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Labelling and Information Schemes for the Circular Economy

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Abstract

Paucity of information, information asymmetries and competency gaps are considered important barriers towards increased resource efficiency and circularity, causing sub-optimal decision-making along all phases of the value chain.

Circular Economy Labels and Information Schemes (CELIS) compose the group of labels, certifications, standards of information schemes that fully or partially address one or more resource efficiency or circular economy elements. CELIS can play an important role in fostering circular economy activities. They can empower market actors to distinguish and discriminate products based on environmental performance, which stimulates market development and innovation in resource efficient products and services. Information systems also enable better supply chain management and allow firms to identify environmental impacts and risks in their supply chains.

This paper provides an overview of the current CELIS landscape, assesses the drivers and barriers to a greater uptake of business-to-business information systems, and identifies circular economy aspects that are underdeveloped in the existing consumer labels landscape.

Keywords:

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Résumé

Le manque d'informations, les asymétries d'informations et les lacunes en matière de compétences sont considérés comme des obstacles importants à l'augmentation de l'efficacité et de la circularité dans l'utilisation des ressources, entraînant une prise de décisions sous-optimales le long de la chaîne de valeur.

Les labels et systèmes d'information de l'économie circulaire (CELIS) constituent l'ensemble des labels, certifications et normes des schémas d'information qui abordent totalement ou partiellement un ou plusieurs éléments d'utilisation efficace des ressources ou d'économie circulaire. Les CELIS peuvent jouer un rôle important dans la promotion des activités d'économie circulaire. Ils peuvent permettre aux acteurs du marché de distinguer et de discriminer les produits sur la base de la performance environnementale, ce qui stimule le développement du marché et l'innovation dans les produits et services économes en ressources. Les systèmes d'information permettent également une meilleure gestion de la chaîne d'approvisionnement et permettent aux entreprises d'identifier les impacts et les risques environnementaux dans leurs chaînes d'approvisionnement.

Ce document donne un aperçu du paysage actuel des CELIS, évalue les moteurs et les obstacles à une plus grande adoption des systèmes d'information inter-entreprises et identifie les aspects de l'économie circulaire qui sont sous-développés dans le paysage actuel des labels de consommation.

Mots clé:

Économie circulaire, utilisation efficace des ressources, ressources naturelles, consommation durable, approches de politiques d'information

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Abbreviations and Acronyms

B2B	-	Business to business
B2C	-	Business to consumer
BSI	-	British Standards Institute
CAMDS	-	China Automotive Material Data System
CBI	-	Confidential Business Information
CE	-	Circular Economy
CELIS	-	Circular Economy Labels and Information Schemes
CFF	-	Circular Footprint Formula
CiP	-	Chemicals in Products
EEE	-	Electric and electronic equipment
ELIS	-	Environmental Labels and Information Schemes
EOL	-	End-of-life
ETC/SCP	-	European Topic Centre on Sustainable Consumption and Production
G2B	-	Government to business
G2C	-	Government to consumer
GADSL	-	Global Automotive Declarable Substance List
GASG	-	Global Automotive Stakeholder Group
GOTS	-	Global Organic Textile Standard
GPP	-	Green Public Procurement
GRI	-	Global Reporting Initiative
ICCA	-	International Council of Chemical Associations
IEC	-	International Electrotechnical Commission
IMDS	-	International Material Data System
ISO	-	International Standards Organisation
LCA	-	Life-cycle Assessment
LCI	-	Lifecycle Inventory
METI	-	Japan's Ministry of Economy, Trade and Industry
MSRL	-	Manufacturing Restricted Substances List
OEF	-	Organisation Environmental Footprint
OEFSR	-	Organisation Environmental Footprint Sector Rules
OEM	-	Original Equipment Manufacturer
PEF	-	Product Environmental Footprint
PEFCR	-	Product Environmental Footprint Category Rules Guidance
PPM	-	Product and Production Methods
REACH	-	Registration, Evaluation, Authorisation and Restriction of Chemicals
RICs	-	Resin Identification Codes
RoHS	-	Restriction of Hazardous Substances
SERI	-	Sustainable Electronics Recycling International
SVHCs	-	Candidate List of Substances of Very High Concern (in REACH Directive)
VCO	-	Value Chain Outreach

Executive Summary

Global raw materials use has grown to almost 90 Gt in 2017 and is projected to more than double by 2060. Increasing materials use and waste generation are putting growing pressure on environmental systems. Resource efficiency and the transition to a circular economy (CE) have become important elements of environmental and green growth policies. These efforts aim at decoupling materials use and related environmental impacts from economic growth.

Paucity of information, information asymmetries and competency gaps are considered key barriers towards increased resource efficiency and circularity, causing sub-optimal decision-making along all phases of the value chain. Upstream in the value chain, firms may miss opportunities to more resource-efficient procurement from higher tiers. At the consumption stage, consumers make misinformed purchasing decisions, leading to market inefficiencies and increased environmental externalities. Further downstream, recycling firms are unable to process potentially valuable secondary material, which can be due to missing information on waste streams and their material composition. In the public sector, these information deficiencies inhibit the greening of public procurement towards more resource efficient and circular products.

Circular Economy Labels and Information Schemes (CELIS) compose the group of labels, certifications, standards of information schemes that fully or at least partially address one or more resource efficiency or circular economy elements. CELIS can play an important role in fostering circular economy activities. They can empower market actors to distinguish and discriminate products based on environmental performance, which stimulates market development and innovation in resource efficient products and services. Information systems also enable better supply chain management and allow firms to identify environmental impacts and risks in their supply chains.

CELIS can broadly be divided into information systems that facilitate the information flow between businesses (B2B) and consumer-oriented labels (B2C). The design and information content of the information system differs according to the target group. Whereas consumer-oriented labels generally provide aggregated and simplified information to improve the clarity and comparability of products for consumers (e.g. EU Ecolabel, Blauer Engel or Nordic Swan labels), B2B information systems tend to be more detailed and sophisticated (e.g. IMDS database or chemSHERPA).

Many labels, certificates, standards and information systems that, at least partially, provide information on resource efficiency and circular economy aspects, exist already. In particular, the last two decades have seen a multiplication of environmental labelling and information schemes of varying scope, size and nature. Labels and information schemes with specific natural resources and waste focus have grown at a similar rate. However, while there has been a reasonable amount of work on environmental labels and information schemes more generally, most studies have focused on consumer-oriented labels and only few studies have systematically reviewed the entire CELIS landscape.

This paper provides an overview of the current CELIS landscape, assesses the drivers and barriers to a greater uptake of B2B information systems, and identifies circular economy aspects that are underdeveloped in the existing consumer labels landscape.

Business-to-business information systems

The fragmentation of value chains across the globe has increased the complexity of their management. Improved information sharing across tiers of the value chain can facilitate a better management of environmentally related risks and uncertainties in supply chains.

Different drivers have led to the development of information systems and declarable substances lists in different industry sectors:

- Regulatory interventions, such as information disclosure requirements at the point of sale, have incentivised some industries to develop information systems in order to facilitate the information flow from upstream tiers. For instance, in the automobile sector an International Material Data System (IMDS) was developed in response to the European end-of-life vehicle directive.
- Scrutiny from civil society actors has been a second driver for developing information systems. This has particularly been the case in industries, where much of the brand value is based on reputation and brand recognition, such as the textiles and fashion industry, where B2B information is used to inform consumer labels.

While existing B2B information systems have contributed to some environmental and social benefits, several barriers to a larger uptake and harmonisation of these systems remain:

- Confidential business information and intellectual property rights can pose a barrier to information disclosure. For instance, firms may consider relevant information such as material composition or the presence of hazardous substance necessary to keep confidential to protect their intellectual property. When designing information systems, a balance needs to be found to provide sufficiently detailed information without infringing on intellectual property rights.
- Furthermore, the multiplication and proliferation of different information systems and circular economy metrics increases transaction costs for companies to adopt these systems. While in some sectors a single information system has evolved as the dominant tool (e.g. IMDS in the automobile sector), other sectors have struggled to agree upon a standardised tool (e.g. chemicals in products systems in the electronics industry). Harmonisation and standardisation are therefore key to increase the industry uptake and improve the value and usability of data.

Consumer-oriented information and labels

Consumer-oriented information and labels can help shift demand towards more resource efficient and circular products and are also relevant for public procurement purposes. Consumer information and labels for the circular economy can comprise multiple lifecycle aspects and can inform consumers about a product's origin, its use-phase performance (e.g. energy efficiency), its lifespan (e.g. durability, reparability and upgradeability), or its end-of-life (e.g. recyclability). To date, most consumer-oriented information is associated with upstream and end-of-life aspects. Finally, labels and certificates for secondary products can also support the uptake of used-goods trading and reuse of products

(i) Labels providing information on a *product's lifespan* are a small but increasingly emerging label segment. These include labels that inform about the expected useful lifespan of a product, which can lead to consumers switching to products with longer lifespans. Different types of information are relevant: reliability (i.e. the expected service lifespan after production until the first failure), reparability (i.e. the extent to what the lifespan can be extended beyond the first and subsequent events of failure through repair), upgradeability (i.e. the ability of a product to continue being useful by enhancing its effectiveness or performance) and durability (i.e. the useful lifespan of a product until it becomes unrepairable for technical, economic or obsolescence reasons).

Two factors influence the optimal lifespan from an environmental point of view of a product: the trade-off between environmental impacts of different phases of the lifecycle and the rate of efficiency improvements in the use phase. Extending product lifespan is most desirable in product groups with high impacts related to production- and EOL-phases, low impacts during the use-phase and low efficiency improvements. Examples are mobile phones, notebooks, clothes, or furniture. As improvements in efficiency from new products diminish over time and the greening of the energy mix progresses, lifetime extension increasingly becomes the preferable option for most energy related products in most OECD countries.

There is considerable work ongoing at national and multilateral levels to support the incorporation of criteria that incentivise extending product lifespans into criteria sets used by ecolabels. A number of initiatives currently develop frameworks, metrics and standards for durability and reparability, which provide the basis for the inclusion of product lifespan criteria in product information and existing labels. So far, however, producers appear to have been reluctant to adopt voluntary product lifespan labels. For instance, the few labels with reparability criteria that currently exist for different electrical and electronic equipment (EEE) show relatively low adoption rates, suggesting that regulatory intervention might be required.

(ii) Labels and certificates for used goods can improve the market for and trade in used goods. Often, markets of used goods are less transparent than markets of new products, and reservations by consumers about the quality of used goods remain a barrier to used goods trading. Labels and certificates for used goods can be effective in increasing confidence and transparency for consumers, but may be challenging to develop due to the original equipment manufacturer (OEM) retaining confidential business information.

Used goods labels, certificates and end-of-waste criteria can also help differentiate legitimate exports of used EEE from illegal exports of waste EEE. These types of labels and information schemes could receive significant support from the industry as they help to reduce business risks related to safety and reputational issues that arise for original equipment manufacturers when their products are traded on used goods markets.

There is a need for policy intervention to strengthen CELIS

Consumer-oriented information and labels that encourage consumers to opt for longer-lived products or to repair and use them for longer timeframes currently remain niche and their uptake is low. Only few consumer-oriented labels include product lifespan criteria. Governments can facilitate methodological advances to support the integration of product lifespan criteria, such as durability and reparability, in product groups where this is expected to lead to reduced lifecycle impacts of products. The uptake and broader integration of these criteria can also be stimulated through corresponding requirements in public procurement and in extended producer responsibility (EPR) systems.

Second, more can be done to encourage enterprises and industrial sectors to develop information systems that can help improve resource efficiency along value chains and ensure their standardisation and harmonisation. Governments can instigate the development of such information systems through regulatory information disclosure requirements, for instance at the point of sale. Facilitating dialogues between stakeholders of upstream and downstream value chains can also help to improve the usefulness of information collected.

Some sectors are beginning to see a multiplication of different private (enterprise-level) information systems and consumer labels. Here, governments can support the harmonisation of information systems and the metrics that they use, in order to reduce transaction costs. Ideally this would be done at the international level. Multilateral fora such as the G7 or G20, as well as the International Organization for Standardization (ISO), World Trade Organization (WTO) and OECD, are well placed to provide a platform for these efforts.

1. Introduction

In recent years, resource efficiency and the transition to a circular economy (CE) have become important elements of environmental policy and green growth, as illustrated in multilateral initiatives at the G7 (G7, 2015[1]) the G20 (G20, 2017[2]) or the European Union (European Commission, 2018[3]), as well as in national initiatives and circular economy roadmaps in countries like China, Finland, The Netherlands or France (Plan Climat, 2017[4]; Dutch Ministry of Infrastructure and the Environment & Ministry of Economic Affairs, 2016[5]; Thieriot, 2015[6]; Ministry of the Environment Finland, 2016[7]).

At the same time, for the private sector, enhancing resource efficiency in value chains is an important challenge that is now increasingly being addressed. As raw materials, energy and water account for a substantial part of the production costs in the manufacturing sector and as value chains are becoming increasingly globally dispersed, it is a challenge for firms to identify and implement resource efficiency measures. Resource scarcity and material criticality may also cause risks in supply chains (Coulomb et al., 2015[8]). Further downstream, waste streams, such as plastics, are rapidly increasing in volume and their leakage into the environment causes harm to environmental systems, calling for increased circularity of material flows and material recovery.

One key barrier towards increased resource efficiency in value chains is the lack of information or information asymmetry, which causes market failures and leads to sub-optimal decision making for firms or consumers (Rizos et al., 2016[9]; AMEC, 2013[10]). Firms lose out on cost savings from more resource-efficient procurement from higher tiers of the supply chain. At the consumption stage, consumers make misinformed purchasing decisions, which lead to market inefficiencies and exacerbate environmental externalities. Further downstream, recycling firms are unable to process potentially valuable secondary material, due to missing information on chemical additives and potentially hazardous content in waste streams. Also in the public sector knowledge-related barriers often inhibit greening public procurement (GPP).

Circular Economy Labels and Information Schemes (CELIS) can be effective ways to promote resource efficiency and other circular economy activities through enabling consumers, businesses and institutions to make more informed purchasing decisions. The basic concept behind any environmental label and information scheme (ELIS) is to enable a distinction on the market of companies that manufacture products or deliver services with less environmental impacts. In the context of the circular economy, labels and certificates help companies to compete on product characteristics related to resource productivity and waste and enables them to realise an advantage in the market. Consumers on the other hand are able to easily identify the best environmental performing product through environmental labels, which can act as a market pull towards more environmentally friendly products and services (Cordella and Hidalgo, 2016[11]).

Eco-labels have been used for over forty years, and as environmental issues change and new environmental challenges arise, the ELIS landscape has been constantly evolving. In particular over the last two decades the ELIS landscape has grown and new types of schemes emerged (Gruère, 2013[12]). Several of these existing labels at least partially provide information on circular economy issues, both public schemes (e.g. EU Ecolabel, the Blue Angel/Blauer Engel, Nordic Swan) and private schemes (e.g. Programme for the Endorsement of Forest Certification (PEFC), EPEAT, BIFMA/NSF ANSI level certification, Cradle-to-Cradle).

Box 1. Previous ELIS work at the OECD

The OECD has a long history of influencing the development of environmental labels. Following the first report on environmental labelling in 1976, extensive reviews of existing and planned schemes were carried out in the 1980s and into the 1990s, contributing to promoting their use and effectiveness. Later work turned to interactions of ELIS and international trade. Recent OECD work has focused on the multiplication of schemes, with three reports produced since 2013:

- A first report documented the scale and nature of the growth and multiplication of ELIS. It provided a new characterisation of the types of schemes and presented quantified growth trends. The report also mapped the complex and dynamic landscape of actors, institutions and stakeholders involved in the development and operation of ELIS (Gruère, 2013[12]).
- A second report investigated the implications of the growth of schemes around the world, notably in the context of environmental effectiveness and international trade (Prag, Lyon and Russillo, 2016[13]).
- A third report focused on how public policies have guided and regulated ELIS, in particular in the context of self-made environmental claims. It included a comparative analysis of guidelines and regulatory instruments, examined definitions, standards and labelling requirements, as well as their monitoring and enforcement (Klintman, 2016[14]).

Several countries recognised the importance of information schemes for a successful circular economy transition. France’s new circular economy roadmap puts specific focus on consumption habits and consumer information. One of the measures proposed is to conduct a comprehensive assessment of existing relevant environmental labels and develop more refined information instruments for consumers (Plan Climat, 2017[4]). In The Netherlands, the National Circular Economy roadmap calls for the development of quality certificates for end-of-life plastics, in order to improve confidence in plastic recyclates (Dutch Ministry of Infrastructure and the Environment & Ministry of Economic Affairs, 2016[5]). Similar work on information availability and accessibility is undertaken at the level of the European Union (EU) in the framework of the EU Circular Economy Package (European Commission, 2018[15]).

While there has been a reasonable amount of work on environmental labels and information schemes more generally[1], issues that are central to RE and the CE, such as product lifespan labels or labels for used goods have received less attention so far. In addition, most research has focused on consumer-oriented labels and information schemes, and business-to-business information systems are less explored.

This paper provides a more comprehensive review of labels and information schemes in the resource efficiency and circular economy sphere. The remainder of the paper is structured as follows. Chapter 2 reviews relevant existing work and provides a definition of what is considered a “circular economy labels and information scheme” (CELIS) in the context of this paper. Chapter 3 describes different typologies that can be used to characterise CELIS. Chapter 4 maps the existing CELIS landscape. Chapter 5 discusses in a number of issues and limitations related to business-to-business and consumer-oriented CELIS. Chapter 6 concludes with policy implications.

[1] This includes substantive work on product and organisation environmental footprint indicators by the European Commission.

2. Labels and information schemes and the circular economy

2.1. Why are environmental labels needed?

It is safe to assume that not all actors in the economy have a comprehensive understanding of the resource footprint and lifecycle environmental impacts of products and services. Environmental labels and information schemes (ELIS), can inform market actors and enable more informed decision-making. ELIS can have a number of benefits:

- They can *inform consumer choices* and empower consumers to distinguish and discriminate products based on their environmental performance.
- From a policy perspective, they can *promote economic efficiency*, as labelling is generally cheaper than regulatory controls and can thus form a suitable substitute or complement.
- They can *stimulate market developments, innovation and economic growth* in green sectors by steering demand towards more environmental friendly products.
- They can *encourage continuous improvements* by providing an incentive structure for firms to invest in measures that reduce their environmental and resource footprint (Sexsmith and Potts, 2009[16]).

In the context of the circular economy and resource productivity, information and competency graphs are present along the entire value chain. Information asymmetries can be the cause of unexploited resource efficiency potentials and suboptimal consumption patterns (Rizos et al., 2016[9]; AMEC, 2013[10]). For example:

- Consumers often make misinformed purchasing decisions, which cause market inefficiencies and may enhance environmental externalities.
- Recyclers are unable to process potentially valuable secondary material, due to missing information on chemical additives and potentially hazardous content in waste streams.
- Manufacturers are exposed to environmental and social risks in upstream value chains, due to insufficient information flow from higher tiers.
- In the public sector, knowledge-related barriers can inhibit greening public procurement (GPP).

Circular economy labels and information schemes can help to overcome some of these barriers and information gaps and thereby lead to more sustainable consumption and production.

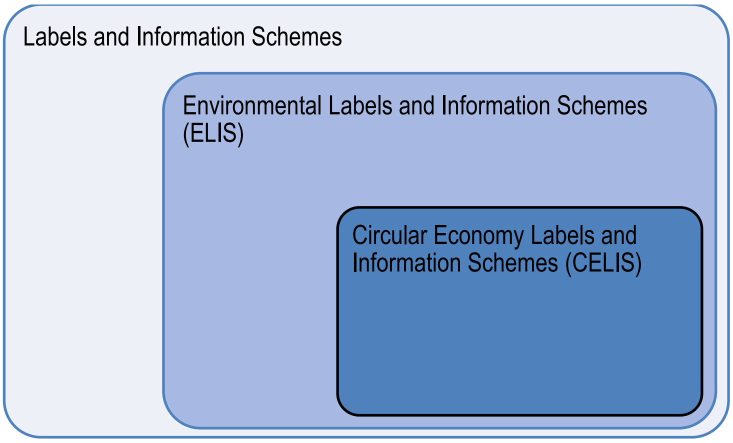
2.2. What are circular economy labels and information systems?

Circular Economy Labels and Information Schemes comprises two key concepts: they are “Environmental Labels and Information Schemes” specifically applied in the context of the “Circular Economy”.

2.2.1. Environmental Labels and Information Schemes definition

Previous work at the OECD has defined Environmental Labels and Information Schemes (ELIS) as “any policies and initiatives that aim to provide information to external users about one or more aspects of the environmental performance of a product or service” (Gruère, 2013[12]). Users may or may not require the information, but they can have access to it. Circular Economy Labels and Information Schemes (CELIS) can be thought of as a sub-set of the broader ELIS group that provides information to external users about all environmental performances that relate to circular economy issues.

Figure 2.1. CELIS as a subset of ELIS

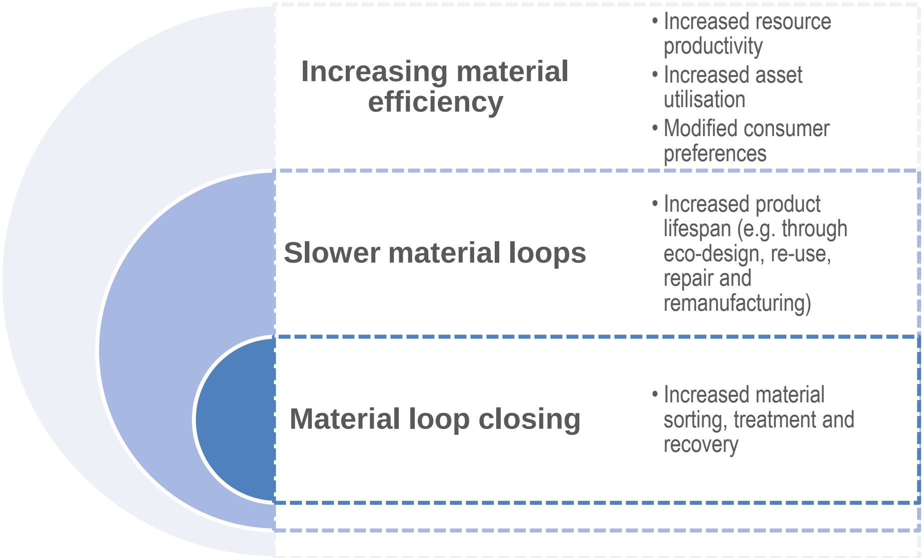


2.2.2. Circular Economy definition

The circular economy seeks to keep products, components and materials in the economy for as long as possible, trying to eliminate waste and virgin resource inputs. Whilst various definitions and interpretations of the circular economy (CE) exist, the approach generally entails lower rates of extraction and use of natural resources, reduced waste generation and increased resource efficiency. Previous OECD work on this topic conceptualised the circular economy along three different elements (McCarthy, Dellink and Bibas, 2018[17]):

- *Narrowing resource flows* aims at a more efficient use of natural resources, materials, products and components along all phases of the value chain. This part addresses the “structural” waste in current consumption patterns and underutilisation of assets (e.g. office space and private vehicles), through improved asset utilisation.
- *Slowing resource loops* stresses the need for fundamental changes in the economic system towards more durable products and increased lifetime through reuse, repair and remanufacture services.
- *Closing resource loops* aims at minimising raw material extraction and waste output through improved end-of-life sorting, treatment and increased material recovery.

Figure 2.2. Three different elements of the circular economy



Source: adapted from (McCarthy, Dellink and Bibas, 2018[17])

Each of these element can contain different circular activities, such as product life extension, repair and recycling activities, resource efficiency improvements or increased material recovery. Labels can be attributed to one or multiple of these activities (Table 2.1).

Table 2.1. Label attributes and their according circular economy element

OECD categorisation	Label attribute
Narrowing resource flows	Fuel efficiency
	Resource efficiency
	Toxicity labels
	Organic food production
Slowing down resource loops	Durability
	Reparability
	Reusability
	Ability to remanufacture
Closing resource loops	Recyclability
	Recycled content
	Renewable resource content

2.2.3. Circular economy label or information scheme definition

Circular economy label or information scheme (CELIS) in the context of this report can be considered as the group of labels, certifications, standards of information schemes that fully or at least partially address one (or more) of the three circular economy elements, as laid out by McCarthy et al. (2018[17]).

3. Characterisation of CELIS

Due to the broad scope of the circular economy, there is also a great diversity of labels and information schemes that can serve towards resource productivity, sustainable materials management and the circular economy. Several typologies have been developed and used to characterise the diverse label landscape.

3.1. The ISO typology

The most widely used typology relies on the ISO 14020 series by the International Standards Organisation (ISO), which separates environmental labelling schemes into three types, namely ISO Type I, II and III:

- Type I (ISO 14024) is the standard for ecolabels. These are defined as multi-criteria, whole life-cycle, approach-based, third-party voluntary labelling schemes that distinguish some of the best performing products according to predetermined environmental criteria, and apply to diverse product categories. The awarding body may be either a governmental organisation or a private non-commercial entity. Examples include the EC Eco-label, Cradle to Cradle, EPEAT, BIFMA/NSF level, Nordic Swan and German Blue Angel.
- Type II labels (ISO 14021 & 14022) are self-declared claims. These are usually privately made and describe a product based on one or more characteristics following general guiding principles. Examples of such claims include “made from *x*% recycled material”. The standard also provides guidance as to the proper use of ubiquitous symbols and terms, such as “recyclable”, or “biodegradable”.
- Type III (ISO/TR 14025) consists of quantified information based on life-cycle assessments. ISO 14040 and 14044 provide normative reference and requirements and guidelines for the design of such lifecycle assessments.

Furthermore, ISO 14051 and 14052 provide a framework and guidance for implementation of material flow cost accounting. This standard is however not intended for the purpose of third party certification.

The ISO classification does not capture the full diversity and range of different labels. For instance, single-issue labels that are third-party audited but neither life-cycle nor multi-criteria assessments, such as Forest Stewardship Council (FSC) and organic food labels, are not covered by any of the three categories in the ISO 14020 series.

3.2. OECD characterisation

To cover all CELIS types along a more comprehensive categorisation, one can include additional criteria about the characteristics of the labels. Previous OECD work identified a set of characteristics for ELIS, based on different modes of communication, and standard attributes (Table 3.1). These can be equally applied for characterising and mapping the CELIS landscape.[2]

[2] Note that previous OECD work on ELIS characterisation and analysis has predominantly focused on B2C ELIS. B2B information schemes have so far only been discussed on the margins. As a consequence, this characterisation matrix is also suitable for B2C labels, and B2B labels may need to be characterised along different or additional dimensions.

Table 3.1. Main characteristics of ELIS

Type of criteria	Categorical responses	Examples
Modes of Communication		
Communication channel	Business-to-business (B2B), Business-to-consumer (B2C), Business-to-government (B2G), Government-to-consumer (G2C)	B2B: Sustainable Apparel Coalition; B2C: Forest Stewardship Council; G2C: Der Blaue Engel, US EPA Safer Choice.
Means of communication	Seal, report or declarations. That can be further decomposed into ISO types and exceptions: organic, other single-issue label, resource efficiency label.	Seal: Types I ecolabels Declarations: Type III labels
Communication scope: category of good or service targeted	Agriculture and food, textile products, forest products, buildings and furniture, energy, transportation, biofuels, tourism, household appliances, electronics, cosmetics, cleaning products.	Agriculture and Food: Protected Harvest; Textile: Oeko Tex Standard 100; Forest products: Forest Stewardship Council; Appliances: Top Runner Program.
Communication content: Environmental attributes	Natural resource, energy, sources of pollution (chemicals), biodiversity, climate, waste, other, multiple	Natural resource: Water Stewardship; Energy: Energy Star; Biodiversity: Shade Grown Coffee; Climate: Carbon Labels.org; Waste: Biodegradable.
Standard Characteristics		
Standard setter	Self-setting External certifier	Type II ELIS: self-claims; ISEAL Alliance members: external certifiers
Leadership or ownership	Private, public, non-profit, hybrid	Private: Crade2Cradle; Public: Der Blaue Engel; Non-profit: Oeko-Tex Standard 1000; hybrid: Roundtable on Sustainable Soy Association
Mode of governance	Voluntary versus mandatory	Voluntary: UL Environment Mandatory: EnerGuide.
Transparency	Availability of information on the standard setting process (yes or no), publication of awardees (yes or no).	Open: EU Ecolabel Not: Bonsucro
Methods for environmental assessment	Life-cycle approach (LCA) based or not	LCA based: Environmental Choice Canada Non-LCA based: USDA National Organic Program.
Monitoring and auditing	First-party, second-party, third-party	First-party: EPA SmartWay Second-party: Green Seal Third-party: Bio-Suisse
Standard focus	Product standard, prPPM, nprPPM, service	Product Standard: Energy efficiency labels prPPM: Imprim'Vert nprPPM: Timberland Green Index
Standard scope	Regional, national, international	Regional: Pure Catskills National: Korean EcoLabel International: Forest Stewardship Council

Note: prPPM= product related process and production methods, nprPPM= non-product related PPMs.
Source: Adapted from (Gruère, 2013[12])

3.3. Characterisation along the value chain

CELIS can also be categorised along the different phases of the value chain that are covered in their assessment criteria. For instance, the global organic textile standard or the “fair mined” gold certificate provide information on the origin of materials. The SEB reparability label provides information about the design for reparability. Energy labels inform about the energy efficiency of a product during their consumption phase. Waste separation labels, such as the French Triman or compostability marks provide information about the end-of-life treatment of products. Other labels cover the entire lifecycle, such as the EU Environmental Footprint label, or the Cradle2Cradle (C2C) certificate (Table 3.2).

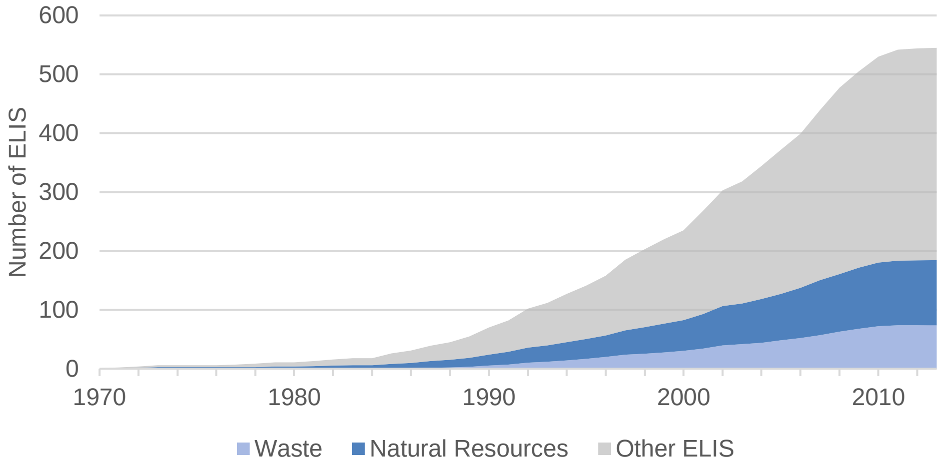
Table 3.2. Selected CELIS covering different phases of the value chain

Primary materials extraction	Design, production, retail	Use, consumption	End of life (Re-use, Recycling, Disposal)	Entire life-cycle
Forest Stewardship Council (FSC) 100%	SEB "Product 10Y Reparable" label	Energy Star	Compostability mark (e.g. BPI)	Blauer Engel
Fairtrade	EWG verified	EU Energy Label	TerraCycle	Nordic Swan
Global Organic Textile Standard	LEED certification	LEED®-EB: O&M	Global Recycled Standard	EU Ecolabel
UTZ certified	BREEAM certification	BREEAM In-USE	How2Recycle	C2C certified
Organic food labels	TÜV TOXPROOF		SCS Zero waste certification	EPEAT
Marine Stewardship Council (MSC) certification			Triman	BASF Eco-efficiency label
Fairmined Gold certification			ASTM Resin Identification System	TRUE zero waste certification
Alliance for Water Stewardship				Global Green Tag cert.
IRMA certification (Initiative for Responsible Mining Assurance)				Carbon Trust reduction label

4. Mapping of the CELIS landscape

A large number of ELIS and among them also a variety of labels which provide circular economy relevant information are already existing and in use. Figure 4.1 shows a rapid increase of ELIS since 1990 from less than 100 to nearly 550. Also the sub-selection of labels with natural resource or waste attributes has increased during the period.

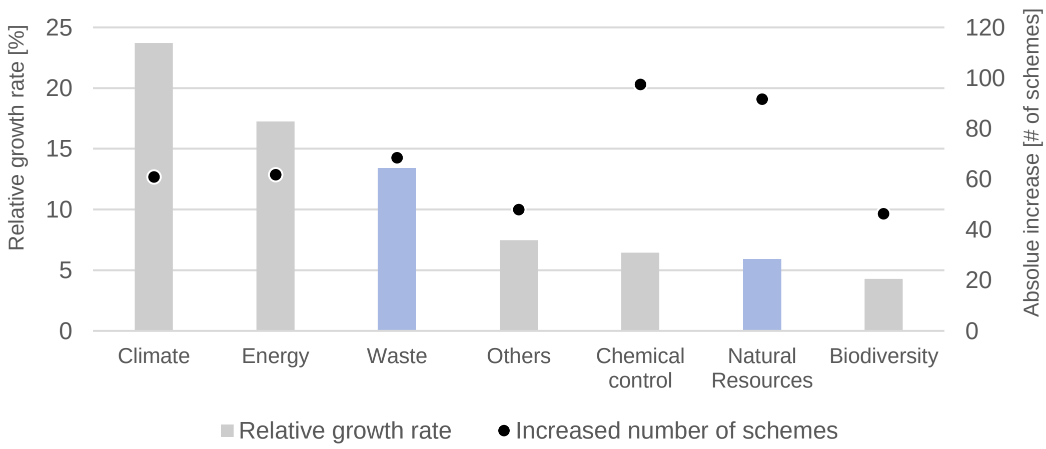
Figure 4.1. Evolution of ELIS and the CELIS sub-sample



Note: All ELIS with specific waste and natural resource attributes were considered CELIS in this assessment of the database.
Source: Ecolabel Index database, based on (Gruère, 2013[12])

Between 1990 and 2012, waste labels and labels with natural resource attributes experienced respectively an annual growth rate of 13% and of 6%. Whilst climate and energy labels experienced the largest relative increase, the absolute growth rates of natural resources and waste attributes are among the highest (Figure 4.2).

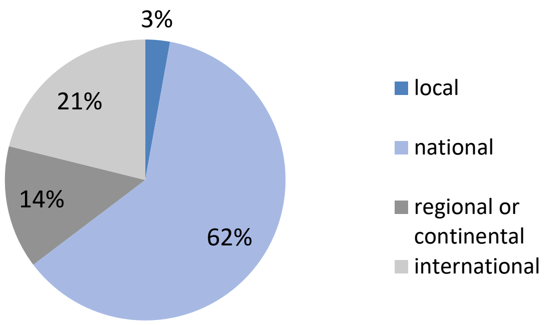
Figure 4.2. Relative and absolute growth of labels divided by attributes (1990-2012)



Source: Ecolabel Index database, based on (Gruère, 2013[12])

As Figure 4.3 shows, most ELIS are national initiatives (62%). More than a third of labels are of international (21%) and continental/regional (14%) scope and some few labels exist for local issues (3%).

Figure 4.3. Scope of existing ELIS with natural resource or waste attributes

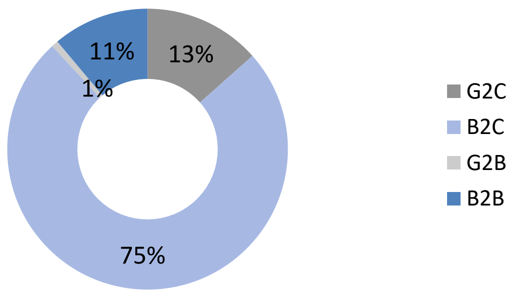


Source: Ecolabel Index database, based on (Gruère, 2013[12])

4.1. Communication channels and modes

CELIS can provide different communication channels and can serve different purposes. The large majority of CELIS labels are consumer-oriented labels. Business-to-consumer labels (B2C) form the biggest sub-group (75%). An example is the FSC Recycled content label by the Forest Stewardship Council. Government-to-consumer (G2C) labels form the second largest group (13%). G2C labels are consumer-oriented labels that are set up by public authorities, such as the Japanese Eco Mark or the German "Blauer Engel". B2B labels are used for information transfer between businesses either upstream (e.g. for sustainable sourcing) or downstream (e.g. for different end-of-life purposes and waste management). These make up 11% of the existing CELIS labels. Only less than 1% of existing CELIS labels serve the information transfer from governments to business (G2B) (Figure 4.4).

Figure 4.4. Communication channels for existing ELIS with natural resource or waste attributes

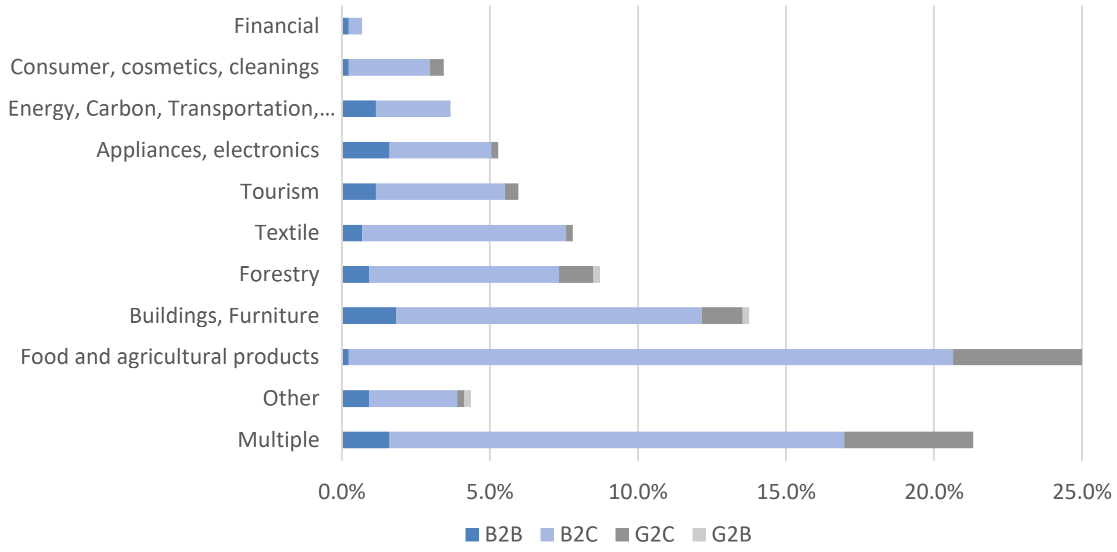


Source: Ecolabel Index database, based on (Gruère, 2013[12])

4.2. Sector-specific distribution

Figure 4.5 shows the product-groups and sectors which are currently most targeted by CELIS. One quarter of all CELIS is associated with food and agricultural products and large shares address buildings (14%), forestry (9%) and textile (8%) industries. Also, the composition of communication channels differs per sector. Labels for food and agricultural products, for instance, are almost entirely consumer-oriented, whereas labels for appliances and electronics and building and furniture have a relatively higher share of B2B labels.

Figure 4.5. Sector-specific distribution of CELIS and composition of communication channels



Source: Ecolabel Index database, based on (Gruère, 2013[12])
Note: Of the 62 labels that associated with the building sector, 34 contain aspects of energy or energy efficiency. Of the 23 labels that are associated with appliances and electronics, 12 contain aspects of energy or energy efficiency.

While the mapping provides initial insights in the characteristics and use of CELIS across different sectors and stakeholders, it should be noted that the underlying database dates back to 2013 and additional labels may well have been developed since. Labels that target certain CE criteria, such as product durability or reparability may not be captured in this database, as they may have still been in development at the time.

4.3. Single-issue vs. lifecycle CELIS

Most CELIS are single-issue labels or certificates. Single-issue labels can be defined as the group of labels that focus on one specific part of the value chain (e.g. use-phase: fuel consumption, production phase: organic food labels) or on one environmental impact category (e.g. water footprint or carbon footprint labels) (Gruère, 2013[12]).

Whilst single-issue labels are effective in enabling the comparability of products on one specific environmental aspect, their narrow focus risks that other environmental impacts are disregarded, potentially leading to unintended consequences. Environmental burden shifting can occur, if a reducion in environmental impacts in one category leads to an increase in environmental impacts in another category that is not monitored by the label. For instance, electric vehicles may be labelled as a preferable option over gasoline cars with regards to climate impacts, but can lead to increased impacts with regards to the depletion of minerals and the end-of-life treatment of batteries (Hawkins et al., 2012[18]).

For a circular economy transition to lead to overall environmental improvements, a careful consideration of environmental performance across all impact categories and stages of the lifecycle is required. Hence, a lifecycle approach is desirable if one wants to assess the overall "circularity" performance of products, services and materials. The ultimate goal should be the development of comprehensive, multi-attribute, lifecycle focused standards and ecolabels, which consider potential negative trade-offs (Box 2).

Box 2. Life cycle analysis: a brief summary

Life-cycle assessments (LCA) commonly compile an inventory of relevant energy and material inputs and environmental releases across the entire lifecycle of a product and provide quantifiable data, which enables comparisons across and between products and product groups. LCA is an internationally standardised methodology for establishing the environmental footprint of a particular product (good or service). Within the requirements of ISO 14040 and 14044, an LCA must comprise the following steps:

- A definition of the goal and intended use of the LCA, and the scope of the assessment concerning system boundaries, function and flow, required data quality, technology and assessment parameters.
- An inventory analysis (LCI), which consists of collecting data on inputs (resources and intermediate products) and outputs (emissions, wastes) for all the processes in the product system.
- An impact assessment (LCIA), during which inventory data on inputs and outputs are translated into indicators of potential impacts on the environment, human health, and natural resource consumption.
- Interpretation of the results of the LCI and LCIA, according to the goal of the study, including a sensitivity and uncertainty analysis.

A LCA can either be conducted for a product in isolation, or for one product relative to another. Because their underlying scope and assumptions often differ, it is generally difficult to compare results across different LCA studies. Complex value chains, with products consisting of intermediary parts, produced in various locations by different producers, often complicates lifecycle assessments.

While the multi-impact, holistic nature of LCAs can help avoid a narrow outlook on environmental concerns, a number of challenges are associated with the approach in practice (Table 4.1). The flexibility in methodological choices can cause large deviations in LCA results. Multiple assumptions need to be made during all phases (EC JRC, 2011[19]). The methodology needs to be meticulously defined to allow comparability between products and product groups.

Table 4.1. Challenges associated with each life-cycle phase

Phase	Challenge
Goal and scope of definition	Functional unit definition Boundary selection End-of-Life assumptions Alternative scenario considerations
Life-cycle inventory analysis	Allocation Negligible contribution ('cut-off') criteria Local technical uniqueness
Life-cycle impact assessment	Impact category and methodology selection Spatial variation Local environmental uniqueness Dynamics of the environment Time horizons
Life-cycle interpretation	Weighting and valuation Uncertainty in the decision process
All	Data availability and quality

Source: (EC JRC, 2011[19])

There is also a question on where to set boundaries and 'cut-offs' and how fine-grained the analysis should be. For instance, should secondary environmental impacts that arise in second or third tier suppliers be considered? Over what time frame are the impacts considered? And what is the assumed end-of-life fate of products? Defining the boundaries in a coherent manner is essential.

Additionally, there is a question around the impact equivalence of different types of environmental impacts. Environmental impacts in LCAs are commonly converted into equivalence units, but the conversion and inclusion can raise challenges. For instance, biodiversity, resource depletion and eco-toxicity are frequently mentioned as poorly-covered in impact analyses. Furthermore, it is challenging to differentiate between local and global environmental impacts (e.g. land-use change vs. GHG emissions) (EC JRC, 2012[20]). The weighting and valuation of the different impact-categories can also lead to different result interpretations.

The European Commission (EC) has dedicated substantial efforts to design a standardised method, in order to increase the comparability of LCA results, as part of their 'Single Market for Green Products Initiative' (Sala et al., 2017[21]). Since 2013, a lifecycle based methodological framework for the assessment of Environmental Footprint of Products (PEF) and Organisations (OEF) has been developed. The PEF and OEF intend to harmonise LCA methodologies at European level and reduce the flexibility of common standardisation requirements (e.g. ISO 14044).

The PEF also includes a "circular footprint formula" (CFF), which considers instructions for the assessment of environmental impacts of the end-of-life products, taking into account different EOL management options. This includes detailed instructions for burdens and benefits related to secondary material inputs/outputs, energy recovery and disposal. Furthermore, it includes a factor that allocates benefits and burdens between multiple lifecycles when a material is recycled (parameter A). The advantage of this formula towards the previous EOL-formula for PEF is that it no longer arbitrarily favours incineration over reuse and recycling (Bach et al., 2018[22]).

A five-year environmental footprint pilot phase took place between 2013 and 2018 to test the elaborated methodology across different product groups. This resulted in the development of validated product environmental footprint category rules (PEFCRs) for 21 product categories and organisation environmental footprint sector rules (OEFSRs) for two sectors. The European Commission now continues a transition phase, during which the implementation of the existing PEFCRs is further monitored and possible policies for implementing and the mainstreaming the PEF and OEF to other product groups and organisational sectors are investigated (European Commission, 2018[23]). There is evidence that some firms are already using the established PEFCRs methodology and the Lifecycle Inventory datasets (LCI) to assess environmental footprints for their products. The European initiative thus seems successful so far and the majority of participating stakeholders demands to move from the pilot phase to the implementation phase.

The European "Single Market for Green Products Initiative" gives a sense of the complexity of designing a standardised assessment method that includes all impact categories at all stages of the lifecycle. The project involved multiple institutions, including the European Commission and the Joint Research Centre (JRC) and rigorous stakeholder discussions.[3] Challenges lie in the detailed conceptualisation and methodology, and in producing robust category rules that are comparable, reproducible and consistent. There is a trade-off between assuring standardisation and comparability of results and risking an over-simplification of the assessment, which omits potentially relevant information on environmental issues (European Commission, 2017[24]). High ambiguity ranges in the different LCA methods may lead to distrust in LCA as an indicator. In some cases single-issue labels may then serve as a more effective second-best option, given the methodological challenges and significant costs involved in conducting lifecycle assessments. So far, however, stakeholders seem to be enthusiastic the developed PEFCRs and OEFSRs.

To sum-up, the diversity and types of CE labels and information systems are broad and their number is increasing. In particular, the last two decades have seen a multiplication of environmental labelling and information schemes of varying scope, size and nature. Existing data suggests that most CELIS are consumer-oriented, single-issue labels with a focus on food products, predominantly implemented at the national level. LCA-based labels are emerging and especially in the European Union the 'Single Market for Green Products Initiative' is supporting the development of lifecycle labelling for specific product groups. In the long-run, countries should work towards developing comprehensive, multi-attribute, lifecycle focused sustainability standards and ecolabels that purchasers can use to identify the overall environmental performance of products.

[3] For more information on life-cycle assessment related to the 'Single Market for Green Products' initiative, see the results and deliverables of the product environmental footprint pilot phase (European Commission, 2018[139]).

5. Key issues of environmental labels in the circular economy transition

CELIS can be roughly divided into consumer-oriented labels (i.e. B2C and G2C) and information schemes and certificates that facilitate the information flow between businesses (B2B). Whereas consumer-oriented labels generally provide more aggregated and simplified information that improve clarity and comparability of products for consumers, B2B information systems tend to be more detailed and sophisticated (Box 3).

Box 3. B2B vs. consumer-oriented CELIS

A distinction can be made between characteristics of consumer-oriented labels and information schemes that act at the interface between businesses. A label or information scheme can also serve multiple communication channels (e.g. consumer labels can also be used by business or governments for procurement purposes). The design and information content of an information system differs depending on the target group.

Consumer-oriented labels commonly aggregate information in a single seal or communicate through a simplified “traffic light” system that enables consumers to quickly read and process information. Consumers tend to respond primarily to clarity, credibility and comparability in labels (UL Environment, 2015[25]). Thus, communication vehicles that report product environmental footprints to consumers should be simple, transparent and easily accessible (European Commission, 2017[26]).

In B2B information systems more quantitative and detailed information may be required. These tend to be more sophisticated and rigorous, comprising a larger and more detailed set of criteria.

This chapter is divided into two sub-chapters. A first part reviews B2B information schemes on the basis of four sectoral case studies. A second part reviews consumer-oriented labels, focusing specifically on product lifespan labels and labels for used goods and secondary materials.

5.1. Business-to-business information systems and labels for resource efficiency and the circular economy

5.1.1. Introduction

Globalisation and the fragmentation of value chains has increased the complexity of value chain management, making it more difficult for firms to identify and realise resource efficiency improvements and to manage uncertainties and risks in upstream supply chains (OECD, 2013[27]).

Whilst the increased outsourcing of production processes has increased productivity, it also gave rise to potential market failures around information asymmetries in complex supply chains. Insufficient information availability about activities of lower tiers can lead to suboptimal decision making of upstream actors and vice-versa. For instance, the source and composition of procured components is important information for producers to be aware of, in order to assess total material, environmental and social footprint of final products. Similarly, information on hazardous substances used in upstream production is crucial in order to adapt quickly to emerging regulatory changes that address these substances. In most supply chains, this information is currently not, or insufficiently, available, or not effectively passed on from one actor in the supply chain to the next.

Business-to-business (B2B) information systems can be useful tools to provide more transparency in value chains, support due diligence efforts and disclose environmental performance and resource footprints. Improved information sharing across tiers can help identify 'environmental hotspots' and lead to resource efficiency improvements and risk reductions. A variety of B2B information systems and metrics that address aspects of resource efficiency and the circular economy have already been developed in different sectors (Box 4). Some metrics have been created voluntarily through private sector initiatives, others as a response to regulatory measures that impose requirements for information disclosure.

Box 4. Metrics and the circular economy

Whereas information systems tend to provide data on a product level, harmonised circular economy metrics can provide useful information to track and compare progress on a firm level. Firms can use circular economy metrics to (1) drive business performance or strategy, (2) justify achievements externally, (3) integrate circularity across the business, (4) manage risks associated with the existing linear business model, or (5) track the impact of their circular activities.

To date, there is not a common framework for measuring circularity. According to a stocktake analysis by the World Business Council for Sustainable Development (WBCSD), 74% of the firms use their own metrics framework to track CE performance, with a high heterogeneity across scope and criteria (WBCSD, 2018[28]). Harmonising existing CE metrics would increase comparability and reduce transaction costs for firms, especially SMEs that may not have the financial means to report and comply with a wide range of different metrics.

Several initiatives are ongoing to establish harmonised and comparable CE metrics (PACE and Circle Economy, 2020[29]). Notable initiatives include the Circular Transitions Indicator framework, developed by WBCSD together with a consortium of 26 member companies (WBCSD, 2020[30]), the Circularity Indicators Project ("Circulytics") by the Ellen MacArthur Foundation (Ellen MacArthur Foundation, 2019[31]), Circle Assessment by Circle Economy (Circle Economy, 2020[32]), the CIRCelligence metric tool by Boston Consulting Group (BCG, 2020[33]), as well as the GRI360 Waste Standard by the Global Reporting Initiative (GRI).

It is likely that there are a variety of information systems in use, which are not disclosed to the public. It is in the inherent interest of vertically integrated firms to maximise information flows that help identify and achieve cost optimisations within their supply chain. Collecting detailed information on such systems is challenging, but it can be assumed that a significant number of firms is using information tools for value chain management. Policy action is needed more, where market failures provide barriers to the development of information systems.

This sub-chapter provides an overview of B2B CELIS that are in use in different industries. Four sectors are discussed in more detail: textiles, automotive industry, electrical and electronic equipment (EEE) and the construction sector. Whilst this overview does not intend to provide an exhaustive list of information systems in the respective sectors, it aims to generate insights into the main systems that are of relevance to resource efficiency and material circularity, the drivers that have led to their implementation and the potential barriers that limit their further uptake.

5.1.2. Sector case studies

Textiles: Information systems for chemicals management

Environmental and climate impacts of the textiles system occur in every phase of the value chain, such as the use of resources, land and chemicals, and the emission of greenhouse gases. The European Environment Agency (EEA) estimates that in the EU, supply chain pressures of clothing, footwear and household textiles are the fourth highest pressure category for the use of primary raw materials and water, the second highest for land use, and the fifth highest for greenhouse gas emissions (European Environment Agency, 2019[34]). Globally, the apparel and footwear industries are estimated to account for 8% of the world´s greenhouse gas emissions (Quantis, 2018[35]).

Textile production processes commonly involve a large amount and variety of chemicals. About 3,500 substances are used in textile production, of which 750 have been classified as hazardous for human health and 440 as hazardous for the environment (KEMI, 2014[36]). It is estimated that about 20% of global industrial water pollution comes from textile dyeing and finishing treatment, affecting the environment and the health of workers and local communities (Kant, 2012[37]). During the use phase, washing textiles releases chemicals and microfibers into household waste water, and at the end of life, the chemicals and material mixes contained in textile products challenge material recycling (Ellen MacArthur Foundation, 2019[38]).

Textile supply chains are complex, globally dispersed and constantly evolving, which makes it difficult to ensure transparency and traceability. Keeping track of all chemicals that have been used along the way and identifying environmental hotspots and other supply chain risks is a challenge. As upstream processing steps tend to generate the largest environmental impacts (e.g. through the use of resources, water, energy and chemicals), information systems are needed to enable effective supply chain management by downstream fashion brands. European regulations, such as the REACH legislation, have put the responsibility on the industry in Europe to manage and evaluate risks of chemicals in their supply chain. Access to information on chemicals in products is key for compliance.

The supply chain complexity in the fashion industry renders the sector vulnerable to environmental and social risks. There are several cases where upstream practices have affected the reputation of major textile brands negatively. Tragic examples are the Nike child labour scandal in the 1990s, or the 2013 collapse of the eight-story garment factory in Bangladesh (known as the Rana Plaza incident), from which several large fashion brands sourced their products (Khurana and Ricchetti, 2016[39]). Other cases relate to unsustainable practices and use of toxic chemicals or raw materials. In response to these incidents, companies have started to develop tools, strategies and initiatives to minimise social and environmental risks and to provide transparency to consumers.

Whilst the development of chemical information systems for textile products is often motivated by mitigating health risks, they can also facilitate environmental improvements. Much of the environmental impacts of textiles are linked to the use of chemicals or environmental harmful substances in upstream production. The industry developed a manufacturing restricted substances list (MRSL), to define a harmonised approach to managing chemicals. The MRSL serves as an industry-wide reference and specifies maximum concentration levels for a list of priority chemicals (Zero Discharge of Hazardous Chemicals Programme, 2015[40]). The OECD Due Diligence Guidance for the garment sector also refers to the MRSL. It encourages the phase out of banned chemicals listed on the MRSL, to communicate the list to all suppliers operating at higher-risk stages of the supply chain and to identify substitutes for listed chemicals, based on scientifically-based hazard assessments (OECD, 2018[41]).

Oeko-Tex Standard 100 is another textile health label that tests the content of harmful chemicals throughout all processing levels. The Sustainable Textile Production (STeP) by Oeko-Tex complements the content-orientated label with a process-oriented standard that certifies sustainable manufacturing processes. The Oeko-Tex 'Detox to Zero' certificate provides independent verification of chemicals management systems and quality of waste water. Oeko-Tex Standards are widely used by brands, retail companies and manufacturers to monitor and communicate environmental sustainability achievements across their supply chain. Since its launch in 1992, the Oeko-Tex Standard 100 has been issued over 160,000 times to 10,000 participating companies (Oeko-Tex, 2019[42]).

Some B2B CELIS in the textiles industry can also have a resource-specific focus and assess environmental and social criteria along the production chain. One example is the Global Organic Textile Standard (GOTS), which certifies textiles with a minimum of 70% organic fibres (GOTS, 2018[43]). The Better Cotton Initiative (BCI) Standard System also provides a standard for the quality of cotton supply chains (BCI, 2018[44]).

The Higg Index is a suite of assessment tools, developed by the Sustainable Apparel Coalition that allows brands, retailers, and manufacturers in the apparel and footwear industry to measure environmental, social and labour impacts across a product's lifecycle. Three modules exist in the Higg Index focusing on products, manufacturing facilities and retail. The Higg Materials Sustainability Index, which is embedded in the product module is of particular relevance in the CE context. It includes environmental metrics on hazardous chemicals, water use, energy and deforestation (Sustainable Apparel Coalition, 2019[45]).

With increasing public concerns about plastic microfiber shedding of textiles, there have also been first developments for a label on the issue. In California there have been discussions around a federal bill to require new clothing composed of more than 50% synthetic material to bear a consumer label that provides information on plastic fibre shedding. Although the bill was not passed, similar information requirements may appear in the near future, which could lead to the development of information systems on this aspect.

Various brands also started to develop their own tools to identify environmental hotspots in upstream value chains. Nike invested USD 6 million to develop tools for material assessment and environmental design, examine lifecycle impacts of materials and support designers to make sustainable design choices (Nike, 2010[46]; Derrig et al., 2010[47]). The Luxury group Kering developed an information tool ("Environmental Profit & Loss"), which helps measuring and quantifying the environmental impact of its activities with the aim of reducing environmental impacts across their supply chain (Kering, 2018[48]).

Overall, the driver for information systems in the textiles sector has been motivated by a combination of public demands and regulatory changes. Environmental and social scandals have led to public distrust and the demand for more transparency in supply chains. As well, chemical regulations of importing countries (e.g. EU REACH legislation) put increasing responsibility on textile companies to ensure that higher tier suppliers are complying with regulations and information disclosure.

Automobile industry: Information systems for end-of life vehicles

End-of-life vehicles (ELVs) constitute a substantial share of waste generation in OECD countries. In the European Union alone, ELVs generate between 6-7 million tonnes of waste per year (Eurostat, 2019[49]). Much of the material in ELVs is already recycled (about 80-90%), but a sizeable share is still being landfilled as automotive shredder residue (ASR). One reason for this is the information gap between manufacturers, consumers and end-of-life actors, leaving recyclers with insufficient information to safely extract and recycle materials and minerals (Miller et al., 2014[50]). There has been increasing policy action to address the issue and to improve conditions for ELV material recovery and recycling, such as the EU ELV Directive[4], which sets guidelines on hazardous substances for new manufactured cars or similar ELV recycling regulations and producer responsibility schemes in Japan, Korea or China (Sakai et al., 2014[51]).

[4] The objective of the ELV-Directive is the prevention of waste from ELVs and to maximise reuse and recycling of components. Automobile producers are required to provide information to EoL treatment facilities, concerning dismantling and re-use (European Commission, 2000[55]).

Several information systems have been developed by the car manufacturers to comply with mandatory information requirements, through for example the European ELV Directive and other regulations, with the goal to track materials use and avoid the usage of critical substances in products. The multiplication of different types of regulations and laws on declarable substances in various jurisdictions has led to the development of the Global Automotive Declarable Substance List (GADSL), a globally harmonised list with clear criteria and a transparent process. The GADSL was developed jointly by vehicle manufacturers, automotive component suppliers and the chemical industries, and covers all substances that are either already regulated or in the regulatory pipeline in any region of the world. It provides a definitive list of substances prohibited or requiring declaration with the target to minimise individual requirements and ensure cost-effective management of declaration practice along the complex supply chain. GADSL is used as a reference spreadsheet in the IMDS Basic Substance List and in company-specific databases for material declaration of automobile parts (GASG, 2018[52]).

The IMDS (International Material Data Systems) is an example of an information system that was developed in response to information disclosure requirements. IMDS was originally a joint development of Audi, BMW, Daimler, EDS, Ford, Opel, Porsche, Volkswagen and Volvo, but has since become a global standard for the industry. Various regulations around the world require automotive manufacturers to report on the material content of their vehicle. IMDS serves as a common system to simplify compliance with the different requirements when parts and components are traded globally (IMDS, 2018[53]). To date, IMDS contains around 40 name-brand manufacturers, representing more than 90 brands of vehicles and more than 120,000 suppliers of materials and components (Oeko Institut e.V., 2018[54]).

IMDS serves as a tool to collect information about substances and materials of products from upstream sub-contractors. The database contains a list of every part, in every car, for all participating international automobile manufacturers. Each listing includes the weight, size and material composition of the component. Tier 1 suppliers collect and bundle the information from sub-tier suppliers and submit the total material content to the original equipment manufacturer (OEM). This provides automobile manufacturers and parts suppliers with a standardised documentation process, which allows automobile manufacturers to comply with national and international standards and information requirements. In conjunction with GADSL, the IMDS has become the state of the art information system for material declarations along supply chains in the automotive sector (European Commission, 2000[55]; GASG, 2018[52]).

Intellectual property rights limit the disclosure and use of collected information in IMDS. IMDS includes provisions for maintaining the confidentiality of proprietary information. Whilst the information system collects information on material content of individual parts, the database does not provide public access to collected information on overall materials use in final vehicles. Only the OEM is able to retrieve information for final vehicles (Oeko Institut e.V., 2018[54]). Third party inspection may be required, where confidential information cannot be shared beyond the OEM.

The centralisation of information stored in B2B information systems requires trust in third parties, which may represent a barrier to a broader uptake. For instance, in China, the automotive industry chose to develop an alternative to IMDS to remain independent; the China Automotive Material Data System (CAMDS). It has nearly the same functionalities, but features slightly different procedures. Conversion tools are required to transform information from the IMDS to the CAMDS system, causing friction in the information flow. Trust is key, when information is stored centrally by third party operators.

Besides IMDS, CAMDS and GADSL, which are mostly used for information transmission during production stages, the International Dismantling Information System (IDIS) serves the purpose of dismantling of ELVs. IDIS provides pre-treatment and dismantling information of potentially recyclable parts for almost all the world's vehicles.[5] Coding standards facilitate identification of components that are suitable for reuse and

[5] The data that a vehicle manufacture provides is not controlled or reviewed by third parties, which may limit the reliability of the information. This is also the case for IMDS.

recovery. Similar to IMDS, the initial IDIS system was developed in the 1990s to fulfil regulatory requirements concerning ELVs. To date, IDIS contains dismantling information of 75 brands of cars and is available in 31 languages and 40 countries in Europe and Asia (among others India, China, Japan, Russia, South Korea) (IDIS, 2019[56]).

Overall, several information systems appear to be in use in the automobile industry, which collect detailed information about materials and chemicals in car components. The driver for developing these has been largely a response to compliance with emerging information disclosure requirements for ELVs in different jurisdictions. IMDS and the IDIS have established themselves as the dominant, state-of-the-art information systems that are widely used in the industry.

Electrical and electronic equipment: information systems for improved recycling

Many countries pose restrictions on the use of hazardous substances in electrical and electronic equipment (EEE). In the European Union, the RoHS (EU Directive on the Restriction of Hazardous Substances), the WEEE Directives (Waste Electrical and Electronic Equipment Directive) and the REACH regulation have had a strong impact on the way electronic products are designed, collected and treated and how information provision and sharing accompanies these processes. The RoHS Directive requires EU member states to ensure that electrical and electronic equipment (EEE) placed on the market does not contain a defined set of hazardous substances. Products that comply with RoHS display the “CE” mark, which indicates the conformity with health and safety standards. Other regions have followed and similar regulations to RoHS can be found in countries such as Argentina, Brazil, California, China, Vietnam, South Korea and India.

Japan takes a different approach to the direct ban found in many countries. Instead, the Japanese Recycling Law JIS C 0950 (referred to as J-MOSS), obliges manufacturers and importers to mark the presence of a defined set of chemical substances for EEE, enabling consumers to make sustainable consumption choices. J-MOSS sets control criteria for six RoHS-specified hazardous substances for seven types of electrical and electronic equipment: personal computers, unit-type air conditioners, television sets, refrigerators, washing machines, clothes dryers, and microwaves. When the content of a specified substance in a product reaches beyond the set criteria, a content mark is required on the product packaging and website that provides information on the substance and contamination level (Jeita, 2008[57]).

To comply with RoHS and other hazardous substance restrictions around the world, firms need to demonstrate that effective production controls are in place. The manufacturer is responsible for ensuring the compliance of the whole product, including any components or intermediary products that may be used in its assembly. The manufacturer must thus retain control over the relevant information provided by sub-contractors to be able to ensure compliance.

Different “Chemical in Products” (CiP) information systems are in use by companies to comply. Many companies report in their own format, which causes considerable burden to mid-stream operators.

There are, however, initiatives to develop an industry-wide information system to smoothen the exchange of information. For instance, the IEC 62474 Standard by the International Electrotechnical Commission (IEC) provides a comprehensive list of declarable substances for electronic and electrical products included in different regulatory systems worldwide. The standard facilitates reporting and compliance, as well as the transferring and processing by defining a common data format. It provides a validated open database, which includes a list of substances, substance groups and common material classes. In some information systems the list of IEC 62474 is used as a template for information transfer requirements (IEC, 2019[58]). Besides IEC 62574, IPC 1752 is another materials declaration management standard that is used in the IT product sector (IPC, 2021[59]).

ChemSHERPA is another example of a CiP information system that aims to harmonise information flows by providing a standardised information system. It was developed in 2015 by the Japan Ministry of Economy, Trade and Industry (METI), after realising that 64% of companies in Japan used their own data format for chemical management, resulting in high data handling costs for firms. ChemSHERPA was developed with the intent of becoming the prominent information system for chemicals management for EEE. It is designed to be flexible and compatible with different declarable substance lists. Templates exist for GADSL, Reach Annex XVII, Chemical Substances Control Law and IEC 62474, depending on which laws and regulations are of concern in the final market (ChemSherpa, 2021[60]). As of October 2017, 102 companies have agreed to the dissemination of ChemSHERPA (METI, 2017[61]). The Japanese Ministry continues its efforts to disseminate the information system in EEE supply chains.

Besides hazardous chemicals, the use of conflict minerals and materials criticality are other potential hidden risks in value chains for EEE. Sourcing information on critical materials and minerals, such as cobalt may be of interest for producers, retailers and consumers. In fact, the EU "Conflict Mineral Regulation" requires EU importers to comply with, and report on, supply chain due diligence obligations as of January 2021 if the minerals originate from conflict-affected and high-risk areas. The Regulation is inspired by the US Dodd-Frank Act, which imposes similar reporting obligations and due diligence measures for US companies (European Union, 2017[62]). This requirement may trigger new developments of information systems in the field, with some examples emerging, such as the Global Tin project, a collaboration between Minespider, Google, Volkswagen, Cisco, SGS, and Minsur, which is partially funded by the European Commission (European Commission, 2019[63]). Another example is the Cobalt Blockchain project, a partnership by IBM and the responsible source group (RCS Group, including Ford, Huayou Cobalt and LG Chem). The group pilots a blockchain based information system to monitor and ensure responsible cobalt sourcing in the Democratic Republic of Congo (Lewis, 2019[64]).

As for other product groups, there appears to be a lack of communication between end-of-life actors and upstream producers of EEE. Recyclers express that recycling and EOL considerations are not sufficiently incorporated in product design and material composition, whereas manufacturers claim to receive little guidance from recyclers on how products could be better designed for recycling (Norden, 2011[65]). Further communication is needed between the two actors. CELIS for purposes of material recovery should be done in a multi-stakeholder setting to identify what information is most needed to improve recycling, whilst ensuring that providing this information is feasible by producers.

Overall, in contrast to other sectors, CiP systems for EEE product groups have not yet resulted in the development of a standardised system. Generally, chemical information systems for EEE can improve conditions for material recovery, as information on presence of substances of concern is often not readily available to those who handle waste. However, many companies currently report in their own format, which causes considerable burden to mid-stream operators. Often this information does not reach actors at the end-of-life. There are initiatives to develop industry-wide information systems to facilitate the exchange of information across actors. Examples are the IEC 62474 information list, which lists all declarable substances for electronic and electrical products worldwide and chemSHERPA, an initiative by the Japan Ministry of Economy, Trade and Industry (METI) to establish an internationally dominant information systems for chemicals reporting. Also, EPEAT category criteria incentivise material disclosure and the provision of information to improve recyclability (EPEAT, 2021[66]).

Construction: Material passports for buildings

Globally, infrastructure and construction have the highest resource footprint of all sectors and will remain a key driver of materials use in the future. Non-metallic minerals, which are mainly used for construction, are projected to grow from 35 Gt in 2011 to 82 Gt in 2060 (OECD, 2019[67]). Increasing circularity and resource efficiency in the construction sector is relevant to slow global resource consumption. An important aspect of circularity in the construction is the reuse of building products and materials. One of the main challenges in reusing building materials is the availability and robustness of data (Hobbs and Adams, 2017[68]). Improved data management at the design stage and throughout an asset's life cycle could enable a more effective reuse of building components and materials.

The EU H2020 funded project "Buildings as Material Banks" (BAMB) addresses this information gap by piloting a material passport platform for buildings. Material banks contain digitalised datasets that describe the characteristics of individual materials and components in buildings. Material passports provide detailed information of the material composition of individual building components or of entire buildings. The BAMB project brings together 16 European parties from industry, academia and policy to develop a prototype of a material passport platform, which is currently in its pilot phase. So far, a total of 428 material passports have been generated for 407 components and products and seven material passports have been created by building owners (EPEA Nederland, 2019[69]).

If material passports are not standardised and harmonised, the proliferation of different material databanks with varying requirements may lead to high transaction costs for stakeholders and decrease trust and accuracy. Several initiatives are ongoing to facilitate standardisation. The "Luxemburg CE Dataset Initiative" by the Ministry of the Economy of Luxembourg and the DOEN Foundation's Healthy Printing initiative aim to develop a standardised approach to materials passport datasets. Other examples include the Scandinavian Coclass and eBVD projects, which aim to standardise data for buildings, the Dutch CB23 project, which aims to standardise material passports in The Netherlands and ISO/CEN's work on a Product Data Template methodology (EPEA Nederland, 2019[69]).

Another important aspect of resource efficiency in the construction sector is the responsible upstream sourcing of primary or secondary building materials. Information systems and certification schemes can facilitate sustainable sourcing. For instance, the Framework Standard for Responsible Sourcing (BES 6001), by BRE Global, provides a Responsible Sourcing League Table that shows all current BES 6001 certificates by construction product category and the rating achieved by each company (BRE Group, 2019[70]). In addition, the Concrete Sustainability Council developed a label for sustainable concrete certifications (CSC, 2019[71]).

5.1.3. Conclusions

Based on the projects and initiatives in this review, it appears there are two main drivers for the development of B2B information systems.

First, legislation and policies that require information disclosure at the point of sale push companies to develop information systems to collect information from OEMs and upstream tiers and to meet compliance. The IMDS in the automobile sector is one example of an information systems that was developed in response to a legislation, in this case the European ELV Directive.

Second, public awareness and pressure from civil society can lead to the development of information systems by individual firms and sectors, in particular in sectors where much of the brand value is based on reputation. For instance, in the textiles and fashion industry, social and environmental scandals have led to the development of labels and standards that aim to ensure sustainable sourcing and risk mitigation (e.g. GOTS and Oeko-Tex). Several fashion brands have also developed their own environmental management and material assessment tools to identify environmental hotspots in their supply chains.

B2B information systems have already led to a variety of environmental and social benefits. Declarable substance lists and chemical information systems have enabled the disclosure, and in some cases, phase-out of hazardous substances. Information systems have also improved material recovery, by providing information for dismantling, such as IDIS for ELVs.

However, several barriers to a greater uptake and harmonisation of B2B information systems remain:

- Confidential business information can pose a potential obstacle to the development of B2B information systems. Intellectual property rights could form a 'natural boundary' to information disclosure, and when designing information systems, a balance needs to be struck between providing sufficiently detailed information and respecting intellectual property rights.
- The proliferation of different information systems increases transaction costs for companies. Whilst in some sectors, information systems have evolved towards one harmonised system (e.g. IMDS in the automobile sector), in others harmonisation is less evident (e.g. CiPs in the EEE industry). The increasing amount of information systems and metrics poses an obstacle to information disclosure due to high transaction costs, particularly for SMEs. Mainstreaming and harmonising CE metrics would reduce transaction costs, increase compliance, as well as potentially increase comparability.
- Trust is key when information is stored and managed centrally by a third party organisation. The use of centralised IT systems could present a barrier to uptake due to trust issues. Blockchain and distributed ledger technologies are attracting increasing attention as one possible solution to ensure trust in information flows. One example is the Chemchain project, which develops an open-source blockchain platform to transfer chemical information along the supply chain (European Commission, 2019[72]).

5.2. Consumer-oriented labels for resource efficiency and the circular economy

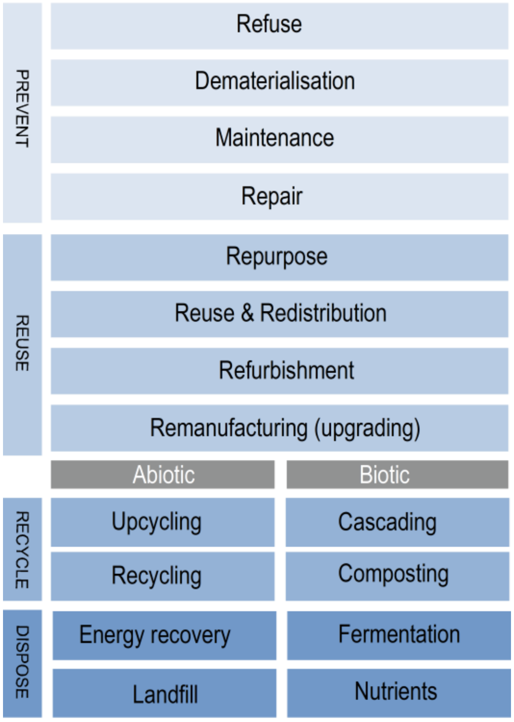
5.2.1. Introduction

Raising public awareness about the circular economy performance of products can shift demand and steer supply chains towards more sustainable production. Overall, consumer awareness with regards to circular economy and resource efficiency has grown in recent years and major brands have started to recognise circularity aspects as a factor in motivating consumer purchasing. As shown in Chapter 4, consumers are exposed to a multitude of labels and certificates. Whilst several studies have looked at the environmental benefits of consumer-oriented ecolabels, there appears to be no assessment specifically on consumer labels for the circular economy (AEAT, 2004[73]; Rubik, Scheer and Iraldo, 2008[74]; Iraldo and Barberio, 2017[75]).

The circular economy comprises a wide range of environmental actions activities and thus also labels for the circular economy cover a number of aspects[6] (McCarthy, Dellink and Bibas, 2018[17]). De Groene Zaak and Ethica (2015[76]) developed a 'circularity ladder', which provides an indication of the 'environmental desirability' of different end-of-life treatments. Extending product lifespans through maintenance and repair is in most cases the preferred option, followed by different modes of recycling. Yet, especially consumer labels that focus on product lifespan extension and reuse are still relatively scarce. This chapter explores existing circular economy related consumer labels and the remaining gaps in more detail.

[6] See Chapter 2.2 for a more comprehensive discussion and definition of CELIS.

Figure 5.1. Circularity ladder



Source: (De Groene Zaak and Ethica, 2015[76])

5.2.2. Product lifespan labels

The useful service life in most product groups has decreased over the last years, due to an interplay of technological, psychological and economic obsolescence (Prakash et al., 2016[77]). Products can become obsolete prematurely for a number of reasons. There can be economic reasons of producers (economic obsolescence), a change in fashion (psychological obsolescence) or, in the case of electronic equipment, insufficient technological compatibility with newest hard- and software (technological obsolescence) (Cox et al., 2013[78]). Extending the lifespan of a product (whether by the original owner through repair or by subsequent owners through reuse) can often increase resource efficiency and lead to better environmental outcomes (see Box 5). For instance, removable and replaceable components in electronic products can help extend the lifespan of a product beyond the lifespan of its individual parts.

Consumers often do not have good access to information on product lifespan and reparability attributes. A recent study by the European Commission showed that consumers are usually poorly informed about the durability and reparability of products at the point of purchase and that consumers have the desire to receive better information (European Commission, 2018[79]).[7] Similarly, the Eurobarometer consumer survey found that 92% of the respondents across the EU27 indicated that the lifespan of products should be better indicated (European Commission, 2012[80]). Meanwhile another study showed that there is a willingness by consumers to pay a premium for better lifespan characteristics of products (European Commission, 2018[79]).

[7] See Deloitte (2016[140]) for a more comprehensive analysis of barriers to increased reparability.

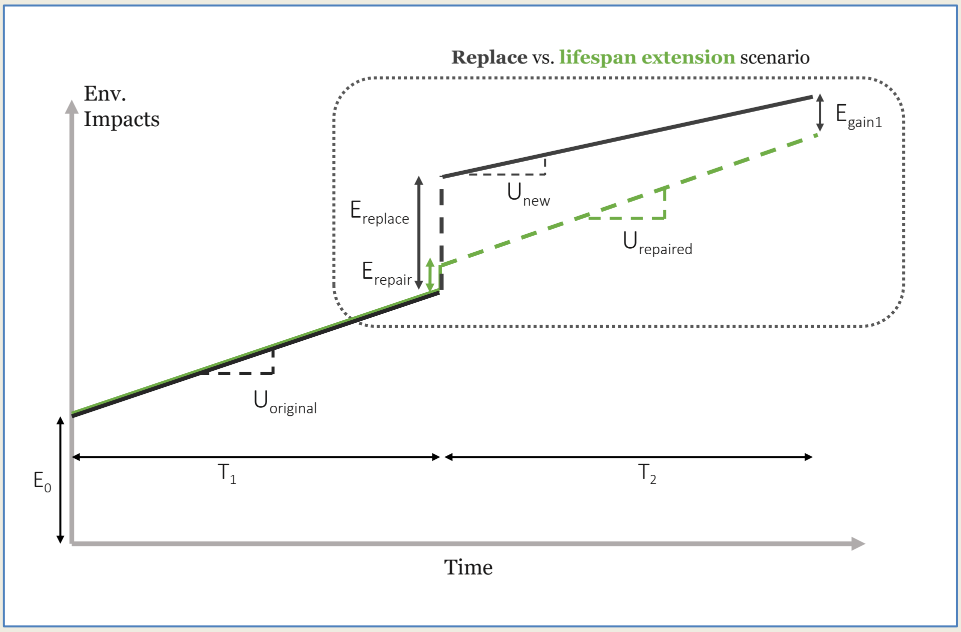
Box 5. Environmental benefits of product lifespan extension versus product replacement

Two aspects are important to consider in order to determine the optimal lifespan of a product from an environmental point of view.

First, there is a trade-off between environmental impacts of different phases of the lifecycle, specifically between production and end-of-life impacts vs. use-phase impacts. Extending the lifespan of a product reduces impacts associated with production (e.g. resource extraction and use) and end-of-life management (e.g. waste treatment and disposal), but increases impacts of the use phase as the product remains in use longer (e.g. fuel consumption or emissions).

Second, the rate of efficiency improvements in the use phase determines how often or quickly a product should be replaced from an environmental point of view. In product groups with rapid efficiency improvements, lifespan extension may hinder the diffusion of more efficient products.

Figure 5.2. Repair and reuse can lead to an environmental gains, but it depends on environmental impacts of production (E) and use phase (U) of old and new products



Source: Adapted from (Cooper and Gutowski, 2017[81])

Particularly in product groups with *high* impacts during production and EOL phases, *low* impacts during the use-phase and *low* efficiency improvements, extending product lifespans can lead to impact reductions (Scenario 1 in Figure 5.2). An example are mobile phones or notebooks, which require valuable metals and minerals for production, but have a relatively low energy consumption during the use-phase (Umweltbundesamt, 2012[82]). Other examples of products that tend to be discarded too early are products with little to no environmental impact during the use phase, such as clothes or furniture (Gutowski et al., 2011[83]; Skelton and Allwood, 2013[84]).

For product groups with relatively *low* impacts during production and EOL phases, *high* impacts during the use-phase and *rapid* efficiency improvements, replacements may be environmentally preferable to allow for a faster diffusion of efficiency improvements (Scenario 2). An example were white goods or air conditioning units between 1990 and 2010. During this period, these product groups underwent substantial efficiency improvements (Kim, Keoleian and Horie, 2006[85]).

As efficiency improvements in new products diminish over time and the greening of the energy mix progresses, lifetime extension increasingly becomes the preferable option for most product groups in most OECD countries (Oeko-Institut e.V., 2018[86]; CLASP Europe, 2016[87]).

Providing information on the durability of a product can positively steer consumer demand towards longer-lived products. Several stated preference surveys concluded that product lifespan labelling shifts consumption patterns of consumers towards products that last longer (Box 6).

Box 6. Stated preference surveys on product lifespan labelling

A variety of stated preference surveys have been conducted to assess the potential effect of lifespan labels.

A study on consumers engagement in the circular economy (n= approx. 12,000) commissioned by the European Commission found that when durability or reparability information was provided, consumers were almost three times more likely to choose products with the highest durability on offer, and more than two times more likely to choose products with the highest reparability ratings (European Commission, 2018[79]).

A study by the European Economic and Social Committee, covering four regions (n=2,917) showed that the sales of the more durable product group was increased through information disclosure by on average 13.8%. Above-average impacts were recorded for suitcases (+ 23.7%), printers (+ 20.1%), trousers (+ 15.9%), sport shoes (+ 15%) and coffee makers (+ 14.4%) (European Economic and Social Committee, 2016[88]).

A study commissioned by the German Environment Ministry tested the effect of a lifespan label on purchasing decisions for electrical products in a simulated online shop situation (n=10,444). The findings confirmed that a longer lifespan at the same price has a positive effect on sales of the product. However, the willingness to pay for a longer lifespan was found to be limited. Combining product lifespan labelling with information about the average operating cost per year resulted in a stronger effect (BMUB, 2017[89]).

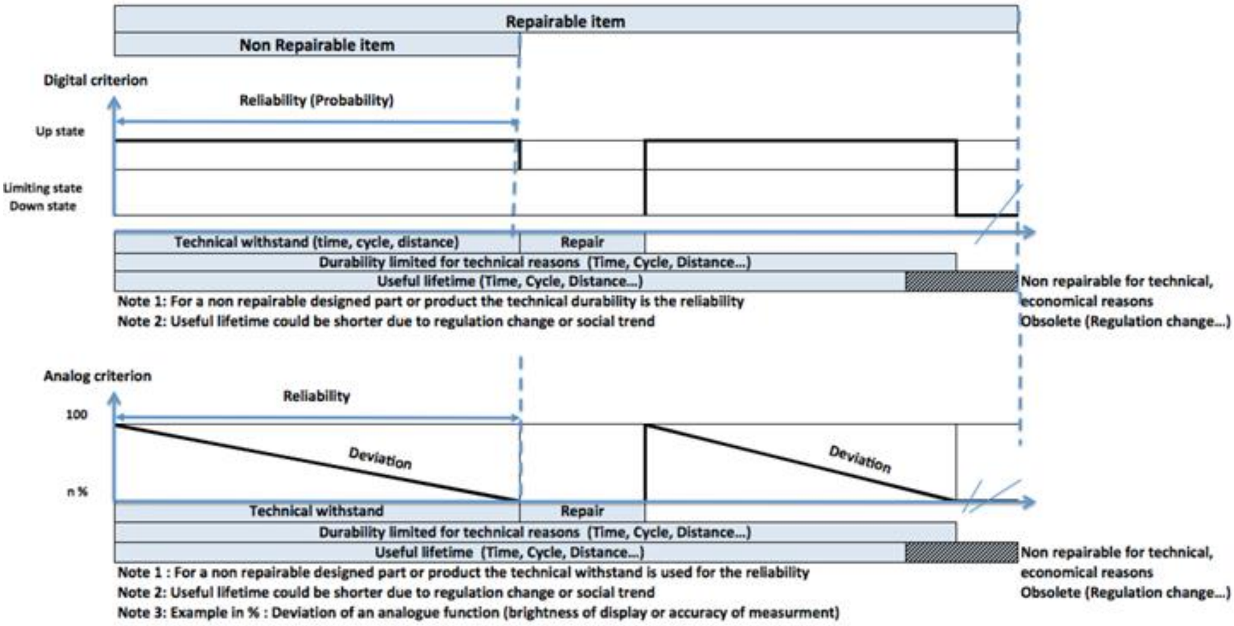
A survey on purchasing electrical appliances among German consumers (n=409) found that information on product lifespan is the second strongest purchase criterion next to price (Jacobs, 2018[90]).

Durability definition

The standard EN45552:2020 defines durability as “the ability of a part or product to function as required, under defined conditions of use, maintenance and repair, until a limiting state is reached”. A “limiting state” is reached when required functions of a product or any part thereof are no longer delivered due to failure or breakdown. In this definition, maintenance and repair services are to some extent included in the durability concept (CEN-CENELEC, 2019[91]).

Reparability is defined as the process of restoring a faulty product to a condition where it can fulfil its intended use. The durability and useful lifetime of non-reparable products or component lasts until the first event of failure, whereas the durability of a reparable product extends beyond the first event of failure until it becomes unrepairable.

Figure 5.3. Products lifespan and durability concepts as defined in EN45552:2020



Source: (CEN-CENELEC, 2019[91])

Three pieces of information can lead to extending the useful lifespan of a product in different ways: reliability and overall durability, reparability, as well as upgradability (Bocken et al., 2016[92]).

Durability and reliability labels

Durability and reliability[8] labels provide information on the expected service life or useful lifespan of a product or component. So far, only few labels that convey specific information on the useful lifespan to consumers exist.

Designing durability and reliability testing methods that enable sufficiently robust differentiations between products is a challenge. Reliability is a statistical measure, which can only limitedly be tested at the point of sale. Moreover, durability tests take a long time, which makes controls and enforcement challenging.

The EU Horizon 2020 project “PROMPT” (Premature Obsolescence Multi-Stakeholder Product Testing Program) aims to establish an independent test program to evaluate the service life of electronic consumer goods. The multi-stakeholder consortium covers research institutes, consumer associations and repair companies and aims to develop an independent durability testing programme for four electronic product groups (smartphones, TVs, washing machines and vacuum cleaners) (PROMPT, 2019[93]).

Some durability testing methods and labels have already been developed. Examples include a product performance and endurance testing for lighting and luminaires by TÜV SÜD (TÜV SÜD, 2019[94]), the independent LONGTIME label (LONGTIME, 2019[95]) or the internal company certificate “le choix durable” by the electrical retailing company Fnac Darty (Fnac Darty, 2019[96]).

Product durability could also be instigated by other policy tools that do not require testing. Warranty claims and minimum lifetime requirements could be used as a proxy for product lifespan. Legal warranties and commercial guarantees give the consumer certain legal and/or contractual rights to have their products

[8] A distinction can be made between reliability (i.e. the expected service life until the first event of failure) and durability (i.e. the expected useful lifespan including one or multiple failure and repair iterations).

repaired or replaced. For instance, the new EU eco-design regulation includes minimum lifespan criteria for some product groups such as vacuum cleaners[9] (European Commission, 2019[97]).

While legal warranties strengthen consumer rights, they does not necessarily lead to increased resource efficiency, as they do not prioritise repair over replacement or reimbursement in cases of defect. It does however incentivise producers to design products for which the expected service lifespan exceeds the legal warranty period.

Reparability labels

Reparability can be defined as "the ability to restore the functionality of a product after the occurrence of a fault" (JRC, 2018[98]). Repairing extends the useful lifespan of a product beyond its expected service life. The practice of repairing is already well established among consumers: according to a Eurobarometer survey, almost 80% of EU citizens make an effort to get appliances repaired before they consider buying a new one (Eurobarometer, 2014[99]). Yet, information about the reparability of a product often remains insufficiently disclosed, making it difficult for consumers to choose products that are easily reparable (Bracquené et al., 2018[100]).

Some consumer-labels and standards exist that provide reparability information, but the adoption rate of voluntary labels remains low. As of January 2021 France established the first mandatory label for reparability for a selected group of electronic products (Table 5.1).

Table 5.1. Review of existing reparability labels, standards and information schemes

Name	Description	Product groups	Uptake in market
CEN-CENELEC standard EN45554:2020	The standards defines parameters and general methods for the assessment of the ability to repair, reuse and upgrade energy related products and aims to define reusability indexes or criteria.	Electrical and electronic equipment	Published in February 2020, no information on adoption so far.
Austrian standard ONR 192102:2014	The systems is composed of 40 criteria for white goods and 53 criteria for brown goods. It includes mandatory pass/fail requirements and requirements based on graded classes. Based on the points rewarded a final rating rates the product in 'good', 'very good' or 'excellent'.	Electrical and electronic appliances (white and brown goods)	24 washing machines and 40 vacuum cleaners tested, no standard awarded yet.
i-Fixit scoring system	A 0-to-10 score is assigned by iFixit to the different categories of devices, a score of ten represents the easiest product to repair on the market. The scoring system considers indicators such as: ease of disassembly, availability of service manuals, types of fasteners used, type and number of required tools, possibility to upgradable the device, and modular design.	Smartphones, tables, laptops	36 laptops, 105 phones and 56 tablets labelled with a reparability score.
"Design for Reparability" tool	Similar to the approach developed by iFixit, the 'Design for Reparability' tool includes 20 criteria related to the ability of consumers to repair a product themselves (DIY repair). The tool's aim is to assess brown goods (TVs, audio equipment and other household appliances). 0-2 points can be earned per criteria, the overall score is then normalised on a 1-10 scale.	So far smartphone and tablets. Prospective use: TVs, audio equipment other small household appliances (brown goods)	Currently still in development phase.
"Product 10Y Repairable" label	The "Product 10Y Repairable" label is an in-house label by the Groupe SEB. I applies with the aim of promoting the reparability of small household appliances that they commercialise. The label provides information on (1) the proximity to authorised repair centres, (2) possibility to fully dis- and reassemble the product without risk of damaging and (3) availability of spare parts (to be in stock for minimum 10 years), their cost and delivery time.	Small household appliances (only for Groupe SEB products)	Only household appliances sold by Groupe SEB

9 The following requirements are included: (1) Minimum operational motor lifetime: 500 hours; and (2) Minimum durability of the hose (if any): still usable after 40 000 oscillations under strain.

French reparability index	A mandatory reparability index providing a score out of 10. The score is calculated based on criteria including: ease of disassembly, price, availability of spare parts and access to repair information. So far, the label is mandatory for washing machines, laptops, smartphones, TVs and lawn mowers.	Washing machines, laptops, smartphones, TVs and lawn mowers. (More product groups planned)	Mandatory in France as of 1 January 2021

Note: See (JRC, 2018[98]; Bracquené et al., 2018[100]) for a more detailed evaluation of the four labels and information schemes.
Source: (Austrian Standards, 2014[101]; iFixit, 2019[102]; Flipsen, Bakker and Bohemen, 2016[103]; Groupe SEB, 2019[104])

In 2007 the Austrian Standardisation Institute developed a first reparability standard: ONR 192102:2014 for household appliances and consumer electronics. So far, 24 washing machines and 40 vacuum cleaners have been tested for this standard, but none of the products sufficiently met the reparability criteria. The main reason for not receiving the standard was that firms provided insufficient information and guidelines for repair.

As announced in France's 2018 roadmap to a circular economy and passed by the French anti-waste bill ("loi anti-gaspillage"), the French government introduced a mandatory reparability index for household electrical appliances as of January 2021 (Plan Climat, 2017[4]). The label criteria were developed in cooperation with the French environmental and energy agency (ADEME). It provides a reparability score out of 10, which is added to the labels of washing machines, laptops, smartphones, TVs and lawn mowers (Indice de réparabilité, 2020[105]). The index aims to be extended to more product groups after 2021.

On request of the European Commission, the three European standardisation organisations (CEN, CENELEC and ETSI) developed standards on material efficiency to support future ecodesign requirements on durability, reparability and recyclability for energy-related products. The CEN-CENELEC Joint Technical Committee 10 (CEN-CLC JTC 10)[10] "Energy-related products - Material Efficiency Aspects for Ecodesign" developed eight horizontal standards and one technical report that provide generic principles and a common framework for the development of future product-specific standards by product technical committees (European Commission, 2018[106]). Among these is a standard on reparability (EN45554:2020) and a standard on durability of energy-related products (EN45552:2020) (Table 5.2).

Table 5.2. CEN/CLC/JTC 10 Published Standards

Standard name	Description	Publication date
EN 45559:2019	Methods for providing information relating to material efficiency aspects of energy-related products	01.03.2019
EN 45558:2019	General method to declare the use of critical raw materials in energy-related products	01.03.2019
EN 45556:2019	General method for assessing the proportion of reused components in energy-related products	07.06.2019
EN 45555:2019	General methods for assessing the recyclability and recoverability of energy-related products	27.11.2019
EN 45554:2020	General methods for the assessment of the ability to repair, reuse and upgrade energy-related products	21.02.2020
EN 45552:2020	General method for the assessment of the durability of energy-related product	11.03.2020
EN 45557:2020	General method for assessing the proportion of recycled material content in energy-related product	29.04.2020
FprEN 45553	General method for the assessment of the ability to remanufacture energy-related products	10.07.2020

[10] The CEN-CENELEC Ecodesign Coordination Group (ECO-CG) coordinates and advises on standardisation activities in the fields of Ecodesign and Energy Labelling. The group serves as a focal point concerning standardisation issues relating to the Ecodesign Standardisation Requests delivered under Directive 2009/125/EC on Ecodesign of energy-related products and the EU framework Regulation 2017/1369 on 'Energy labelling of energy-related products' and their future versions.

CLC/prTR 45550	A compilation of definitions related to material efficiency	04.12.2020

Source: (CEN-CENELEC, 2020[107])

The new standards developed by CEN-CLC/JTC 10 are intended to be used horizontally and to inform other EU policy tools, such as updates of the ecodesign directive, as well as new ecodesign and labelling efforts announced in the European Green Deal (European Parliament, 2020[108]). It is also discussed to gradually include reparability criteria into the mandatory EU energy label and to have a unique label covering energy and resource efficiency criteria, starting with household appliances (i.e. refrigerators and washing machines).

In parallel, the European Commission started work on a repairing scoring system. A first technical study aimed to analyse and develop a potential scoring system for three product groups (Laptops, Vacuum Cleaners, Washing Machines) (Cordella, Alfieri and Sanfelix, 2019[109]).

Box 7. The role of standards and standardisation for CELIS

Standards can be a key enabler for a harmonised and efficient information flow across value chains. Standards limit the amount of reference documents and by “standardising” information input, they can streamline reporting and reduce transaction costs for firms. With the multiplication of green claims and private ecolabels, standards can also serve as a reference to distinguish the stringency of different labels. ISO, IEC and ITU are examples of major standardisation organisations at the global level.

Standards are in itself not legally binding and always voluntary, but they can be used by laws and regulations as a reference and can then become a legal requirement. Standards can also be used as criteria for Green Public Procurement.

Upgradability labels

Upgradability can prevent technological obsolescence and extend the useful lifespan of products, especially for electronic and electrical equipment. Upgradability can be understood as “the ability of a product to continue being useful by enhancing the quality, value, effectiveness or performance” (Bocken et al., 2016[92]). For instance, computers or smartphones are often discarded before the end of their useful product life, due to the fact that the product – or some of its components – cannot keep up with technological advances. Upgradeability of products can lead to resource savings. Information on upgradeability can increase consumer demand of products that allow for easy replacements and updates of individual components or software.

Box 8. Product lifespan aspects in the EU Ecolabel

The EU Ecolabel considers different product lifespan criteria in the assessment for some of their 24 product groups. For instance, durability aspects and minimum lifespan requirements are included in assessments for shoes, vacuum cleaners, televisions and the wood and metal components of furniture. For other product groups reparability aspects are part of the assessment, including furniture, mattresses, sanitary tapware (European Commission, 2019[110]). Upgradeability criteria are included for computers, where certain components are required to be easily accessible and replaceable and the availability of spare parts must be ensured for at least five years (European Commission, 2016[111]).

The EU Ecolabel scheme is a voluntary label and industry uptake remains low in some product groups. Whilst the number of products registered has increased steadily over the past years, the number of participating companies (licenses) has only increased by less than 100 since 2013 and remains modest for the European Union as a whole. As of March 2021, 78,071 products and services are registered and 1 892 licenses awarded to participating companies. Uptake is large for various cleaning, hygiene and DIY product groups, but less so for electronic and electrical displays (European Commission, 2021[112]).

To sum-up, product lifespan labels for the circular economy still remain in early stages of development. The challenge lies in defining a robust methodology for assessing durability, which poses an obstacle for developing a reliable label. Some product lifespan labels (durability as well as reparability labels) exist, but their market uptake is limited. Work is ongoing at the national and international level to drive product lifespan labelling forward.

5.2.3. Labels and certificates in used-goods markets

Secondary and used-goods markets are an integral part of the circular economy as they enable reuse. A study conducted in The Netherlands estimates that the useful lifespan of products traded on used goods marketplaces is 40-60% longer than standard product lifespans, resulting in climate change impact reduction of about 30% (CE Delft, 2019[113]).

Although used good trading is increasing for some product groups, it remains a niche economic activity. Often, markets of used goods are less transparent than markets of new products, which inhibits trading and purchasing for consumers. Reservations by consumers about the quality of the used goods seems to be a barrier to the uptake of used goods trading (Verivox, 2019[114]; Shimabukuro and Leandro, 2016[115]; Clausen et al., 2010[116]). Providing better information on the quality of used goods can encourage their trading. The circular economy White Paper of the Paris metropolitan region states second-hand product labelling as one of the measures that need to be implemented for their urban transition towards a more circular economy (ADEME Paris, 2017[117]).

Standards and quality labels for used goods can be of interest for consumers and original producers alike. Consumers gain more confidence about the quality of used products, while original producers and used good traders can better control safety liabilities and reputational risks.

There is an increasing demand for used-goods trading, in particular for EEE products, such as mobile phones. As innovation rates of new mobile phones converge, refurbished phones become more attractive for the consumer. According to Counterpoint Research, the global market for refurbished smartphones grew by 13% in 2017 (in contrast to 3% market growth for new phones in the same year). For 2017, the total market share of refurbished smartphones reached close to 10% of the total global smartphone market, with 140 million units being sold (Counterpoint Research, 2018[118]).

For some used goods, which have safety and legal concerns, governments already require regulated markets. For instance for firearms and cars, government licensing bodies commonly require certification and registration of the sale, to prevent the sale of stolen, unregistered, or unsafe goods. However, in most other cases used consumer goods markets remain informal or less regulated and quality assurance is either missing, or conducted through peer-to-peer ratings and feedback systems within the market community. As the quality of used goods can vary across products or vendors, providing reliable quality information is important to earn the confidence of consumers.

At the same time, quality standards for used EEE can also support trade, as it can help to differentiate legitimate exports of used EEE from illegal exports of WEEE under the guise of being sent abroad for re-use. The International Correspondents Guidelines agreed under the Basel Convention and the EU WEEE Directive require functionality testing of used EEE prior to export. Quality standards and labels can be a useful reference to provide information on the functionality of products. They can support exporters to comply information requirements and provide an opportunity to EEE producers to protect their reputation by ensuring their products are not illegally sent abroad for material recovery.[11]

Box 9. Selected examples of labels, certificates and standards for used goods

The Responsible Recycling Standard for Electronics Recyclers (R2:2013) and the e-Stewards Standard for Responsible Recycling and Reuse of Electronic Equipment are standards that require documentation and assurance measures related to the management of equipment destined for reuse and resale. The standard mandates specific testing and quality assurance for "fully functional" products with the aim of reducing the risk of improper transboundary movements of hazardous waste and end-of-life equipment and components (SERI, 2014[119]; E-Stewards, 2014[120]).

The PAS 141:2011 standard, developed by the British Standards Institute (BSI), is a voluntary standard designed to build confidence in reused mobile device consumer markets. It sets a benchmark for minimum functionality standards for reusable mobile devices. Electrically safe and functionally fit for purpose mobile devices receive a PAS 141 Registered mark. Besides consumer confidence, it also aims to reduce reputational risks and safety liability of original producers (OECD, 2011[121]; BSI, 2013[122]; Quariguasi-Frota-Neto et al., 2014[123]). The stated goals of the standard are:

- to encourage reuse as promoted by the WEEE Directive (2002/96/EC), Article 1;
- to provide a framework for assuring consumers of the quality and safety of reused electronic and electrical equipment (REEE);
- to provide a framework for assuring manufacturers that the placing of REEE on the market will not adversely affect their brands; and
- to discourage the illegal export of WEEE under the guise of reuse by providing a tool to the Environmental Agencies for differentiating between REEE and WEEE.

RCube, a Paris-based non-profit association involved in waste reduction and re-use, offers a quality label for refurbished products. The label is developed with the intention to encourage used good trading. Testing methods exist for refurbished phones and are currently extended to other consumer products (Rcube, 2019[124]).

The American Law Label (or "Yellow Tag") informs consumers of hidden contents and filling materials in bedding and furniture and ensures that the product has been sanitised before resale. In some US States this label is mandatory for certain groups for quality assurance (American Law Label Inc., 2018[125]).

Overall, quality standards and labels for used products appear to be relatively scarce. These labels can be effective in increasing confidence and transparency for consumers and may reduce liabilities of original producers, but the label landscape is so far not extensively developed. One reason for this may be that information required for the development of used goods labels is retained as confidential business information by the original equipment manufacturer.

[11] In this context the end-of-waste criteria of the EU Waste Framework Directive are also relevant, which specify when certain waste ceases to be waste (when it has undergone a recovery operation) and obtains a status of a product or a secondary raw material.

5.2.4. Other consumer labels with relevance to resource efficiency and the circular economy

Other notable consumer-oriented labels for resource efficiency and the circular economy include waste separation labels, as well as labels on secondary (raw) materials and recycled content.

Waste separation labels

Waste separation labels can guide consumers in sorting waste, which improves conditions for recycling. Some jurisdictions require mandatory waste sorting markings for all applicable products placed on the market, other waste separation labels are voluntary and may be motivated by an industry's corporate responsibility efforts.

Box 10. Selected examples of waste separation labels and standards

The public 'Triman' label in France is a mandatory waste label that marks all household waste that is recyclable. The label was set up by the government to provide a unified signage for all recyclable products that are placed on the French market under Extended Producer Responsibility (EPR) schemes (ADEME, 2015[126]).

The ASTM D7611 International Resin Identification Coding System (RICs) contains a set of symbols with number codes that identify the plastic resin out of which a plastic product is made (ASTM International, 2019[127]). The ASTM Standard in itself is voluntary, but may become mandatory in certain jurisdictions, when referred to in legislation, which is the case in several US states. The coding system provides information about the plastic resin type, which municipal waste management organisations can refer to for setting criteria for waste separation. For instance, as a response to the China plastic waste import restrictions, and pressures on local recycling infrastructure, several US waste management companies now instruct citizens to only sort plastic #1 and #2 (i.e. PTE and HDPE) for recycling (Waste Dive, 2019[128]).

The private How2recycle label is a voluntary waste sorting label in the US. Firms may choose to include this label on their products to provide consumers with sorting and recycling guidance (How2Recycle, 2019[129]).

Recycled content labels

Labels on recycled content can differentiate products containing recycled materials and strengthen the demand for secondary materials. For instance, the OECD analysis on secondary plastics markets suggests that labelling recycled content in plastics products can strengthen the demand for secondary plastics and improve the overall competitiveness of recycled plastics (OECD, 2018[130]). A number of independent recycled content labels, in particular for wood and paper, are in use (Box 11).

Box 11. Selected examples of recycled content labels

The Sustainable Forestry Initiative (SFI) and the Forest Stewardship Council (FSC) offer labels that certify recycled content for wood and paper products (FSC, 2018[131]; Sustainable Forestry Initiative, 2019[132]). Both are examples where a recycled content label has differentiated and driven demand for a secondary material. Since the first FSC label was created in 1993, the demand for this label has increased steadily, as firms are increasingly recognising the improved market access and the competitive advantage of adopting the recycled content label. The FSC is now certifying almost 40,000 products in 127 countries and the secondary paper market is well-established in most countries (FSC, 2019[133]).

SCS Global Services, a certification body, has developed a voluntary standard for recycled content claims and a recycled content certificate, applicable to different materials (SCS Global Services, 2019[134]).

The RAL quality mark provides information on recycled content in PET beverage packaging (RAL, 2021[135]).

5.2.5. Conclusions

Consumer-oriented labels for the circular economy can shift purchasing power and demand and steer supply chains towards more sustainable production. However, these labels are often voluntary and their market penetration and market impact remain small.

Product lifespan labels for the circular economy are still in early stages of development. Some product lifespan labels exist, but their adoption rate is low. A challenge lies in defining a robust methodology for assessing durability, which appears to be the main obstacle to their development. Lifespan extension is most environmentally preferable in product groups with high environmental impacts during production, low environmental impacts at the use-phase and low improvement rates in use-phase efficiency. Examples are electrical and electronic equipment, where energy-efficiency improvements have stalled. A focus could thus lie on developing lifespan labels for these product groups. There is work ongoing at the national and European levels to drive product lifespan labelling forward. Notable efforts include the European standardisation mandate executed by CEN-CENELEC, the French reparability scoring systems, as well as the EU Horizon 2020 project "PROMPT" on premature obsolescence of energy-related products.

Quality labels and certificates for used goods also remain limited to some product groups. These labels may have significant development potential as the global market for refurbished EEE continues to increase in size and market share.[12]

Labels and certificates for used goods can improve the conditions for used good trading by providing quality assurances and mitigating safety, health and environmental risks. In the case of WEEE and other hazardous product waste, labels on used goods can also help differentiate transboundary trade of used EEE from illegal exports of WEEE under the guise of reuse. Developing this label segment may receive support from the industry as it can reduce business risks related to safety liabilities and reputation of original producers when their products are traded on used goods markets.

Other consumer-oriented labels, such as waste separation labels or recycled content labels can improve the conditions for recycling by improving the waste stream and increasing the market demand for recycled materials.

Importantly, the multiplication of different types of environmental product labels and certificates risks consumer confusion and negative effects on international trade due to increased compliance and transaction costs (Prag, Lyon and Russillo, 2016[13]). In a recent survey by the European Commission nearly half of the consumers did not recognise any of the labels that were shown to them and only 32% of consumers stated that labels actually influenced their purchasing decision (European Commission, 2017[136]). Negative effects of multiplication of consumer-oriented labels should be considered by policy.

[12] The global market for refurbished smartphones reached 10% in 2017, with a growth rate of 13%, compared to only 3% for new smartphones in the same year (Counterpoint Research, 2018[118]).

6. Policy Implications

CE labels and information systems are diverse and of varied types, and their number is increasing quickly, similarly to environmental labels more generally (Prag, Lyon and Russillo, 2016[13]; Klintman, 2016[137]). In particular, the last two decades have seen a multiplication of environmental labelling and information schemes of varying scope, size and nature. Existing data suggests that most CELIS are consumer-oriented, focus on food products and are implemented at the national level. The proliferation of CELIS has implications for consumers and producers alike. Multiplication tends to increase compliance costs for producers to meet the many (regional) requirements. This can also have negative implications for international trade and competitiveness. Consumers may have difficulty in differentiating the criteria behind the many labels, which can lead to confusion and overall loss of credibility of CELIS. Competition may also drive down stringency of labels and standards, as different schemes bid for market share. Policy intervention is needed to address these issues, in order to reduce the complexity of the CELIS marketplace, while maintaining high standards.

A related issue is that most CELIS are single-issue labels, which are effective at enabling the comparability of products on specific environmental aspects, but carry the risk that their narrow focus leads to environmental burden shifting. Governments have a role to play in helping to develop more complex methodologies that allow for life-cycle-based labels, such as spearheaded by the European Union, with its “Single Market for Green Products Initiative”, which developed lifecycle labelling for specific product groups.

Beyond the more general need to contain the proliferation of CELIS and to improve the methodologies that they are based upon, there are two aspects of the CELIS agenda that require further government attention: (i) there is a lack of consumer-oriented labels that encourage consumers to opt for longer-lived products or to use them for longer; (ii) relatively little has been done so far to encourage enterprises and industrial sectors to develop information systems that are standardised and harmonised across value chains and that can help to improve resource efficiency along them.

6.1. Consumer-oriented labels that encourage longer products life spans

Extending product lifespan slows down resource use and can be environmentally beneficial for most product groups. Stated preference surveys have shown that providing information on the longevity of a product can be an effective means of steering consumer demand towards longer-lived products (Box 6). Efforts currently focus on the development of methodologies that allow to determine different lifespan aspects such as durability, reparability and upgradeability. Similarly, there are efforts to develop product quality labels for secondary goods, which can help to improve demand for used goods in the market and also lead to extended product lifespans.

Governments have a role to play in facilitating the development of sound methodologies, ideally harmonised at the international level and in furthering their up-take in the market. The latter can be achieved by using CELIS labels in the context of public procurement or in EPR schemes. An example is the US EPA “Recommendations of Specifications, Standards, and Ecolabels for Federal Purchasers”, which covers more than 20 categories and gives preference to multi-attribute standards and ecolabels for which a competent certification program has been confirmed.

When choosing product groups to which lifespan labels are applied, the focus should be on product groups that have a proportionally large environmental footprint at the production and end-of-life stages of their life-cycle and where innovation rates of use-phase efficiency improvements are modest. Product groups such as computers, hand-held electronic devices or other EEE would appear well suited as a starting point for these types of labels. In product groups that still exhibit dynamic product innovation with regards to use-phase efficiency, lifespan extension could delay the diffusion of energy- or fuel-efficient improvements. For these product groups, a more careful lifecycle assessment might be needed, to ensure that lifespan extension is environmentally preferable. However, as efficiency improvements in new products tend to diminish over time and the greening of the energy mix progresses, extending a product's lifespan is likely to become environmentally beneficial for most product groups in most countries.

6.2. Business-to-business information systems and labels

The fragmentation of value chains across the globe has increased the complexity of value chain management. Improved information sharing across tiers of the value chain can facilitate a better management of environmentally related uncertainties and risks in supply chains.

Ultimately, firms need to be leading the development of B2B information systems, but governments can play a facilitating role. Regulatory information disclosure requirements have in some cases provided an important driver for the development of information systems by industry to achieve compliance. The IMDS in the automobile sector is one example of an information system that was developed in response to the EU end-of-life vehicle directive.

Often, Information Systems are developed for reporting requirements at the point of sale, but only seldom take into account information requirements by recyclers at a product's end of life. Governments can play a role in facilitating dialogue between stakeholders of upstream and downstream value chains in order to improve the usefulness of information systems for all stakeholders and improve their uptake. For instance, the principles of the Value Chain Outreach (VCO) initiative developed by the International Council of Chemical Associations (ICCA) can serve as guidance for developing adequate multi-stakeholder information systems (ICCA, 2019[138]).

Whereas in some sectors the availability and uptake of CE information systems is slow and needs to be encouraged through policy measures, other sectors are beginning to see a proliferation of different private (enterprise-level) information systems. While such efforts are laudable in principle, the multiplication of different circular economy metrics in these systems can also lead to increased transaction costs for firms, and pose particular challenges to SMEs with limited resources. There appears to be a role for governments to support the harmonisation of information systems and the metrics that they use, in order to reduce transaction costs. Ideally this would be done at the international level. Multilateral fora such as the G7 or G20, as well as the ISO, WTO and OECD, are well placed to provide a platform for these efforts.

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