Der Digitale Produktpass (DPP) – Chance zur Transformation

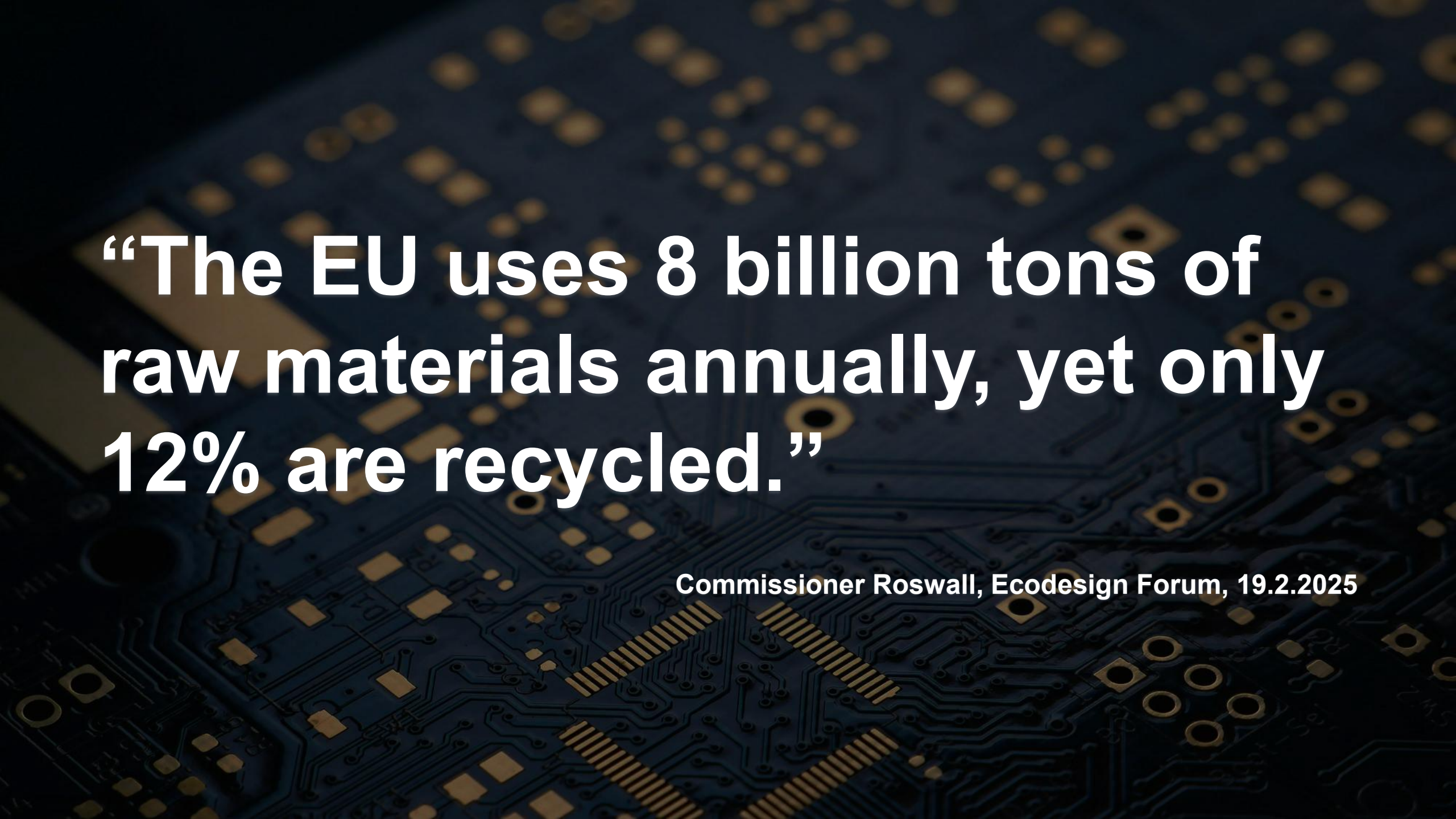
Herwig Zeiner, 25/2/2026

Agenda

DIGITAL PRODUCT PASSPORT

- Circular Economy
- Brief introduction to Digital Product Passport
- Background - ‘Asset Tracking’
- Marking Technologies
- Integration into Digital Product Passport Applications

Circular Economy


“The EU uses 8 billion tons of raw materials annually, yet only 12% are recycled.”
Commissioner Roswall, Ecodesign Forum, 19.2.2025

Circular Economy

The concept of the circular economy essentially aims to keep products, materials and components in circulation for as long as possible, so that hardly any waste is produced at the end.

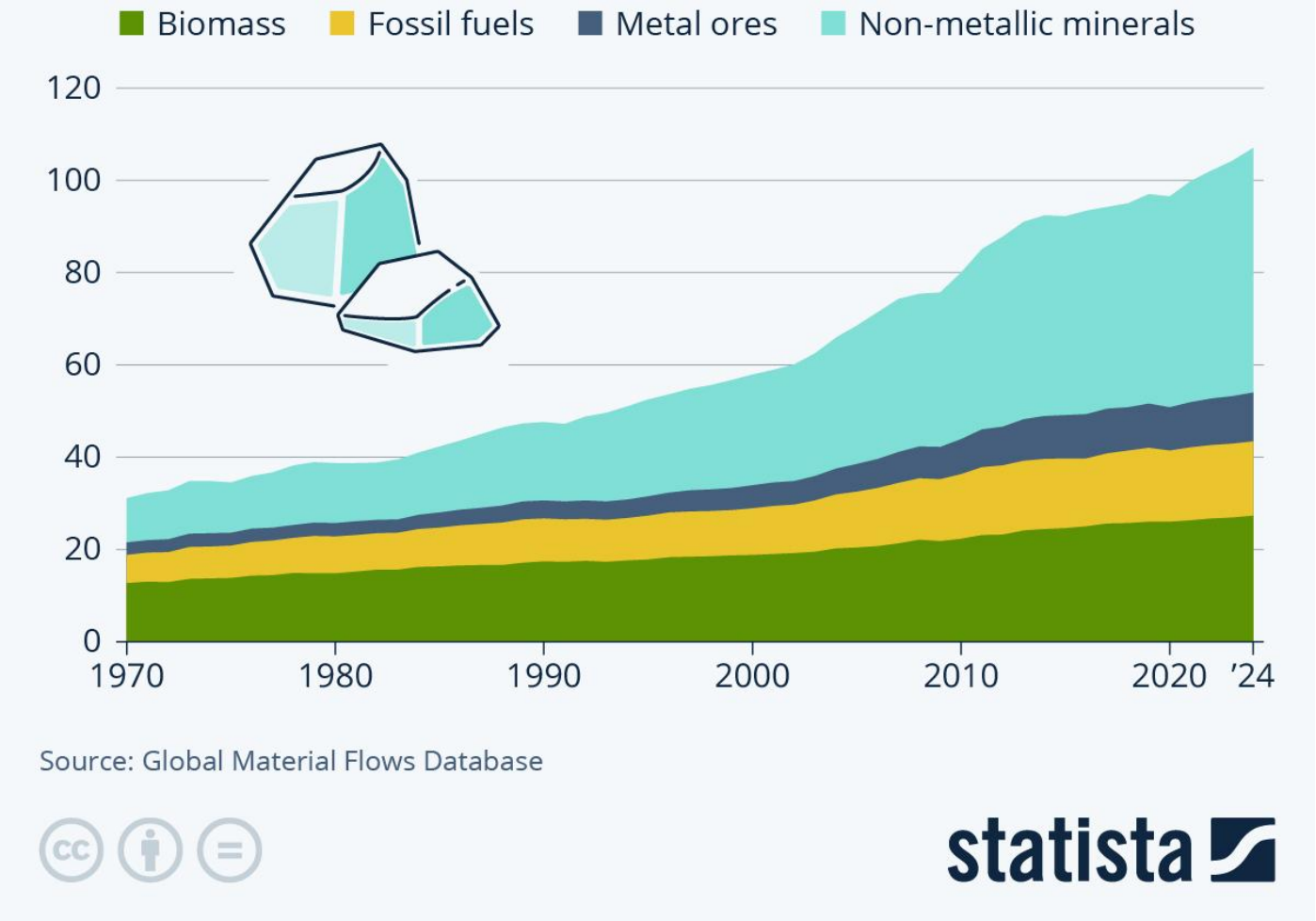
This distinguishes it from the current economic system, which is organised according to the so-called **flow principle (‘take, make, consume and dispose**’, also known as the ‘**linear economy**’).

Where does the circular economy come from?

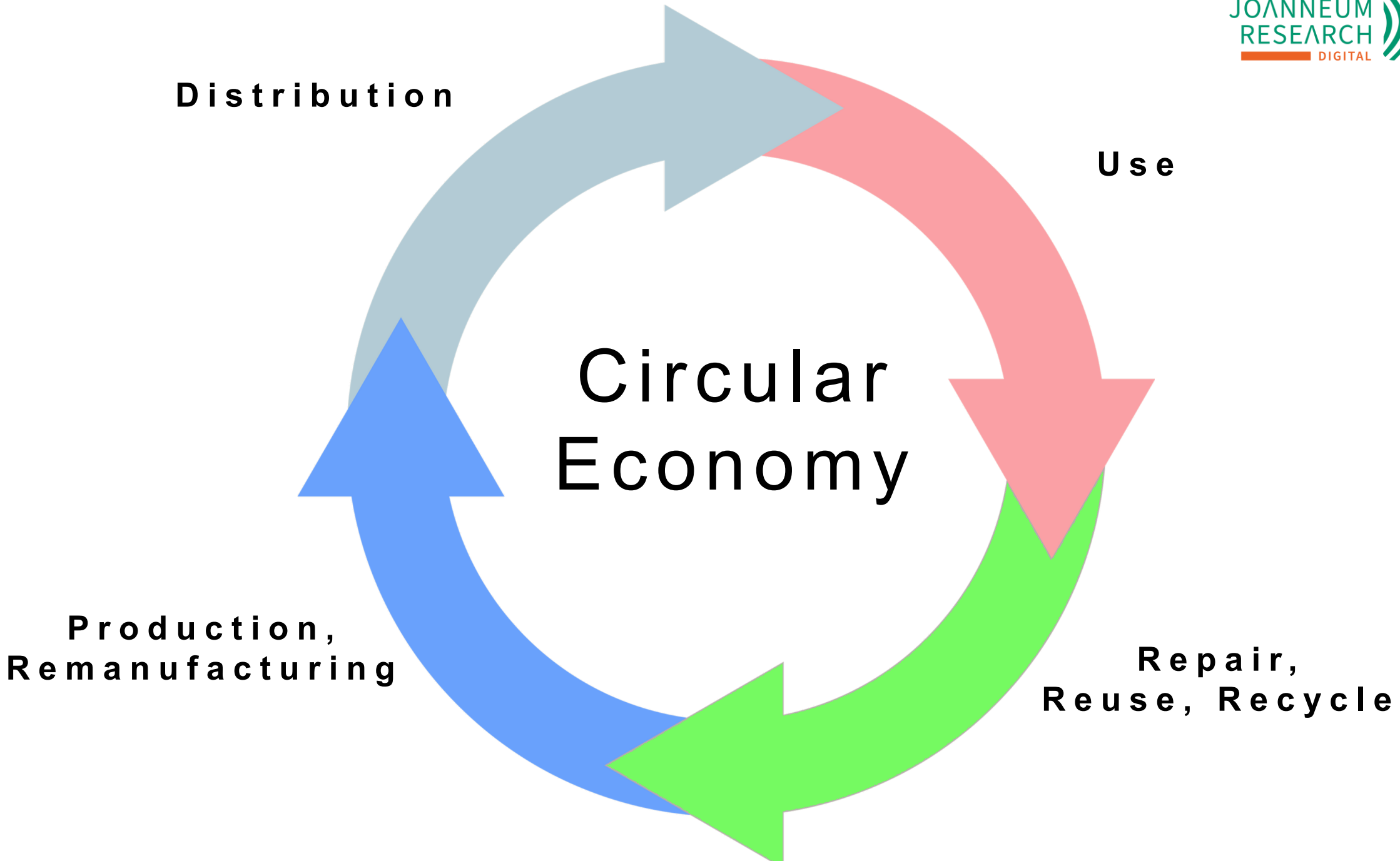
The idea of a circular economy is not new. In fact, it was the basis of human activity for thousands of years and can still be found in some countries today. With industrialisation and the accompanying rural exodus, this sustainable way of life was pushed aside.

British economist David W. Pearce introduced the modern idea of the circular economy in the **1990s**. It developed from the concept of industrial ecology, which aims to minimise the use of resources and promote clean technologies.

GLOBAL MATERIAL CONSUMPTION HAS APPROXIMATELY TRIPLED SINCE 1970.



Brief introduction to Digital Product Passport


Distribution
Use
Circular Economy
Production, Remanufacturing
Repair, Reuse, Recycle

A digital information record and service infrastructure is the Digital Product Passport (DPP). It summarises components, materials and chemical substances, as well as information on repairability, spare parts or proper disposal for a product over its entire life cycle.

For a holistic circular economy, the digital product passport is crucial. This is because it has the potential to close the information gap that exists along the entire value chain.

Access to information is enabled through a data carrier and the corresponding unique identifier

1

© Picabay

2

https://{domain}/identifier1

u
X

3

Data of Product

Back-Up

4

Provenance/traceability

Footprint

Durability

Warranty

Compliance documents

Classes of performance

Substances of concern

Labels

JOANNEUM RESEARCH DIGITAL

Digital Product Passport

Product Information

Production Data

Technical Documentation

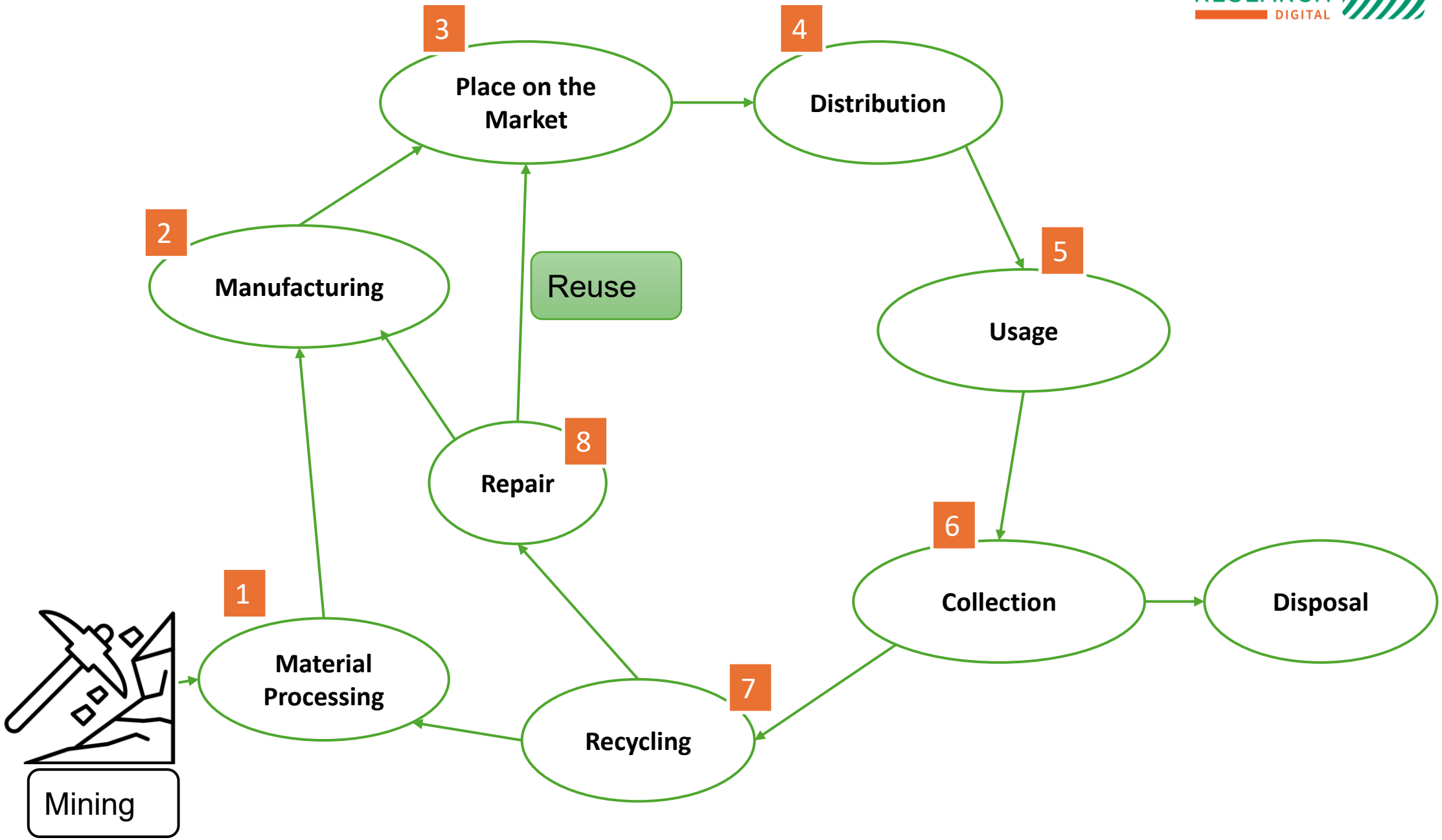
Material Composition

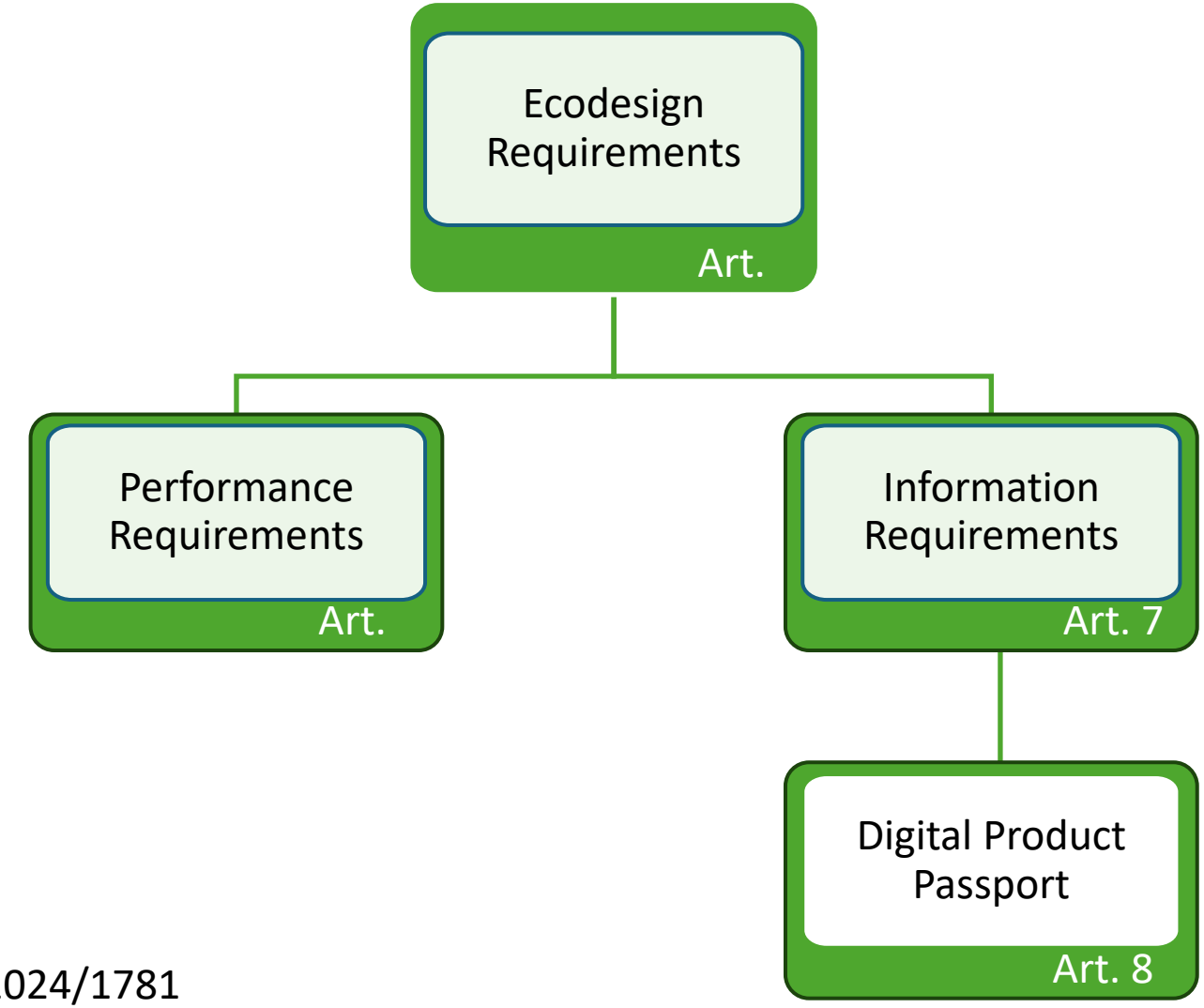
Recycle Material

RECYCLED MATERIALS

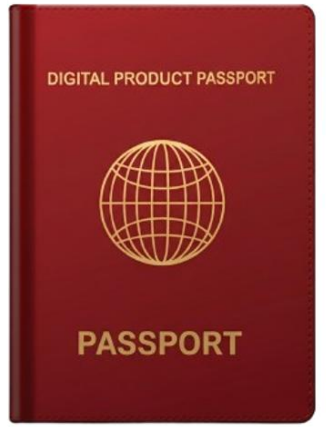
Repair Information

Authenticity Guarantee


3
Place on the Market
4
Distribution
2
Manufacturing
Reuse
5
Usage
8
Repair
6
Collection
Disposal
1
Material Processing
7
Recycling
Mining



Ecodesign Regulation 2024/1781
URL: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L_202401781



European Green Deal

Regulation for Eco-design

Digital Product Passport

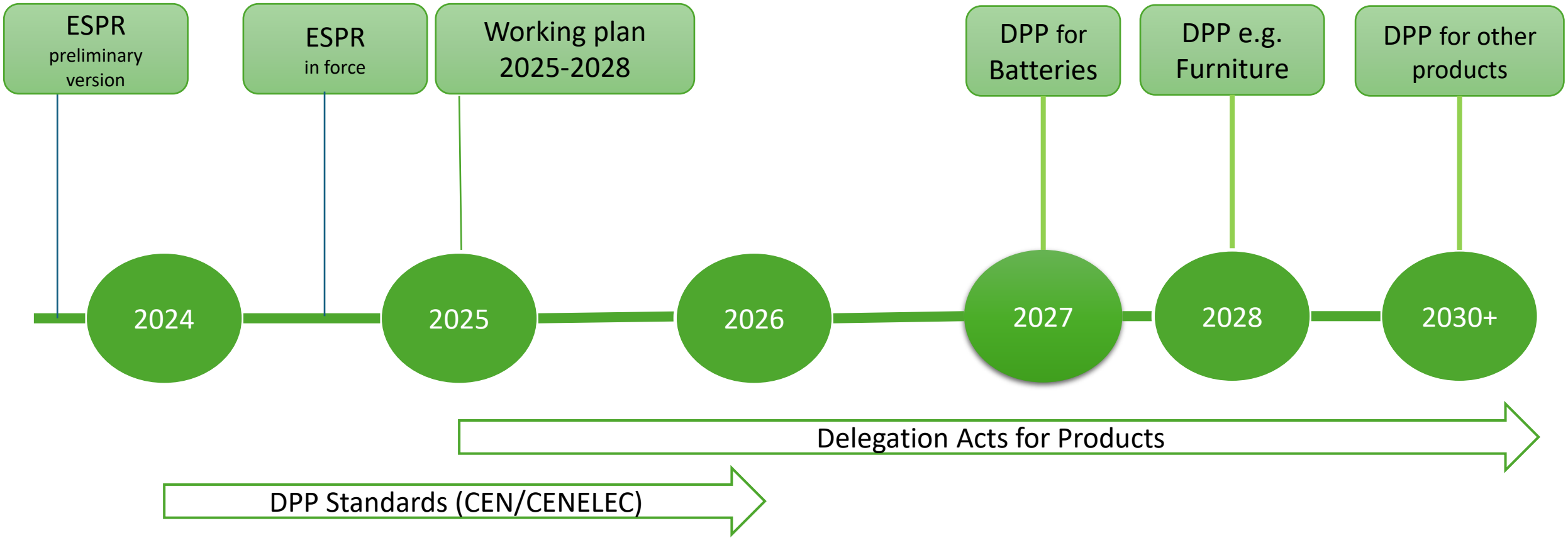
2019

2020

2024

2026-2030

Circular Economy Action Plan


ESPR
preliminary version
ESPR
in force
Working plan
2025-2028
DPP for Batteries
DPP e.g. Furniture
DPP for other products
2024
2025
2026
2027
2028
2030+
Delegation Acts for Products
DPP Standards (CEN/CENELEC)

Digital Product Passport – timeline for adaption

Products

1. *Textiles/Apparel , 2027*
2. *Furniture, 2028*
3. *Tyres, 2027*
4. *Matresses, 2029*

Intermediate Products

1. *Iron/Steel, 2026*
2. *Alumnium, 2027*

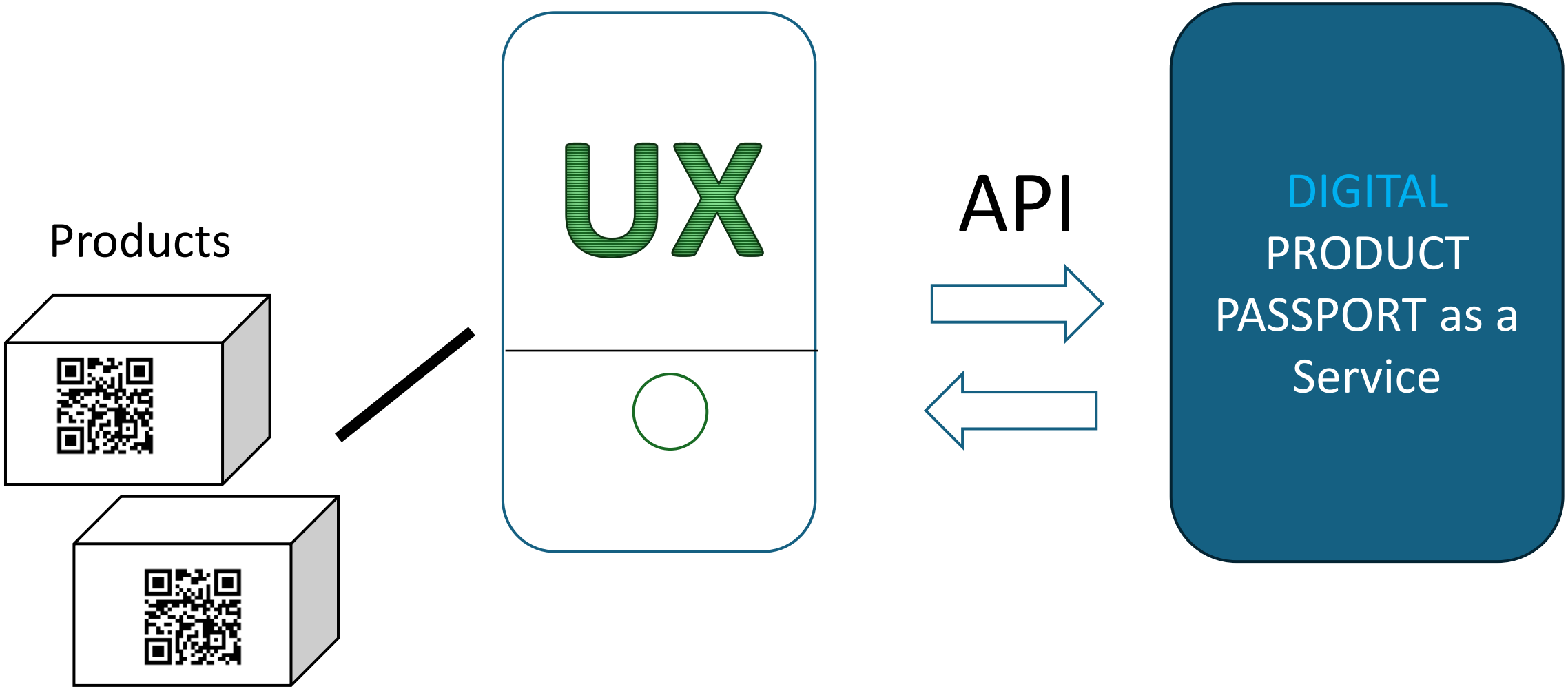
Horizontal requirements

1. *Repairability (including scoring), 2027*
2. Recycled content and recyclability of electrical and electronic equipment, 2029

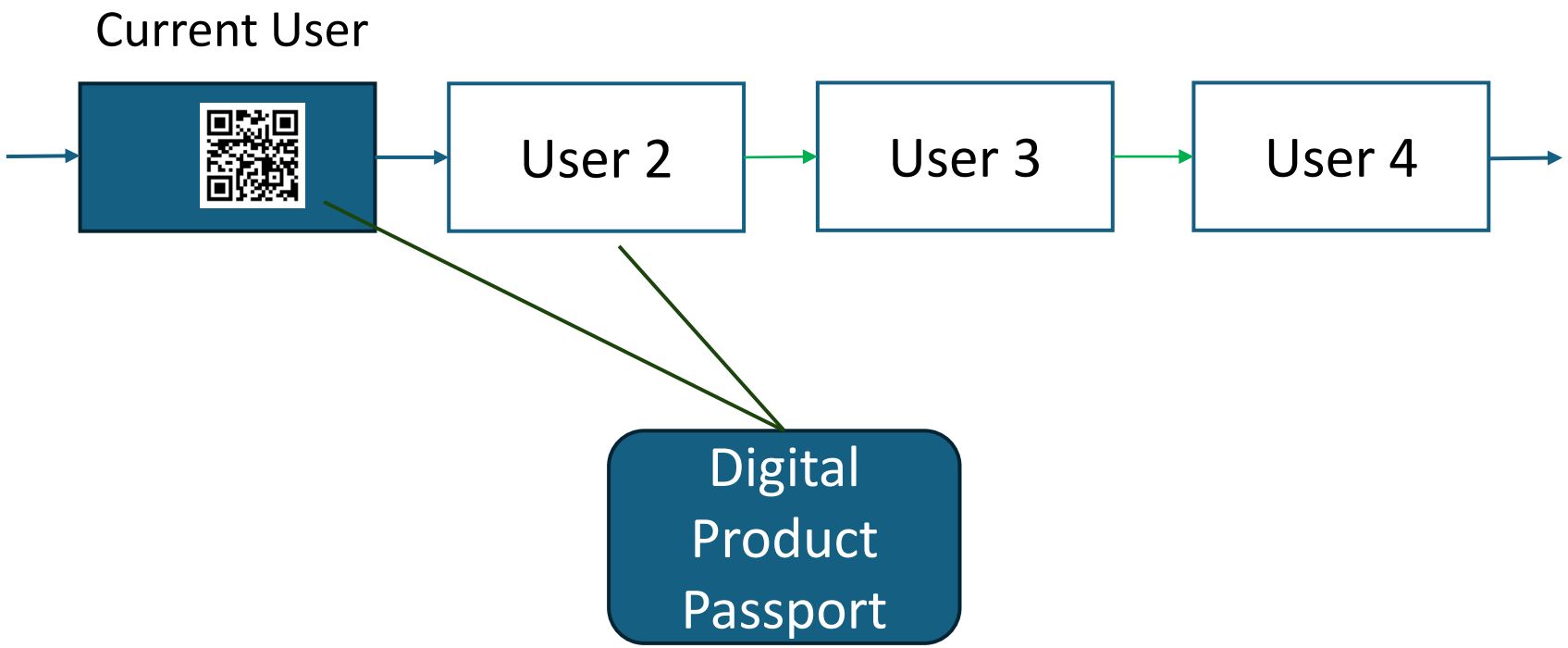
Source: Ecodesign for Sustainable Products and Energy Labelling Working Plan 2025-2030

Energy-related products	New product	Ecodesign requirements	Energy label	Indicative timeline
Low-temperature emitters	Yes	No	Yes	Adoption: 2026
Displays	No	Yes	Yes	Adoption: 2027
EV chargers	Yes	To be specified	To be specified	Adoption: 2028
Household dishwashers	No	Yes	Yes	Adoption: 2026
Household washing machines and household washer-dryers	No	Yes	Yes	Adoption: 2026
Professional laundry appliances	Yes	Yes	To be specified	Adoption: 2026
Professional dishwashers	Yes	Yes	To be specified	Adoption: 2026
Electric motors and variable speed drives	No	Yes	No	Adoption: 2028
Refrigerating appliances (including household fridges and freezers)	No	Yes	Yes	Adoption: 2028
Refrigerating appliances with a sales function	No	Yes	Yes	Adoption: 2028
Light sources and (only for ecodesign) separate control gears	No	Yes	Yes	Adoption: 2029
Welding equipment	No	Yes	No	Adoption: end 2030
Mobile phones and tablets	No	Yes	Yes	Adoption: end 2030
Local space heaters	No	Yes	Yes	Energy label: adoption in 2026 Ecodesign requirements: Adoption: mid-2030
Tumble dryers	No	Yes	Yes	Adoption: end 2030
Standby and off mode consumption	No	Yes	No	Adoption: end 2030

Source: Ecodesign for Sustainable Products and Energy Labelling Working Plan 2025-2030


Products
UX
API
DIGITAL
PRODUCT
PASSPORT as a
Service

Digital Product Passport make product usage transparent



Main Benefits from a User perspective

A digital product passport can **create new business opportunities for producers of products** that are able to provide new services related to the product and information about the production process.

Consumers can make more informed decisions about the products they purchase.

- With access to information about a product's environmental impact, recycled materials content, and end-of-life treatment, consumers can choose products that are more sustainable.

Main benefits of a Digital Product Passport

Businesses can improve their products and services. By tracking the performance of their products throughout their product life cycle, businesses can identify areas where they can improve their sustainability.

Governments can enforce environmental regulations more effectively.

In general, digital product passport can support the **transition to a circular economy** by helping to improve resource efficiency.

A circular economy is an economic system that aims **to eliminate waste and keep products and materials** in use for as long as possible.

Marking Technologies

Barcode 128, Data Matrix, QR Code as a Marking Technologies

Barcode 128

Barcode 128, also known as Code 128, is a type of alphanumeric barcode standard developed in 1981.

Alphanumeric encoding: Unlike traditional barcodes that only handle numbers, Code 128 can encode all 128 characters of the ASCII code set. This includes uppercase and lowercase letters, numbers, symbols, and even control codes.

Variable length: The length of a Code 128 barcode can vary depending on the amount of data it needs to store.

Multiple character sets: It offers three different character sets (A, B, and C) optimized for encoding uppercase only, both upper and lowercase letters, or digits respectively. Additionally, there's an auto-switching mode that automatically selects the most efficient set for the data being encoded.

Error checking: Code 128 includes a built-in error checking mechanism using a checksum digit. This helps ensure the accuracy of the encoded data when scanned

Barcode 128 - **Advantages**

High information density: Compared to other linear barcodes, Code 128 can store more data in a smaller space due to its ability to use different bar widths.

Alphanumeric encoding: It offers superior versatility by encoding all uppercase and lowercase letters, numbers, symbols, and even some control codes. This allows for including more detailed information like batch numbers, serial numbers, or expiration dates.

Variable length: The barcode size adjusts based on the data encoded, making it adaptable to various applications.

Multiple character sets: With options for uppercase only, uppercase/lowercase, or digits, Code 128 optimizes encoding for different data types. Additionally, the auto-switching mode simplifies data input.

Error checking: Built-in checksum digit helps ensure the accuracy of scanned data by detecting errors

Barcode 128 - Disadvantage

Printing requirements: The barcode requires high-quality printing due to its use of four different bar widths. Dot matrix or inkjet printers might not produce clear enough codes.

Limited scanning capabilities: Standard barcode scanners may not be able to read Code 128, requiring scanners specifically designed for this format.

Susceptibility to damage: Code 128 relies on precise lines and spacing. Scratches, smudges, or poor printing can render it unreadable.

Less user-friendly for human reading: The encoded data is not directly readable by humans, requiring a scanner for interpretation.

Data Matrix

A Data Matrix code is a two-dimensional code made up of black and white squares called "cells" or dots. These cells are arranged in a square or rectangular pattern, hence the name matrix. The code can store information in the form of text or numerical data. The usual data size ranges from a few bytes to 1556 bytes.

Compact data storage: Compared to linear barcodes, data matrix codes can store significantly more data in a smaller space. This makes them ideal for marking smaller products or components.

Error correction: Data Matrix codes have integrated error correction mechanisms. This means that even if parts of the code are dirty or damaged, the scanner can still read the data correctly.

Versatile application: Data Matrix codes can be found in a variety of applications, for example in manufacturing for product tracking, in logistics for shipment tracking or on medicine packaging for authenticity checks.

Data Matrix- **Advantages**

Higher data density: Compared to linear barcodes, data matrix codes can store significantly more data in a smaller space, making them ideal for labelling small products or components with extensive information.

Error tolerance: Thanks to integrated error correction mechanisms, data matrix codes can still be read even if parts of the code are dirty or damaged. This is particularly advantageous in harsh environments or in the event of improper handling.

Wide range of applications: Due to their unique properties, Data Matrix codes are suitable for use in a wide range of applications, including production, logistics, medicine and aviation.

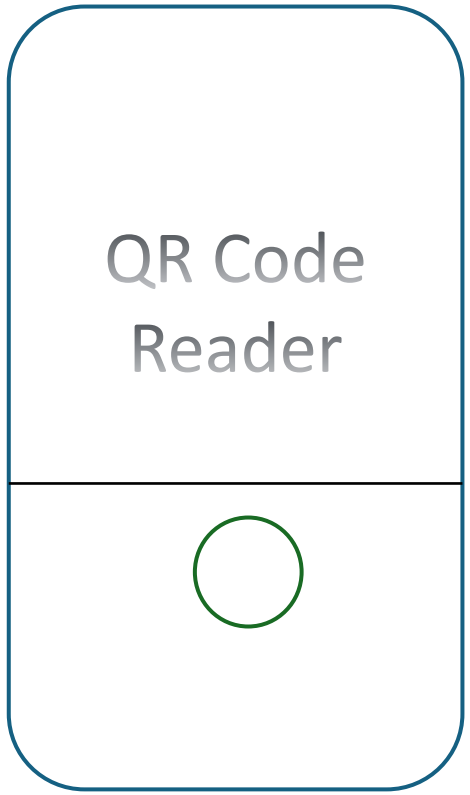
Data Matrix- Disadvantage

Although Data Matrix codes are somewhat error-tolerant, their readability can be compromised if they are severely damaged or soiled.

Data Matrix codes are less popular than QR codes. QR codes are more common in everyday life and are easier to read with smartphone cameras. This may result in Data Matrix codes being used less in public areas.

Motivation for a QR code as a Data Carrier

- They provide quick and easy access to information.
- QR codes can be placed on a product and scanned with a smartphone to direct the user to a website with product information.
- They can be applied to any material, are easy to use and take up little space.



QR Code - **Advantages**

Larger data capacity: making them ideal for complex product data or detailed marketing campaigns.

Faster scanning: QR codes are designed for quick and easy scanning with smartphones and dedicated scanners.

Versatility: They can be used on a wide range of materials and surfaces, making them adaptable for various marking applications.

Offline to online bridge: QR codes act as a bridge between physical products and the digital world. By scanning the code, users can access additional information online, enhancing the product experience.

QR Code - Disadvantage

User Awareness: Not everyone is familiar with QR codes and how to use them. This can be a barrier to adoption, especially for older demographics who might not be as tech-savvy.

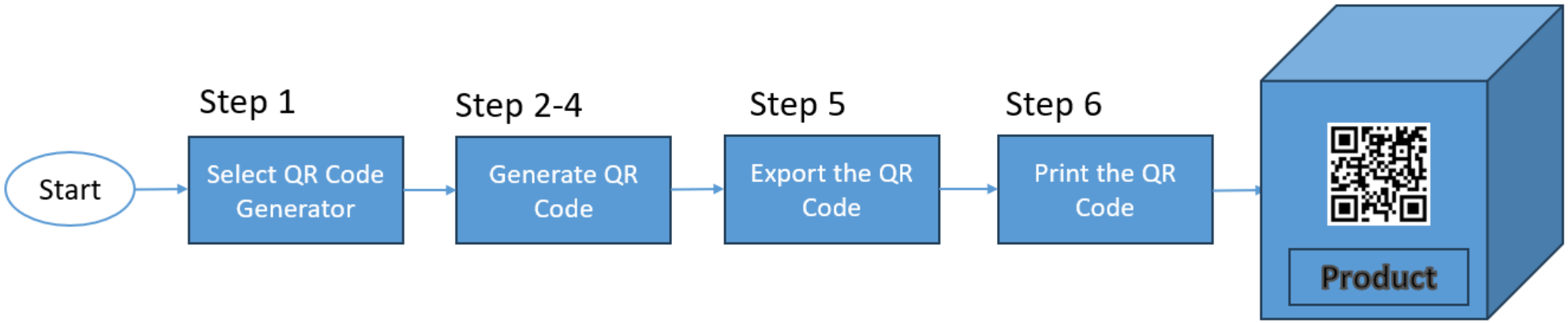
Reliance on Clarity: QR codes can become unreadable if damaged, dirty, or poorly printed. This can be frustrating for users and defeat the purpose of using them.

Security Concerns: QR codes themselves don't offer any inherent security. Anyone who scans the code can access the information encoded within. This is why it's important to be cautious about what information is encoded, especially sensitive data.

Example Data for a Battery

Product Identification	• Battery unique identifier: ConFactsX34XPCDADARERE
Product Information	• Manufacturer's identification: ID-DERKDFO56855484535 • Manufacturing date: 12/12/2022 • Manufacturing place: Graz
General characteristics: 'original' (Lifecycle status of the battery.	• Possible options suggested as follows: , 'repurposed', 'reused', 'remanufactured', 'waste')
Environmental Information	• **Battery carbon footprint:** The carbon footprint of the battery, calculated as kg of carbon dioxide equivalent per one kWh of the total energy provided by the battery over its expected service life, as declared in the Carbon Footprint Declaration.

QR Code as a Data Carrier



Choose a suitable QR code generator. Integrate this tool into your overall process.

Enter the information you want to encode in the QR code. This can be a URL, text, image or a combination of these.

Customise the style of the QR code. You can change the colour, size and shape of the QR code.

Create the QR code. Once you have entered all the information and adjusted the style, you can create the QR code.

Export the QR code.

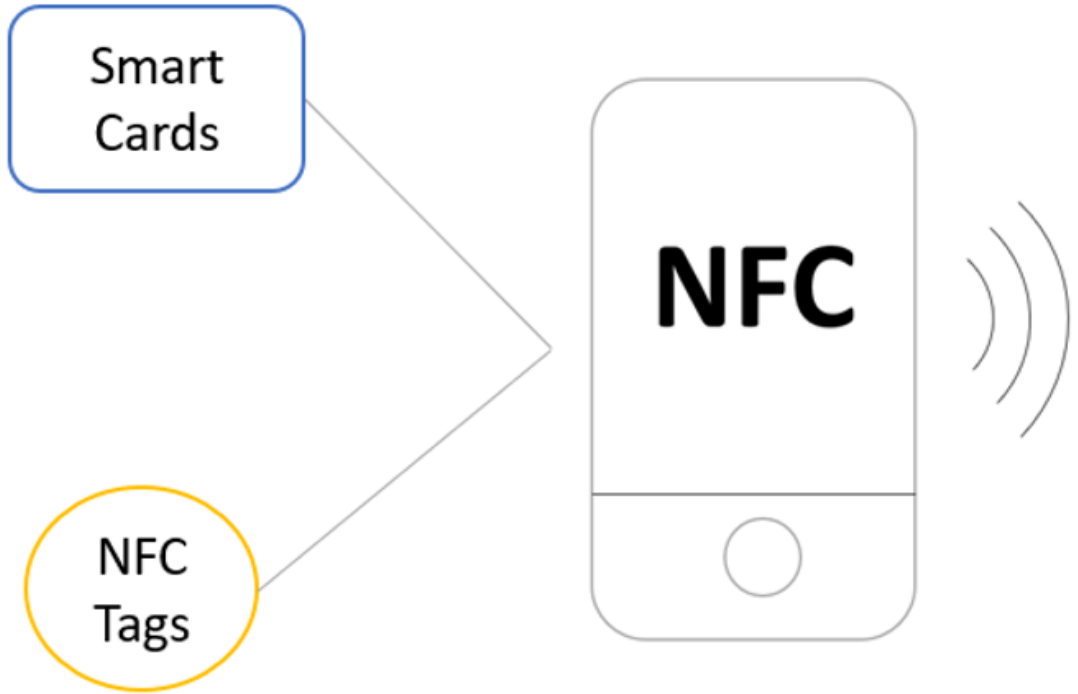
Print the QR code. Once you have exported the QR code, you can print it and place it on your product.

Compare Barcode 128, Data Matrix, QR Code

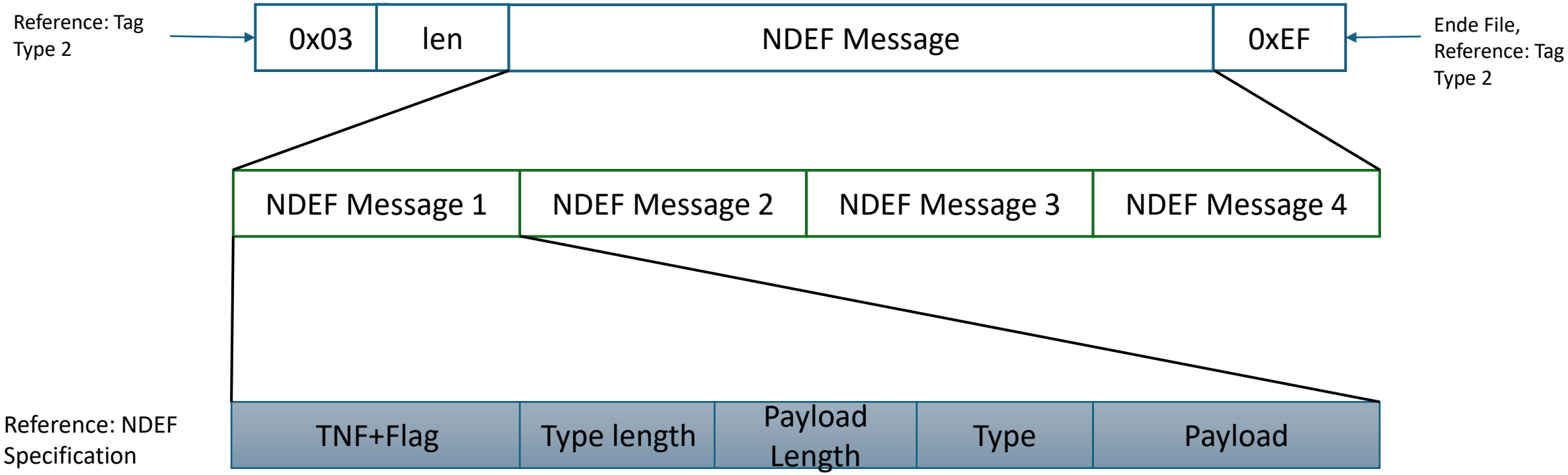
Feature	Barcode 128	Data Matrix	QR Code
Type	1D Barcode (Linear Barcode)	2D Barcode	2D Barcode
Data Capacity	Up to 128 characters (numbers, some special characters)	Up to 2,335 alphanumeric characters	Up to 4,296 alphanumeric characters
Size	Smaller	Smaller, high density	Larger
Error Correction	Low, less tolerant of damage	High, can tolerate damage or partial obscurity	Moderate
Scanning	Unidirectional (must be scanned in a specific direction)	Omnidirectional (readable from any angle)	Omnidirectional
Typical Uses	1. Inventory management, 2. Retail product identification, 3. Shipping & logistics	1. Part identification & tracking in manufacturing - Electronic components, 2. Healthcare (GS1 standards)	1. URLs & website links, 2. Marketing & advertising, 3. Tickets & coupons
Advantages	Simple and inexpensive, widely used and supported, efficient for encoding basic data	Stores more data in a smaller space & highly secure with error correction and ideal for small components	Larger data capacity than Data Matrix & User-friendly scanning with smartphones
Disadvantages	Limited data capacity & Not readable from any angle	Less common than QR codes, May require specialized scanners for some applications	Larger size compared to Data Matrix & Lower error correction than Data Matrix

NFC Code as a Marking Technologies

NFC (Near Field Communication), co-developed by NXP and Sony, is a contactless identification and connectivity technology that enables close wireless communication between mobile devices, consumer electronics, PCs, and smart control tools. NFC provides a simple, touch-based solution that enables consumers to share information, accessing content and services easily and intuitively.



NFC Tag Data


Reference: Tag Type 2
0x03
len
NDEF Message
0xEF
Ende File, Reference: Tag Type 2
NDEF Message 1
NDEF Message 2
NDEF Message 3
NDEF Message 4
Reference: NDEF Specification
TNF+Flag
Type length
Payload Length
Type
Payload

Formats for data exchange

Common NFC record types

- **vCard:** Stores contact information (e.g. electronic business cards)
- URI: Stores Universal Resource Identifiers (URIs), which include web addresses and other network resources and files
- **Text:** Stores text strings in multiple languages.
- **Smart poster:** Stores text strings, URLs, SMS or phone numbers.
- **Connection handover:** Stores pairing with Bluetooth, Wi-Fi or other protocols
- **Device information:** Stores basic details about the device mode and its identity.
- **Signature:** Provides an algorithm or certificate type for use as a digital signature

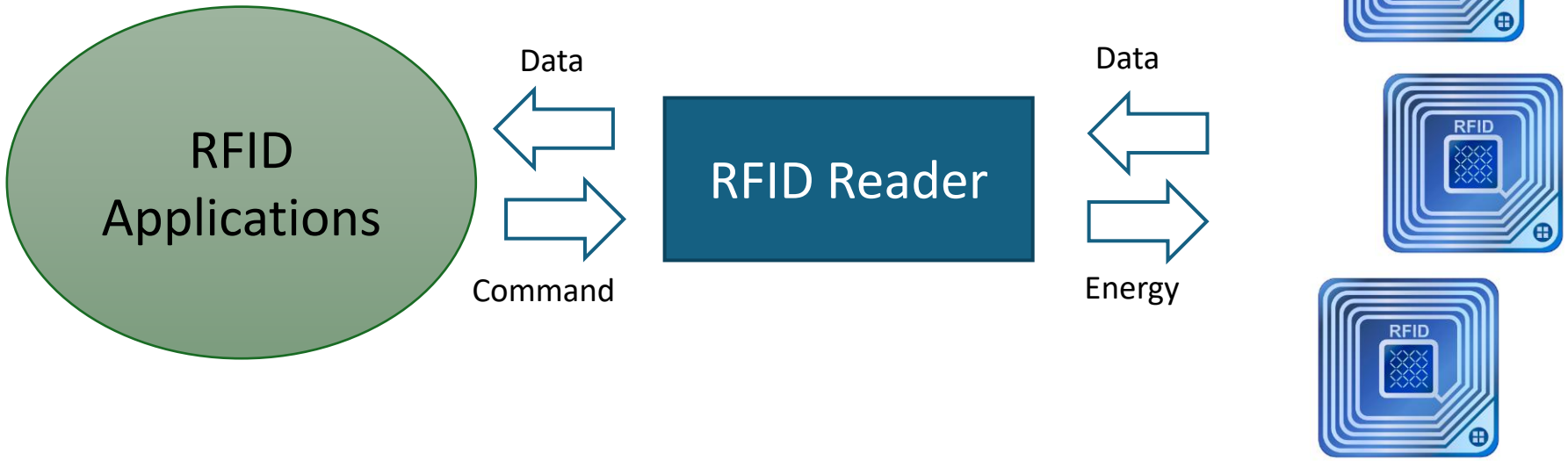
Most relevant Steps for using NFC tags for a Digital Passport

NFC as a Data Carrier

- **Choose the appropriate NFC tag from the several available on the market that vary in size, capacity, and cost.**
- **Ensure that you have sufficient storage space to accommodate the information that you wish to save.**
- **Add the right data on it.**
- **To obtain the information stored on the NFC tag, use an NFC reader to scan the tag attached to the product.**
- **The majority of smartphones are compatible with reading NFC tags.**

RFID as a Marking Technologies

RFID – Radio Frequency Identification – technology is an automatic identification technology for things in which information, **typically a serial number, is stored on a RFID transponder with microchip and serves as an electronic data memory**. Such RFID Transponders are linked to an object.



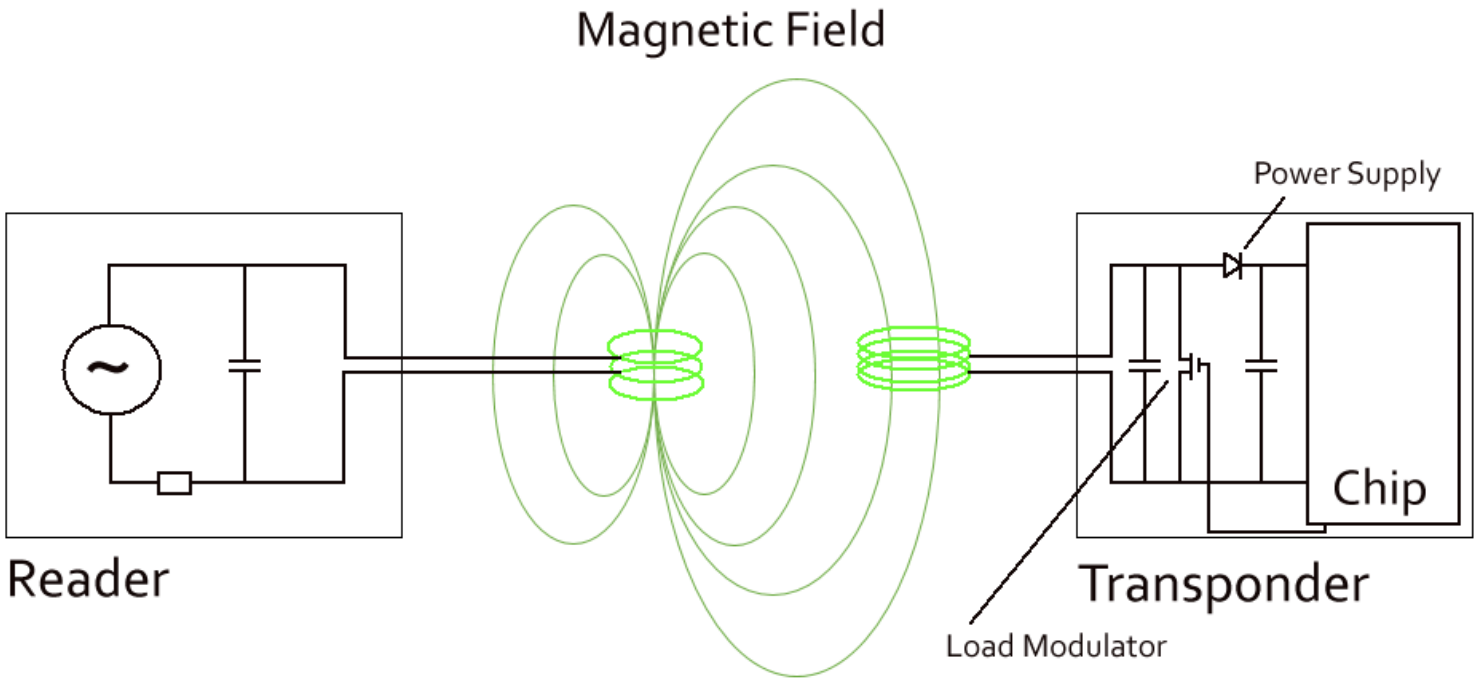
Frequency Bands	Low Frequency (LF) 125 kHz – 134 kHz	High Frequency (HF) 13.56 MHz	Ultra High Frequency (UHF) 860 MHz – 960 MHz
Range	up to 1m	up to 1,5 m	passive system up to 10 m
Antenna	Induction Coil on Ferrite Core, or flat many turns	Induction Coil flat 3-9 turns	Single or double Dipole
Typical Application in Industry	Access Control Inventory Control Car Immobilizer	Smart Cards Item or Case level Tagging Proximity Cards	Pallet or item level tagging
Transponder Costs	50 Cent – 2€	50 Cent – 2 €	From 8 Cent
Standards	ISO 14223, ISO/IEC 18000-2	ISO/IEC 14443, ISO 15693, ISO/IEC 18092, NFC	ECPglobal Gen2 (ISO 18000-6C)

RFID Tags

How does a RFID tag work?

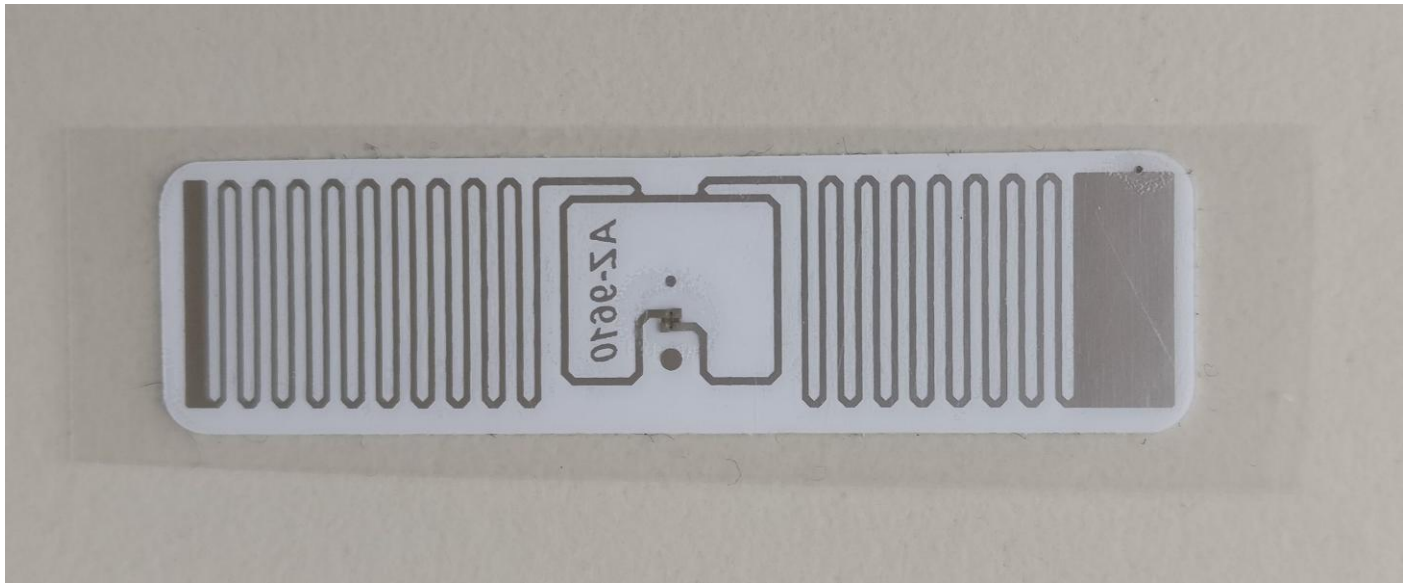
A read/write device (the RFID reader) builds up an electrical field which is used to transmit information and to power-supply the tag.

The field generates - or induces - an electric current in the RFID tag, which is used to power the tag (or transponder). This transponder has an analogue electronic circuit that interacts with the electric field generated by the reader, allowing information to be received and sent back to the device. The transponder also has a digital chip that can at least store information and often has control functions.



RFID tag design

Basically, every tag looks like this:



RFID tag design

Depending on the application, the design can be completely different

Types of RFID-Tags

Active Tags

- Active RFID systems use battery-powered sensor tags that connect to various access points throughout an area (e.g. a building) and transfer data to a receiver-node. Usually, active RFID tags use one of two frequencies to transmit information which is either 915 MHz or 433 MHz.

Advantages:

- can transmit over longer distances and adapt to more complex application environments
- compared to other wireless communication technologies (like BLE, Wi-Fi,..)
- requires only a simple transmission of ID signals
- lower power
- lower costs

Disadvantages:

- battery-powered means limited life-time
- more expensive
- bigger

RFID and Metal Surfaces

Metal surfaces reflect energy emitted from RFID readers and create interference for RFID tag antennas, which means the tag isn't able to receive power and transmit information

But metallic environments are a very important part of logistic (vehicles, machines, medical instruments,…)

Specific RFID tags will work around metal surfaces!

If you choose the correct RFID equipment for your application, you won't need (anymore) to worry about interference from metal

RFID Reader

Stationary RFID Reader

From the overall view a RFID reader environment consists of two parts:

- antennas
- the reader

Mobile readers

Mobile readers normally consist of a combination of

- a reader
- a small antenna
- a small computer system with a keyboard and a display (or as an additional device for a smartphone)

The shown Zebra-mobile-reader uses Android as operation system - therefore it is easy to implement specialized software.

The disadvantage of these devices is the small antenna, where you have to scan the tag directly from small distance - which is also an advantage in many cases (e.g. the deliverer only wants to scan one parcel at a time).

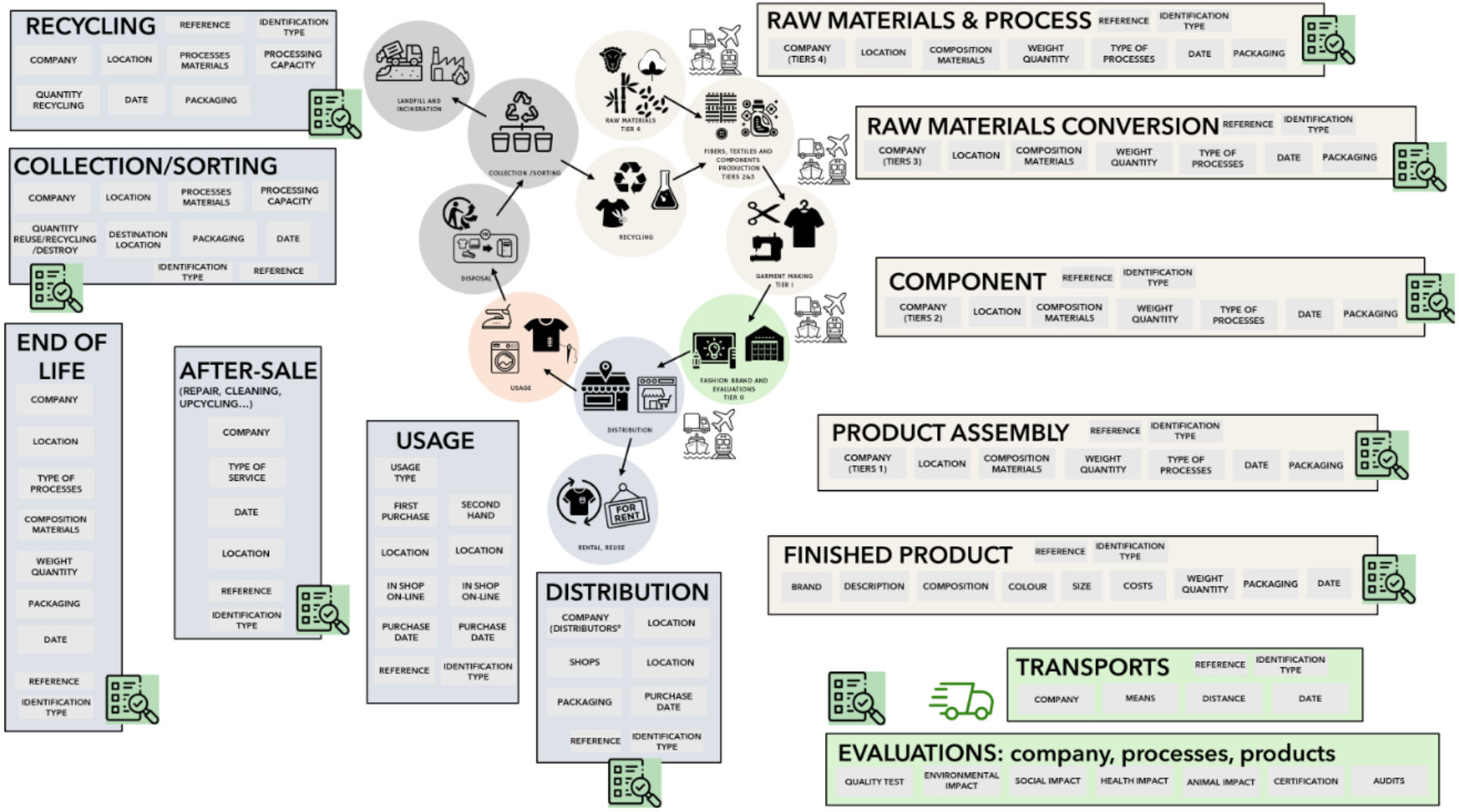
Comparison of Marking Technologies

Comparison of QR, NFC and RFID as Data carrier

Feature	QR Code	NFC	RFID
Data Storage	Limited (up to a few kilobytes)	Larger (up to a few hundred kilobytes)	Varies (depends on tag type)
Data Type	Text (URL linking to DPP data)	Text, URLs, small files	Text, URLs, large files
Read Range	Requires line-of-sight	Requires close proximity (a few centimeters)	Varies (depends on tag type)
Readability	Requires smartphone camera or dedicated scanner	Requires NFC-enabled smartphone	Requires RFID reader
Security	Low (data easily copied)	Higher (can be password protected)	Varies (depends on tag type)
Cost	Low	Medium	High
Durability	Susceptible to damage	More durable	Highly durable
Rewritable	No	No (common types)	Yes (some types)
Offline access	Limited (data stored online)	Limited (data stored online)	Yes (data stored on tag)

Integration into Digital Product Passport Applications

Example: Textile

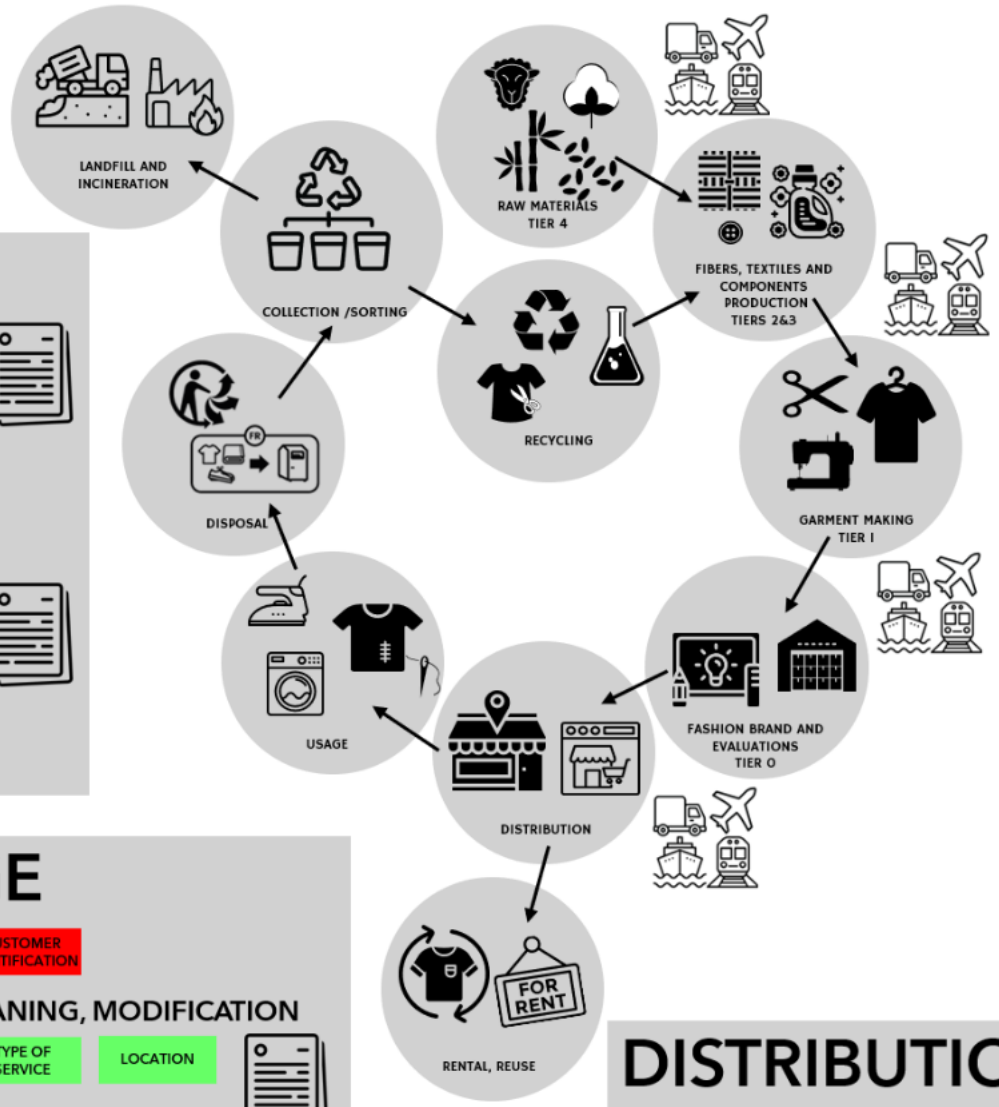


Generic Model

Majority agree to include

No consensus

Majority agree to not include



END OF LIFE

COLLECTING/SORTING

REFERENCE	IDENTIFICATION TYPE	INPUT
TYPE OF PROCESSES	OUTPUT	COMPANY (COLLECTING)
LOCATION	DATE	

RECYCLING

TYPE OF PROCESSES	COMPANY (RECYCLING)	LOCATION
RECYCLING STRATEGY	COMPOSITION	DATE

USAGE

USAGE TYPE	CUSTOMER IDENTIFICATION

REPAIR, CLEANING, MODIFICATION

COMPANY (AFTERSALES)	TYPE OF SERVICE	LOCATION
DATE		

DISTRIBUTION

COMPANY (DISTRIBUTORS)	LOCATION	PURCHASE DATES
IN SHOP	ON-LINE	SECOND HAND

SUPPLY CHAIN

PRODUCTION

REFERENCE	TRACEABLE ASSET	IDENTIFICATION TYPE
TYPE OF PROCESSES	COMPANY (TIER)	LOCATION
WEIGHT QUANTITY	COMPOSITION MATERIALS	DATE

TRANSPORTS

COMPANY	MEANS	DISTANCE
DATE		

FINISHED PRODUCT

REFERENCE	IDENTIFICATION TYPE/ AUTHENTICATION	DESCRIPTION
COLOUR	COMPOSITION	SIZE
COSTS	PACKAGING	WEIGHT
CIRCULARITY STRATEGY	COMPANY (BRAND)	DATE
QUANTITY	PERFORMANCE	

EVALUATIONS

QUALITY TEST	ENVIRONMENTAL IMPACT	SOCIAL IMPACT
HEALTH IMPACT	ANIMAL IMPACT	CERTIFICATION
AUDITS	COMPANY (EVALUATION)	DATE

Erlu Textiles

Crew Neck Tee

Product ID: 675742654

dpp.europe.uba.de/675742654

- Product Overview
- Materials & Composition
- Service
- Sustainability & Circularity

User role:

Consumer

Product Overview

BRAND NAME
Erlu Textiles

PRODUCT IDENTIFIER
675742654

COUNTRY OF MANUFACTURE
Turkey

SEASON
Autumn/Winter

SIZE
Medium

WEIGHT
0.150 kg

FIT
Slim

YEAR OF SALE
2021

COLOUR
Grey

CATEGORY
Clothing

PRICE (RRP)
€ 30

TYPE
T-Shirt

MATERIAL COMPOSITION
Recycled Organic Cotton (50%)

PRODUCT DESCRIPTION

Designed with circularity in mind, our signature crew neck T-Shirt is made from premium heavyweight cotton jersey.

Erlu Textiles

Crew Neck Tee

Product ID: 675742654

dpp.europe.uba.de/675742654

NNEUM
EARCH
DIGITAL

- Product Overview
- Materials & Composition
- Service
- Sustainability & Circularity

Service

The manufacturer of this product offers a takeback service.
Details from the manufacturer can be found **below** and at https://www.erlu-textiles.de/takeback

Care Instructions

- 30°C mild fine wash
- Iron at low temperature
- Do not tumble dry
- Do not bleach
- Do not dry clean
- Dry flat

Take-back and Return

Erlu Textiles Takeback Service

User role:

Consumer

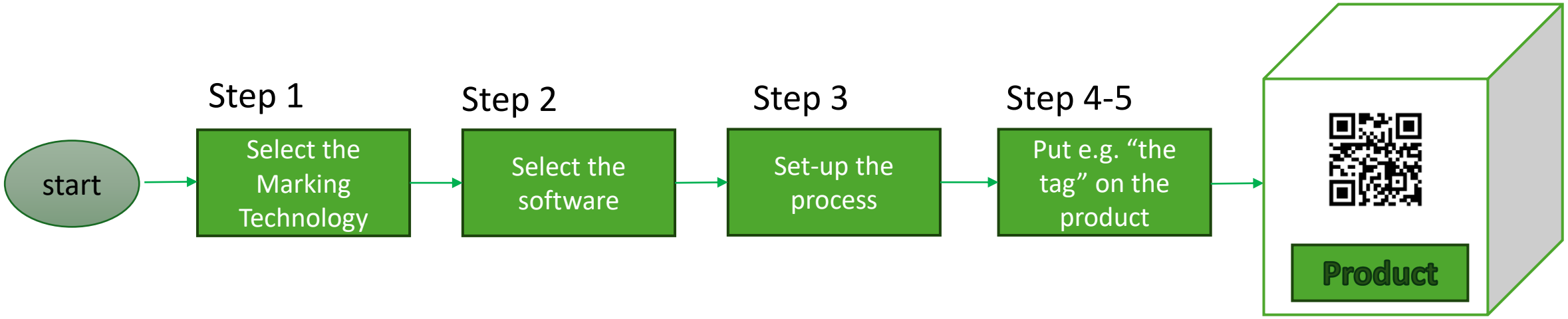
Example: Furniture

Product: Height-adjustable writing desk

1.) Table
2.) Motor
3.) Frame

© YAASA

Major Steps


start
Step 1
Select the Marking Technology
Step 2
Select the software
Step 3
Set-up the process
Step 4-5
Put e.g. “the tag” on the product
Product

Step 1: Marking Technology



Define the objectives of the Product Passport. What are the desired outcomes of implementing a Product Passport?

Data Collection

- What specific information is required to achieve your goals?
- This document provides details on the raw materials, manufacturing process, packaging, transportation, usage, and disposal of the product.
- Outlines a plan for gathering and storing data. Specifically, the plan should include the methodology for data collection, storage, and protection against misuse.

Interfaces

- Develop an interface for accessing the data and consider how it can be utilised by various stakeholders, such as businesses, consumers, authorities, and other organisations.

Nahtcodierung als Schnittstelle zu web3 oder NFTs

Step 2: Relevant Steps for selecting the Software

Define the objectives of the Product Passport. What are the desired outcomes of implementing a Product Passport?

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Step 3-5: Information Model

Product Characteristics

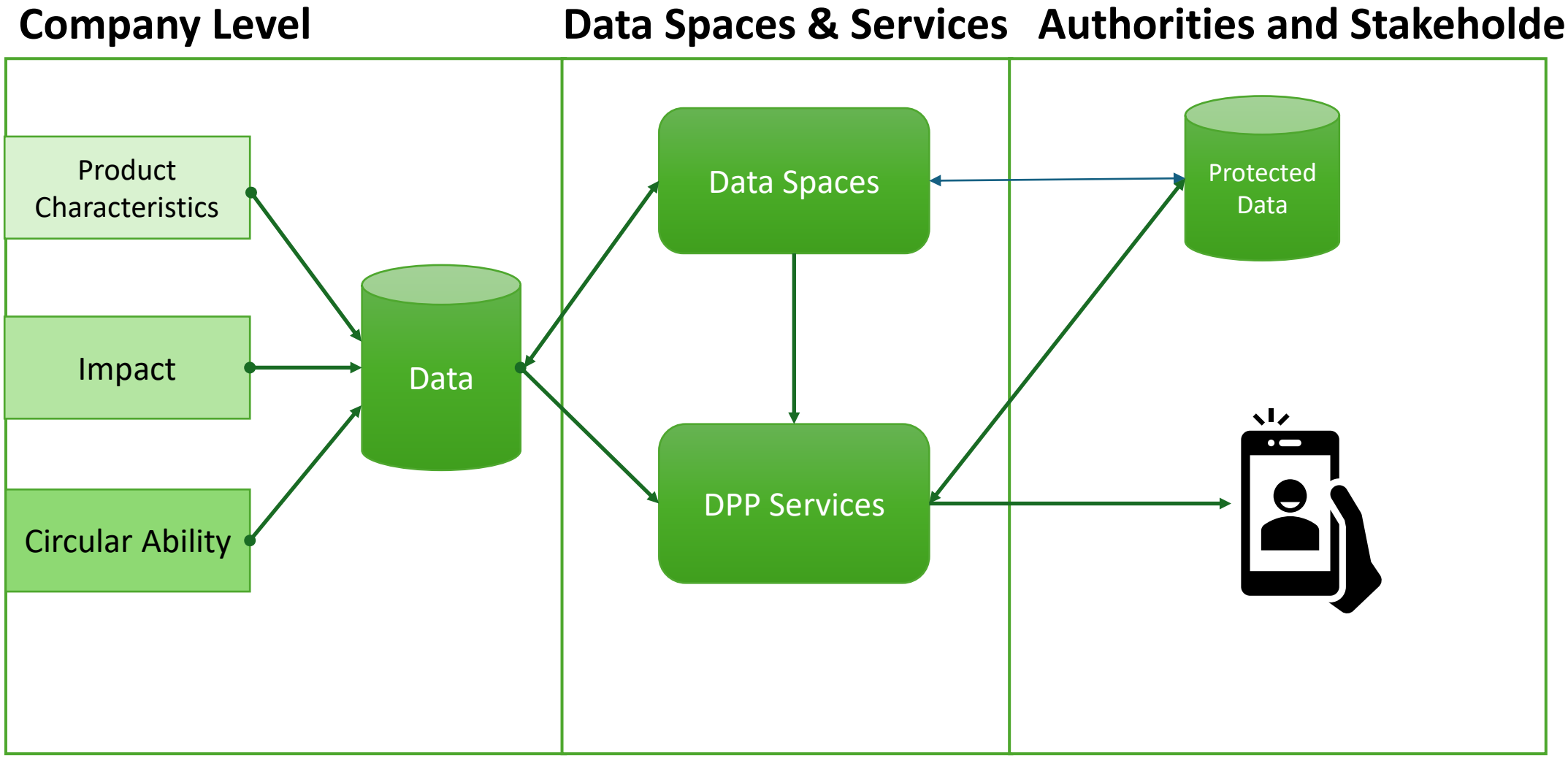
- **Specification:** Product and packing attributes
- **Identifiers:** Unique Identifier for public authorities
- **Compliance:** Certificates and declarations

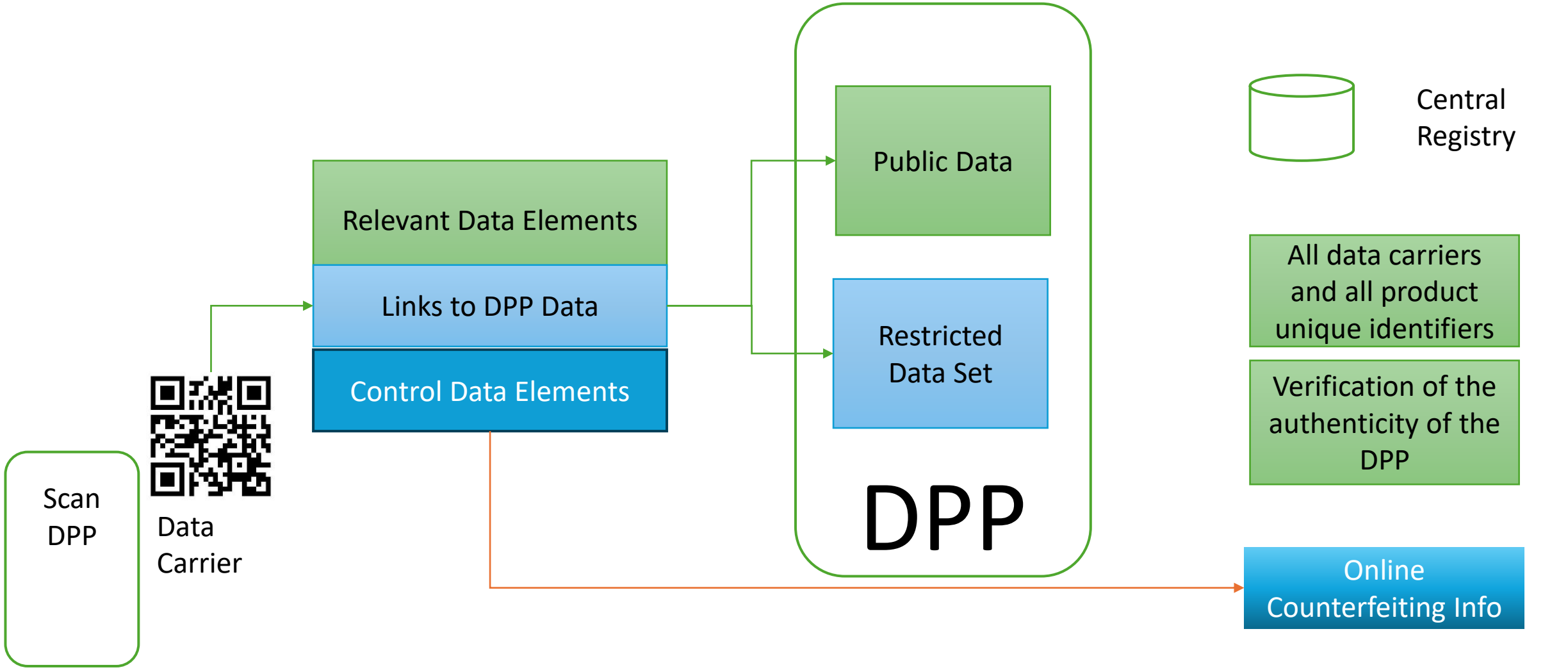
Impact

- **Sustainability:** Footprint and environmental influences
- **Recyclability**

Circular Ability

- **Durability**
- **Upgradeability**
- **Repairability**
- **Reusability**


Company Level
Data Spaces & Services
Authorities and Stakeholders
Product Characteristics
Impact
Circular Ability
Data
Data Spaces
DPP Services
Protected Data


Relevant Data Elements
Links to DPP Data
Control Data Elements
Public Data
Restricted Data Set
DPP
Central Registry
All data carriers and all product unique identifiers
Verification of the authenticity of the DPP
Scan DPP
Data Carrier
Online Counterfeiting Info
Offline Data Set
Online Data Set
Control Data Set

Further Material

Supplies of Future DPP Solutions as a Service

Avery Dennison, https://www.averydennison.com/, Video: https://www.youtube.com/watch?v=DrR1bYFl644

Rennon, https://www.renoon.com/

Scantrust, https://www.scantrust.com/

PicoNext, https://piconext.com/

Additional Information of 2 Austrian Lighthouse Projects

PASSAT, https://digitaler-produkt-pass.at/

- **Presentation:** https://www.ffg.at/sites/default/files/allgemeine_downloads/thematische%20programme/Produktion/Zeiner_Digital%20Product%20Passport%20Austria%20and%20Beyond.pdf

PACE-DPP

- **Presentation:** https://plattformindustrie40.at/wp-content/uploads/2025/02/2025-02-19-i40-DPP-CheckIn-PACE-DPP-Vorstellung.pdf

Questions?

Contacts

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