RFID tag on the inside for supply chain and inventory tracking.

Why RFID is Essential for DPP

Beyond simple identification, RFID technology provides the unique digital identity necessary to enable a functional passport system due to the following capabilities:

- **Automation:** Enables bulk reading of multiple items simultaneously without manual scanning
- **Data Integrity:** Securely links each physical product to a unique digital identity
- **Lifecycle Tracking:** Captures data across manufacturing, distribution, usage and recycling
- **Durability:** Operates reliably in harsh environments including heat, moisture and chemicals.

Did You Know? RFID tags can operate for up to 20 years in industrial environments.

Navigating Frequencies: NFC vs. RAIN RFID

There are a variety of RFID frequencies being considered for the DPP applications:

Near-field Communication (NFC) has a short read range (<10 cm) and is already enabled in consumer smart mobile devices, making it ideal for the consumer.

UHF RFID (RAIN) enables longer read ranges and high-speed data capture, making it ideal for the manufacturing, logistics and supply chain environments. While it currently requires industrial readers to read the tag, leading chip providers are working to integrate RAIN RFID into future consumer mobile devices.

Security

Data security is essential to ensure that sensitive supply chain information remains protected while meeting regulatory requirements. Yet, the technology used for DPP applications also must balance transparency with confidentiality. RFID supports the following security features:

- Cryptographic authentication
- Controlled data access
- Tamper detection capabilities.

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Real-World Applications and ROI

Current Use Cases

RFID is already enabling lifecycle visibility across various industries, as demonstrated by a broad range of diverse applications profiled on RFID.com, including the following:

- **Returnable Transport Items (RTIs):** Specialized solutions like Gitterbox Tagging ensure ownership confirmation and prevent loss in shared automotive logistics.
- **Industrial Assets:** Applications such as Heavy-duty Rope Tracking, Oil and Gas Yard Management and Gas Cylinder Tracking enable lifelong asset tracking even in extreme temperatures and harsh conditions.
- **Consumer Goods Authentication:** Solutions for Consumables Management provide unique identification to authenticate genuine products and protect brand reputation.

What Is the ROI Beyond DPP Compliance?

RFID delivers measurable value that substantially enhances profitability, such as:

- Reduced manual labor and errors
- Improved asset visibility
- Enhanced supply chain efficiency
- Stronger brand trust
- Extended product lifecycles.

How to Prepare for DPP Compliance

Assessment

Organizations should begin by evaluating current capabilities, including:

- Existing labeling and identification systems
- Data collection and storage infrastructure
- Supply chain visibility gaps.

Integration

To align with DPP requirements, businesses should:

- Embed RFID tags into products or packaging
- Integrate RFID readers into manufacturing and logistics workflows
- Connect data to centralized digital platforms.

HID offers a broad portfolio of RFID tags designed for diverse environments, from embedded components to rugged industrial tags.

Strategic Advantage

DPP should not be viewed solely as a compliance requirement. By ensuring standardized transparency across the entire product lifecycle, DPP presents valuable opportunities to:

- Enhance brand trust through transparency
- Improve inventory accuracy and efficiency
- Reduce operational costs and losses.

Final Thoughts

“DPP is not merely a regulatory requirement for goods manufacturers and economic operators; it is also a strategic opportunity to harness extensive product and lifecycle data to drive product design optimisation, enhance supply chain intelligence, enable predictive quality and reliability analytics, support sustainability, circular economy and end-of-life recovery initiatives, and generate deeper insights into customer behaviour”

Ayyaz Bucha, Business Development Manager at HID IDT

Future Outlook

Forward-looking organizations are already reframing the Digital Product Passport initiative from a regulatory obligation into a strategic advantage. By leveraging technologies such as RFID, businesses can strengthen brand trust, enhance operational efficiency and unlock new insights across the value chain.

“The DPP is a regulation that will impact the companies that provide the products and implement the technology, but also impact our lives as end users.” Giovanni Riganti, Sales Manager at HID IDT

Final Thoughts

The transition to DPP is already underway. Organizations that act now by investing in RFID-enabled digital identity will be better positioned to meet evolving regulatory demands while improving visibility, reducing inefficiencies and driving sustainable growth.

Delaying this transformation is no longer a viable option. In an increasingly regulated and transparent market, early adoption will define the leaders.

Watch our informative webinar on **Digital Product Passport & RFID: Compliance Made Simple** for more information.

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