

Deliverable report

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ABBREVIATIONS

B2B	Business to consumer
B2C	Business to business
G2C	Government to consumer
G2B	Government to business
ISO	International Organisation for Standardisation
HBCD	Hexabromocyclododecane
PE	Polyethylene
PP	Polypropylene
PVC	Polyvinyl chloride
PET	Polyethylene terephthalate
PS	Polystyrene
QMS	Quality management system
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
ROE	Recycling organisation exposition
SLS	Smart labelling system

PROJECT ABSTRACT

CREAToR is focused on process development and demonstration to sort and remove hazardous, already banned bromine containing flame-retardants from waste streams using continuous sorting and purification technologies: LIBS technology for sorting and supercritical CO₂ and natural deep eutectic solvents (NADES) for continuous extraction in twin-screw extruders.

CREAToR will cover the whole value chain, starting from collecting thermoplastic waste streams from building and construction and from waste electrical and electronic equipment. The project will implement ways to collect secondary raw materials, identify the presence of hazardous flame retardants, remove these contaminants from the materials and finally reuse the materials. As case studies they will be reused as valuable secondary raw materials for new B&C insulation panels, closing the circle of economy, for automotive interior application, and for producing 3D printed parts for aerospace applications.

For further increasing the economic feasibility of the approach an optimised logistic concept and a harmonized material quality classification scheme will be developed and applied. CREAToR will create a circular economy solution, transforming waste streams that are currently incinerated into value-bringing secondary raw materials. The economic viability of CREAToR will be validated through material benchmarking and LCA/LCC assessment for the whole value chain resulting in next generation products.

DOCUMENT HISTORY

Table 1: Version management

VERSION NR	REVISER	CONTENT
V0	Christina Dalla, Rocco Lagioia (ITB)	Deliverable template (V0)
V1	Francisca Gaona (ITB)	First draft (V1)
V2	Justina Devoto (ITB)	Second draft (v2)
V3	Mathilde Taveau (CLR)	Review
V4	Irma Mikonsaari, Carolyn Fisher (Fraunhofer ICT)	Review and submission

Table 2: Partners' contribution to the deliverable

CONTRIBUTION OF THE PARTNERS

PARTNER	SHORT NAME	ROLE IN THE WP	CONTRIBUTION TO THE DELIVERABLE
ITRB Group	ITB	Leader WP7 (task 1.7)	Author of deliverable 7.3
Coolrec BV	CLR	Contributor and reviewer	Information generated in WP2 & WP1 (Material requirements for the purification process)
TREEE SRL	TRE	Contributor	
Volbas SA	VLB	Contributor	Recycler's perspective on SLS methodology
Fundacion Gaiker	GKR	Leader of WP	Deliverable 1.3 (information on material characteristics)
Openbare Vlaamse Afvalstoffenmaatschappij	OVM	Contributor	Information from deliverable 1.3 (information on legislation and certification schemes)
Fraunhofer Gesellschaft zur Foerderung der Angewandten Forschung e.V.	ICT	Contributor	Information generated in WP3. Procedures to introduce in the quality assurance system

1 INTRODUCTION AND OBJECTIVES

Adequate information and a guarantee that recycled materials fulfil all the requirements placed on equivalent new materials (virgin materials) are the key to increase acceptance of products made from recycled plastics. Safety, cleanliness, and design are specific concerns for potential customers. Campaigns to raise public awareness, and certificates/labels, can make an important contribution to increase the demand for recycled products.

Traceability and a transparent certification on the content of recycled material could help Europe to achieve a full circular economy. Two significant examples are: RecyClass and EuCertPlast. These are already existing certifications that can be obtained, EuCertPlast focussing on the recycling process and RecyClass focussing on the content of recycled material included in a product and the level of recyclability of the plastic product. In short, the first focuses on the recycling process and the second on the component we produce from that material.

The RecyClass certification has doubled capacity to certify recycled plastic content¹. The EuCertPlast certification has grown by 27% since 2019. With 45 new recycling facilities, there are now 214 companies certified by EuCertPlast, demonstrating its wide recognition in the plastics industry².

The CREAToR project aims to implement one or more labels throughout the material process - from waste sorting to its transformation into recycled materials - to control the materials throughout the whole process chain and to deliver data to the end-user to result in full traceability of the materials. Moreover the project will develop a quality assurance system for CREAToR's purification technology using extractive extrusion. The idea is to merge the definition of the label with the quality assurance system to create a certification for materials that have passed through the purification technology developed.

This new certification, resulting from the combination of these two tasks, would become a stamp of quality for the recycled materials, guaranteeing that all the quality and safety requirements defined in the regulations have been met.

This deliverable report is divided into three chapters:

1. Chapter 2 addresses the vision defined by the existing certifications in the field of recycling actors. It describes the types of existing certifications, their implementation, the recyclers' and other stakeholders' perspective on these and their impact on business and marketing plans.
2. Chapter 3 contains the results of the "Plastics recycling workshop". In this workshop in March 2020, CREAToR partners and external stakeholders discussed the importance of labelling.
3. Chapter 4 presents the first draft of the smart labelling system defined for the reusable materials exiting the recycling and purification process steps. It contains a first draft of the quality assurance system and the key factors affecting the implementation and certification of the CREAToR label.

¹ <https://www.recycling-magazine.com/2021/03/31/recyclclass-doubles-capacity-to-certify-recycled-plastics-content/>

² <https://www.eucertplast.eu/post/over-half-of-the-total-eu-plastics-recycling-capacity-certified-with-eucertplast>

2 CERTIFICATION CONCEPTIONS. BELIEFS OF RECYCLING AGENTS AND CONSUMERS

Certification is the provision by an independent body of written assurance (a certificate) that the product, service, or system in question meets specific requirements. Certification schemes consist of two key elements:

- The criteria outlining specific requirements. These form the 'standard' against which the conformity of a product or service is assessed.
- The audit methodology and testing methods used by the certification body to carry out that assessment.

There are different certification schemes for recyclers and eco-friendly products. Each country has a different certification to highlight that the products offered are recycled or contain a percentage of recycled material. Some of these certifications follow the standards set by the EU. The public deliverable report "7.3 Certification Assessment Layman Report" summarises the certification schemes that recyclers and eco-products can obtain in the European Union (and will be published in parallel to this report in June 2021³).

2.1 CERTIFICATION & LABELS, A KEY SUCCESS FACTOR FOR RECYCLING

The large number of labelling schemes across a number of different sectors and products are based on the belief that they can inform and empower stakeholders (i.e. consumers, producers, governments), increase shared responsibility and accountability, and encourage actual behaviour change based on widely accepted and desired societal and environmental goals. However, to successfully implement a certification, several conditions must be met. The factors⁴ that play an important role in the successful implementation of a new certification are summarised in Figure 1:

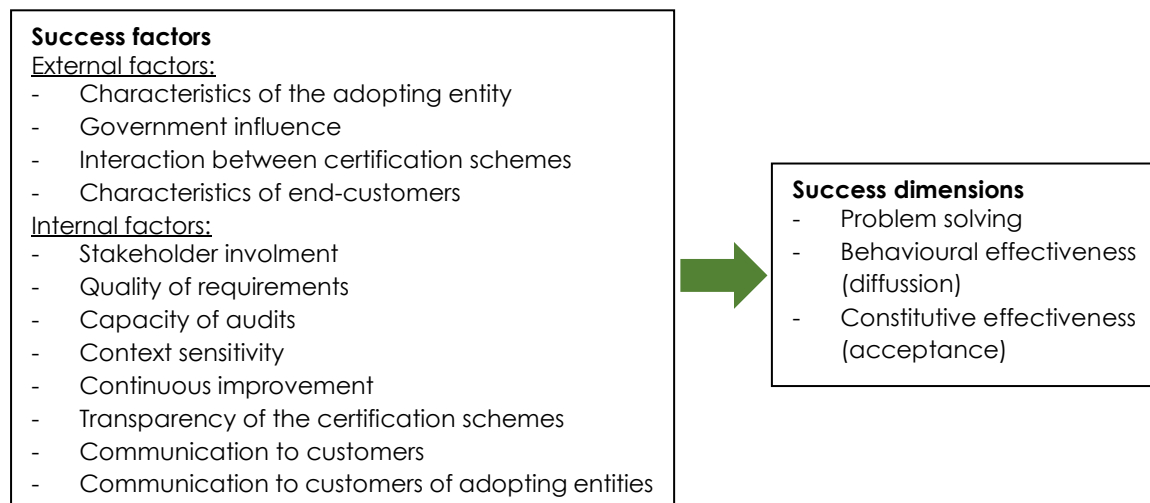


Figure 1: Analytical framework

³ <https://www.creatorproject.eu/publications/>

⁴ Rasmus Tröster, Michael Hiete, Success of voluntary sustainability certification schemes – A comprehensive review, Journal of Cleaner Production, Volume 196, 2018, Pages 1034-1043, ISSN 0959-6526, <https://doi.org/10.1016/j.jclepro.2018.05.240>.

Even if labels are relatively successfully implemented, numerous challenges must still be faced. Moreover, the ambitious goals existing at the beginning are not usually fully achieved in the course of their use.

We have focused our analysis on two successful cases: the European Ecolabel and the EuCertPlast. This is due to the fact that the Ecolabel is one of the best-known types of labels, used to give information to consumers (B2C) and the EuCertPlast certification is a label whose purpose is the communication between two companies (B2B). The latter case could be a competitor to CREAToR's label, or the two labels could complement each other.

The **Ecolabel** was created to show European citizens which products and services have the smallest negative impact on the environment. The EU Ecolabel is a label for products and services meeting high environmental standards throughout their life cycle: from raw material extraction, to production, distribution, and finally disposal. The EU Ecolabel promotes the circular economy by encouraging producers to generate less waste and CO₂ during the manufacturing process.

As of March 2021, 1,892 licenses have been awarded for 78,071 products⁵ (goods and services) in the EU market. Nevertheless, some studies⁶ have identified a lack of demand for products bearing the EU Ecolabel, although respondents recognised a higher demand for environmentally friendly products. Furthermore, there is lack of a marketing/communication strategy coordinated at the European level.

EuCertPlast has established a European certification for plastic recyclers. The requirements defined in EuCertPlast are based on the European Standard EN 15343:2007 "*Plastics. Recycled plastics. Plastics recycling traceability and assessment of conformity and recycled content*" and guidelines to encourage recycling of plastics, particularly focusing on the process for traceability and assessment of conformity and recycled material content. The certification is not limited to the EU and may also be used in Asia. Currently, about 214 plastic recycling factories (nominal capacity amounting to 3.4M tonnes⁷) are certified, most of them in the EU but some also in China and Malaysia. The certification gives confidence to suppliers that the plastic waste delivered to recyclers certified under the scheme will be recycled as per best practice, with respect to the environment and in accordance with national legislation and customers' demands. The certification, with on-site inspection, is valid for one year, based on evaluating ten different aspects such as licenses, the management team, the recycling process, controls on recycled outputs, environmental protection, and sub-contracting.

According to a global study conducted by the UN Environment Programme, the most negative perception of this label⁸ is that it is hard to interpret. Its priority is the traceability.

According to some interviews carried out by the Circpack project⁹, recyclers face two big issues with the current European legislation. First, there are no European standards concerning the quality that recycled materials should accomplish. Moreover, there is an absence of a unique market for recycled materials. Therefore it is concluded that European legislation should promote and support the creation of a unique market for recycled materials that includes information about the material quality and other parameters. In addition, no traceability of the material is currently possible. Some European initiatives, like **EuCertPlast**, are dealing with the traceability issue.

The implementation of the label which is being developed in the CREAToR project can support a unique market and determine quality standards for recycled plastics. Although our certification may be seen as a direct competitor to the EuCertPlast, it aims to support the existing certification.

5 <https://ec.europa.eu/environment/ecolabel/facts-and-figures.html>

6 Marrucci, L., Iraldo, F. & Daddi, T. Investigating the management challenges of the EU Ecolabel through multi-stakeholder surveys. *Int J Life Cycle Assess* 26, 575–590 (2021). (<https://doi.org/10.1007/s11367-021-01866-5>)

7 <https://www.plasticsrecyclers.eu/recyclers-certification>

8 <https://consumersinternational.org/media/352255/canirecyclethis-finalreport.pdf>

9 https://circpack.eu/fileadmin/user_upload/CIRC-PACK_D6.4_LegislativeBarriers_RINAC_VF.pdf

At the moment, we consider two scenarios or implementation plans for our label:

1. Being competitors of EuCertPlast. The recycler market is wide and the EuCertPlast certification, although it is the most recognised certification, there is still a large sector to compete. The two greatest added values of our proposition would be the label, which contains necessary information for end users and generate a good B2B & B2C communication strategy, which would be developed by ITRB.
2. Collaborate with EuCertPlast. If we consider working together, our approach would be to introduce the label that we have developed together with its certification. Moreover, our certification focuses on the implementation of our purification technology, maintaining some quality standards. The EuCertPlast certification focuses on the traceability and quality of the materials, consequently we do not have to compete but rather be a complement to each other.

Certification & eco-labels influence in company's business plan

Labelling & certification are one way for a company to try to improve its competitive position in the market. The reasons to choose this option instead of others might be quite diverse, but they can always be translated into traditional business criteria, aimed at short-term and long-term profits. The incentives that can stimulate a company to improve its environmental and social performance will also depend on various forms of societal pressure, resulting from the interests of different stakeholders (i.e. government agencies, shareholders, customers).

A company (recycler) may invest in its brand to make the relevant sustainability issues consistent with other brand messages that it is sending to its customers. Such signals include quality assurance labels certified by the company itself (first party), by industry-related associations or the country of origin (second party) or by an independent third party.

A company's decision on sustainability labelling & certification will be ruled by strategic and political circumstances¹⁰, and influenced by technological innovations and public campaigns which emphasise the harms of a certain industry.

A company's decision on labelling and certification might involve a mixture of competitive and collaborative strategies. A collaborative approach could be essential to overcome barriers to the dissemination of credible information about sustainability issues. The assurance by a distinctive label, indicating collective membership of an organisation or certification by an independent third party, may serve this purpose at lower costs than other marketing strategies that can differentiate a product. Still, companies may also collectively decide not to compete on a sustainability issue to protect their industry's image and avoid additional costs. Consequently, much will depend on the pressure of other actors, who might emphasise the relevance of the issue.

Greenwashing is one of the big issues regarding certification and labels. This happens when a company spends money on marketing itself as environmentally friendly rather than on minimising its environmental impact. It is a dishonest advertising trick intended to misinform consumers who prefer to buy goods and services from environmentally conscious brands. However, the incentive to greenwash is high, as 66 %¹¹ of consumers will spend more on a product if it comes from a sustainable brand, and that figure increases to 73 % among millennials.

The influence of certification & eco-labels in a company's communication channels

Certifications and eco-labels can be used in different types of communication channels according to the objectives. Moreover, several communication channels can be applied to a scheme: for instance, certain

¹⁰ Forest L. Reinhardt; Environmental Product Differentiation: Implications for Corporate Strategy; Volume: 40 issue: 4, page(s): 43-73; July 1, 1998; <https://doi.org/10.2307/41165964>.

¹¹ <https://www.nielsen.com/wp-content/uploads/sites/3/2019/04/global-sustainability-report-oct-2015.pdf>

schemes applied to buildings could be considered both business-to-business (B2B) and business-to-consumer (B2C). The following Table 1¹² presents the diverse types of communication channels that a label can use:

Table 1: Labels and their communication channels

COMMUNICATION CHANNELS	MOST USED TYPE OF LABELLING	EXAMPLE
B2C (Business to Consumer)	ISO 14024 - Type I: multi-criteria, multi-sectoral third party certified	ECO-Labeling
G2C (Government to Consumer)		Japanese Eco-Mark
B2B (Business to Business)	ISO 14025 - Type III – product declarations, similar to nutritional values matrix, based on LCA	Fair trade Energy start
G2B (Government to Business)		

Not all brands offer sustainable products. In 2014¹³, 65 % of total sales measured globally were from brands that used a marketing-only tactic. A claim-only tactic correlates with the highest growth in sales (7.2 %), but brands using this tactic account for only 2 % of global sales. It is likely used by smaller brands with fewer resources for marketing campaigns and/or less media competition (see Figure 2). The label communication is not enough: it requires marketing to strengthen the messaging and guarantee that the message reaches consumers.

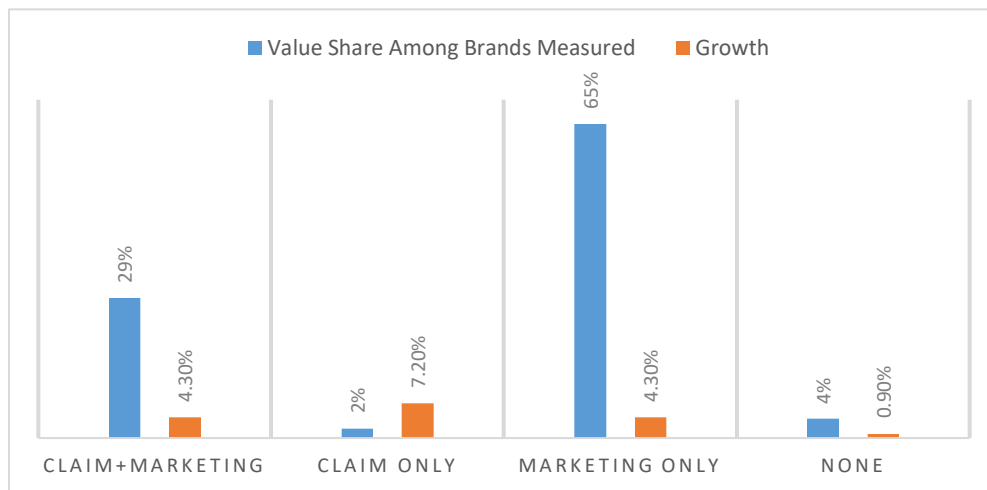


Figure 2: Types of “green marketing” and growth in sales.

¹² <https://www.oecd-ilibrary.org/docserver/5k3z11hpdgq2-en.pdf?expires=1620513840&id=id&accname=guest&checksum=4DE38D85B12AC8BBBE851A12115B1F7A>

¹³ <https://www.nielsen.com/wp-content/uploads/sites/3/2019/04/global-sustainability-report-oct-2015.pdf>

Ottman et al. (2006)¹⁴ suggested that all marketing activities must convince the consumers through identifying the basic product features by using the following strategies:

- **Consumer value positioning:** Focus on designing a product that is differentiated and that performs better than the alternatives.
- **Calibration of consumer knowledge:** In marketing communication, the product's unique features should be presented, as well as environmental benefits and solutions that match with the customer's values.
- **Credibility of product claim:** By certification of claimed green products.

2.1.1 B2B & B2C MARKETING TOOLS

These tools facilitate communication on the social media or website to collectively optimise outreach to the B2B and B2C target audiences. The list below shows the main tools used for B2B digital marketing that could be used to improve the communication channels with audiences while clearly stating the benefits of the labelling.

- **Marketing automation:** refers to software platforms and technologies designed for marketing departments and organisations to more effectively market in multiple channels online and automate repetitive tasks.
- **Social sharing:** One of the primary aims of corporate social media marketing strategies is to generate brand awareness by leveraging their existing audience to share content.
- **Video hosting**
- **Webinars**
- **Landing page:** is a single web page that appears in response to clicking on a search engine optimised search result, marketing promotion, marketing e-mail or an online advertisement.
- **Interactive charts:** these can be used to show positive impacts on the business with clear metrics and reports.
- **Live chat**
- **E-mail signatures:** the signature sent at the bottom of an e-mail can be used for marketing purposes, for example to promote a campaign or a link to a video.
- **Marketing collateral:** this is the collection of media used to support the sales of a product or service (i.e. web content, sales scripts, visual aids, sales brochures).
- **Analytics:** this refers to the tools used to analyse and report on marketing data collected through the digital channels on which a brand holds a presence. These channels might include social media platforms such as Facebook, Instagram or LinkedIn.

The European label¹⁵ is an example of the B2B and B2C toolkit for target audiences which an eco-label can offer.

¹⁴ Ottman, J.A., Stafford, E.R. & Hartman, C.L. (2006). Avoiding green marketing myopia: Ways to improve consumer appeal for environmentally preferable products. *Environment*, 48(5), 22–36.
https://www.researchgate.net/publication/254339098_Avoiding_Green_Marketing_Myopia_Ways_to_Improve_Consumer_Appeal_for_Environmentally_Preferable_Products

¹⁵ https://ec.europa.eu/environment/ecolabel/digital_toolkit.html

3 RESULTS FROM CREATOR RECYCLERS' WORKSHOP

The plastic recycling workshop¹⁶ took place on March 10th, 2020 at the Kühne University in Hamburg (parallel online due to the COVID-19 outbreak). The workshop hosted 21 participants in total from Spain, Italy, Belgium, and Germany. Besides the project partners, 7 representatives from external companies attended, including recycling companies, academics, and consultants.

The second session was led by the project partner ITRB Group and gave an overview of the demand of "Plastics labelling & codification systems" in CREATOR. This topic was also discussed by the participants, who gave valuable information on the perception of labels in today's recycling companies.

The project established contact with recycling stakeholders to collect information on the following issues:

1. Labelling for traceability

The quality of a recyclate is defined and impacted at every stage of the value chain, starting with production, use, collection, sorting and finishing with recycling. In recent years, the European Committee for Standardisation¹⁷ has been active in drafting product standards that allow to determine which test standards should apply to recycled PE, PP, PVC, PET and PS. The European plastic recyclers initiative has collected all the standards regarding recyclates on its webpage¹⁸.

As commented previously, the implementation of a traceability control system is a top priority in the recycling market. A good traceability system helps the manufacturer to improve quality, reduce costs, optimise processes and, ultimately, to improve the time-to-customer throughout the supply chain. Usually, to ensure quality, customers using recycled content will ask recyclers to measure some characteristics of recyclates. The development of a certification together with a label that informs about the properties of the recycled material could result in a seal of quality, promoting high standards among recyclers and increasing confidence in the quality of these materials.

2. Information to decide which kind of labelling was better to implement

At the beginning of the CREATOR project, 2 initial types of smart labels were proposed: one for the entry of waste into the sorting facilities that could help with the classification of the input stream, and a second label for the material that exits the recycling process and is used as an input stream for an application at polymer converters. The idea of a material label for the input waste was discarded after several meetings with recycling companies that are part of CREATOR's consortium and after conversations within the Recyclers' Workshop. The stakeholders consulted believe that the implementation of this label would entail both an economic and a time cost that they are not willing to assume at this stage, and that the measures they currently have in place for quality assurance are better adapted to the specific processes.

3. Information about the required information for this labelling

The label for output materials exiting the recycling process (placed on the polymer granulate bags) will contain a list of properties of the recycled materials (see Table 2). The labelling should combine only key parameters to facilitate its use by polymer converters. This selection of parameters was made according to a series of conversations between the partners ITRB Group, Fundacion Gaiker, Coolrec and the information collected in the workshop.

¹⁶ <https://www.creatorproject.eu/workshop/>

¹⁷ Circular plastics alliance, Design for recycling work plan; 4-March-2020

¹⁸ <https://www.plasticsrecyclers.eu/recyclates-characterisation>

Table 2: End-user specifications for labelling

TECHNICAL SPECIFICATIONS	TEST METHOD
Density	ISO 1183-1A
Melt -flow rate	ISO 1133-B
Charpy impact strength	ISO 179-1eA
Tensile modulus	ISO 527-2
Tensile strain at break	ISO 527-2
Flexural modulus	ISO 178
Flexural strength	ISO178
Flame rating	UL 94
Flame retardant content	GC-MS

4 CREAToR'S CERTIFICATION PROPOSITION

4.1 CREAToR'S SMART LABELLING SYSTEM DRAFT

The first data about CREAToR's labelling was presented in the public deliverable 1.3 Smart labelling system methodology report³. This current report is an update of the work carried out on the possible implementation on the market and a summary of the quality assurance system that could support the development of a new certification for recyclates.

4.1.1 KEY PARAMETERS FOR ENVIRONMENTAL LABELLING

CREAToR's label could be implemented like a **Type I "Third-party verified product labels"** label. This scheme is a voluntary programme by independent third parties. Products are classified within a specific product category according to their comparative or relative impact based upon established criteria. This type of label is awarded to market-leading products with improved performance from a sustainability point of view.

Our label will introduce information on the recycled material so that traceability between recyclers and end users is given. Having full knowledge of the characteristics of recycled materials gives greater credibility to eco-labels, since the origin of recycled materials and their quality are guaranteed.

The 7 parameters against which the label type characteristics are analysed were chosen by an Environmental Resources Management's report¹⁹ on the basis that they represent potential and existing barriers to the use of product environmental information by: producers, purchasers and government (as a policy tool).

Key parameters affecting producers (CREAToR's consortium)

- 1) **Data sensitivity** (i.e. confidentiality): QR codes are important because of their high data capacity. However, most existing QR code systems use insecure data formats and encryption is rarely used. However, we do not expect our label to contain sensitive information.
- 2) **Labelling costs** including
 - a) **Certification costs**: To be confirmed. For instance, the Nordic Swan application fee is currently 1,800 € and, following approval, the annual license fee comprises 0.4 % of the product's annual turnover from a minimum of 1,100 € to a maximum of 41,500 €.
 - b) **Expertise requirements**: these requirements were listed in the deliverable 3.6 Qualification of CREAToR purification technology (to be updated in following deliverables regarding the quality assurance system, D3.7 in November 2021 and D3.8 November 2022) and in the deliverable D1.1. Recyclers' requirements. Both of these deliverables are confidential.

Key parameters affecting purchasers (for CREAToR recyclers)

- 3) **Product availability**: according to the Plastic Recycler Europe initiative²⁰, the plastic recycling industry in Europe is made up of more than 600 companies amounting to a treatment capacity of 8.5 Mt. We know that a capacity of 3.4 Mt²¹ is certified by EuCertPlast. The rest of the market could be persuaded to implement CREAToR label & certification.
- 4) **Consumer education and awareness**: labels are more likely to be effective if there is already a high degree of public awareness of the environmental issues involved. Consumer awareness means being

¹⁹ https://ec.europa.eu/environment/ecolabel/about_ecolabel/reports/erm.pdf

²⁰ <https://www.plasticsrecyclers.eu/plastics-recyclers-publications>

²¹ <https://www.eucertplast.eu/post/over-half-of-the-total-eu-plastics-recycling-capacity-certified-with-eucertplast>

conscious of and having knowledge about the benefits that the certification could represent for recyclers. The marketing tools could be a required instrument to keep end-users informed about their rights regarding CREAToR's certification scheme. Moreover, workshops with potential stakeholders and purchasers could be carried out to enhance the image of the label.

- 5) **Consumers' understanding** of the information presented is critical. CREAToR's label will be easily understandable since it will be a statement itself that a quality system and security procedures have been followed. Also, the QR code will collect additional information on the characteristics of the recycled material. It is also expected to present this label to recycling companies to hear and register their opinions on the possible implementation in the recycled plastic supply chain. This comments will be collected in the deliverable "D1.8. Report of process and end users' limitations and regulatory gaps" (August 2022 by Openbare Vlaamse Afvalstoffenmaatschappij).
- 6) **Perceived credibility (including data quality, and management, monitoring and verification):** The necessary procedures have been established within the consortium for recycling organisations that wish to implement the purification process developed by CREAToR. Moreover, our certification could be an important tool to improve the traceability and the qualification of the plastic's recyclates, working together with EuCertPlast.

Key parameters affecting government use of labels as a policy tool

- 7) **Environmental effectiveness:** Unstandardised and unharmonized collection and sorting schemes across Europe inhibit the recyclers' ability to provide the market with the required constant supply of recyclates with homogenous quality level. Our label could help with this objective.

4.1.2 KEY PARAMETERS FOR QR CODES

ITRB Group started to study the problems that could arise in the implementation of the code, and to define the size and characteristics that the codes should have to ensure that they can be easily read by end users.

The QR code size must be large enough to be scanned using most available smartphones. For most smartphone cameras to read a QR Code, its size should be at least 2.5 x 2.5 cm or 115 x 115 pixels (in width and height).

The following images show the code in different sizes and with the possible introduction of CREAToR's logo. It has been noted that some readers are not able to interpret a code sized at 2.5 x 2.5 cm, so the consortium opted for one that has a minimum size of 4 x 4 cm (s. Figure 3).

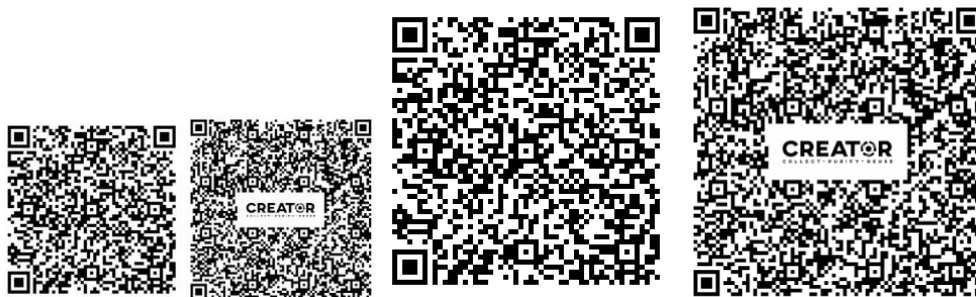


Figure 3: QR codes with different sizes

The following issues were considered to obtain the right QR code size:

1. Scanning distance

A QR code needs a 10:1 distance-to-size ratio. This is not likely to pose a problem. It is expected that the work areas where the code is read will be wide. The label could be placed on the packaging in which the bags containing the recycled material are placed, or/and on the bags themselves.

2. Amount of data to be encoded

If the data to be encoded is increased, the number of rows and columns also increase. As a result, the scannability decreases. If the information contained in the label is high, another option would be to encode a web address that would display the characteristics of the recycled material, thereby not decreasing the quality of the code.

In this case, the consensus is that it will be unnecessary to have a webpage to upload the information. However, if at any time the label needs to contain more information, a page could be easily established to allow simplification of the QR code.

3. Printing requirements

There must be sufficient colour contrast between the QR code and its background. If the QR code is dark-coloured, a light colour must be chosen for the background. Moreover, the QR code should have appropriate margin width. This width should be equal to about four data modules. This helps scanners read the QR code well. The demonstrator label it will be realised at M30 (November 2021).

4.2 CREAToR'S QUALITY ASSURANCE SYSTEM

In the CREAToR project, a new process is being developed for the purification of thermoplastic materials containing brominated flame retardants. CREAToR's process, not yet introduced to the market, is not covered by any industry standards. Because of this, an internal quality standard was created for this new process, **quality assurance system (QA)**, which was reported in the confidential deliverable report 3.6 *Qualification of CREAToR purification technology (1)*.

This system is proposed to **certify** that the necessary procedures will be established for recycling organisations that implement the purification process developed in CREAToR. These procedures will be based on the quality procedures followed by the partners during the project.

To develop these procedures, the aircraft components production market - as one of the most demanding fields regarding quality procedures - has been considered as a reference. If an organisation wants EASA approval to manufacture aircraft parts, there are three obligatory requirements:

- A quality system to enable the organisation to ensure that each product, part, or appliance produced by the organisation, or by its partner or supplied from or subcontracted to outside parties, corresponds to the applicable design data and is in condition for safe operation.
- An appropriate organisation (a manager accountable to the authority, a quality manager, staff at all levels with appropriate authority, certifying staff and staff privileges inside the organization).
- A Production Organisation Exposition (POE) which should show the structure of the organisation, identify the capability, and refer to the procedures used.

In the first two years of the CREAToR project, ITRB Group has started work on the first and third requirements (quality system & POE). In the case of CREAToR, the health and safety system are imperative because the researchers/workers will be in contact with hazardous materials. The development of a health and safety

system is beyond the scope of the project, but some guidelines will be given for the safety of workers who are in contact with these hazardous materials.

The quality management system (QMS, based on ISO 9001:2008) specifies four levels of documentation that an organisation must comply with: manual, procedures, work instructions and records & documents.

The quality assurance documentation proposed in CREAToR are:

- The quality manuals, which collect all the end users' requirements
- The quality procedures to maintain a quality level
 - waste material inputs procedure
 - quality of recycled materials and traceability procedure
 - control of documents procedure
 - control of records procedure
 - internal audit procedure
 - control of nonconforming products procedure
 - corrective actions procedure
 - preventive action procedures
- The work instructions, which are the actions to carry out procedures
- The forms and templates to carry out all the procedures specified by the quality assurance system (route sheets, planning, skills matrix, and a handbook)

On the other hand, the ROE (recycling organisation exposition) has been proposed for early adopters. This document is based on the POE.

The first draft proposed for the structure of this document is reported in the abovementioned confidential deliverable D3.6 Qualification of CREAToR purification technology (1), and is as follows:

Table 3: Proposed structure for process certification

GENERAL INFORMATION ON THE FIRST PAGE
Name and address of the organisation complying with official name
Approval reference of the ROE
Reference of the exposition with issue number
Approval date
GENERAL INFORMATION FOR EACH PAGE
Name of the organisation
ROE identification
Amendment/revision number of the ROE
Page number
GENERAL CHAPTERS
Table of content
History of revision
List of effectives pages
Distribution list
Terms and abbreviations
Introduction / Description of the organisation
MANAGEMENT PROCEDURES
Signed corporate commitment by the Accountable Manager
Nomination of Accountable Manager with reference to delegation letter when the AM is nominated by top management
Management personnel
Duties and responsibilities of:
- Accountable Manager
- Quality Manager

- Production Manager
- Any other manager

Organisation chart

List of certifying staff

General description of the human resources available

General description of the facilities

Scope of work

Notification procedure of organisational changes to Competent Authority

Amendment procedure of the exposition

Description of the quality system

Supplier/subcontractor list

QUALITY SYSTEM

Distribution of the documents

Document issue, approval, or change

Vendor and subcontractor assessment audit and control

Verification that incoming products, parts, materials and equipment, including items supplied new or used by buyers of products, are as specified in the applicable design data

Identification and traceability

Manufacturing processes

Special processes

Inspection and testing

Calibration of tools, jigs, and test equipment

Non-conforming items control

XXX coordination with applicant for, or holder of, the design approval

Records completion and retention

Personnel competence and qualification

Certifying staff qualification and training

Issue of XXX release documents

Handling, storage, and packing

Internal quality audits and resulting corrective actions

- Quality audit of processes
- Quality audit of product
- Quality audit remedial action procedure
- Quality audit personnel
- Planning for compliance audits

Work within the terms of approval performed at any location other than the approved facilities

Work carried out after completion of production but prior to delivery

Issue of permit to buy recycled materials

Occurrence reporting

Control of critical parts

APPENDIXES

Capability list

Internal documents

The health and safety requirements for the CREAToR consortium and future early adopters have been set. In the case of CREAToR, the health and safety systems are imperative because the researchers/workers will be in contact with hazardous materials.

5 CONCLUSION

Eco-branding is green business and marketing instrument which enables corporations around the world to comply with specified environmental performance criteria or standards, and enables consumers to adopt socially responsible practices to ensure equitable and sustainable utilisation of natural resources.

There are a wide range of opinions on certifications and their labels throughout the recycled material supply chain. From the studies carried out, it is known that consumers want to buy products with recycled material content and the minimum possible environmental impact. They seek sustainability, yet there are a large number of people who complain about the labels' complexity, or in some cases lose faith in them (greenwashing).

In addition, recyclers face a market that has not yet been standardised, producing a wide variety of recycled materials with different qualities. This often leads to scepticism among end users. The need for standardisation and traceability in this market is a problem that has not yet been resolved, but certifications that support this uniformity are undoubtedly necessary.

A good marketing and communication strategy with recyclers and European authorities is the best way to strengthen the image of certifications. This will help to increase the number of companies and certified recycled materials on the market, thus ensuring quality.

The certification that is proposed in this deliverable would be a declaration that the recyclers will maintain a quality and safety system throughout their processes. In addition, ITRB Group has introduced a QR code on the label containing information on the characteristics of the recycled material.

The next actions that will be done regarding CREAToR's label will be:

- Establish an implementation plan to introduce CREAToR's label in the recycling supply chain. This label will help to improved one of the recycling's issues, traceability.
- Develop a communication strategy B2B and B2C. A good strategy is necessary so users (recyclers) and consumers know and trust the information on the label.

This information will be collected at the end of the project in the deliverable D7.7 Business Model (II) in November 2022 (M42).

Moreover in the coming months, Openbare Vlaamse Afvalstoffenmaatschappij will work together with the ITRB Group in the consortium to present this idea to possible stakeholders (recyclers' agents) and to obtain the opinions of several recyclers regarding the possible implementation of CREAToR's label. These interviews will be summarised in the public deliverables "D1.6 Smart labels for the materials utilised within CREAToR" (December 2021 by ITRB Group) and "D1.8. Report of process and end users' limitations and regulatory gaps" (August 2022 by Openbare Vlaamse Afvalstoffenmaatschappij).